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DIGITAL CFO WITHIN THE INDUSTRY 4.0 PARADIGM:

INSIGHTS FROM A PLS-SEM BEHAVIOURAL INVESTIGATION

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2 ABSTRACT

Since its born in the early 1930s, the role of Chief Financial Officer has always been subjected to evolutions and expansions which rose its relevance and made it one of the most influencing professionals within today enterprises. Recently, as consequences of Industry 4.0 and digital revolution, new responsibilities, new technologies, new skills, new business models brought by the introduction of a brand-new digital environment promise to change the CFO once again. In this digital context, a new professional figure is identified to set a gap with the previous one: the Digital CFO. The aim of this research is to assess the on-going changing occurring to CFOs, clearly identifying: (1) the determinants of the evolution; (2) the key characteristics of the Digital CFO, and (3) the psychological impact of introducing digital technologies. These research topics were investigated through a pragmatic and structured literature review and by the development of a survey research, which involved 41 CFOs of medium-large Italian firms. The answers of the survey were applied into two research frameworks, the Job Demand-Resource (JD-R) model and the Ability-Motivation-Opportunity (AMO) model. This research provides several meaningful insights to academics and practitioners. First, the qualitative analysis of the results allowed to show the actual digitalization level of Italian firms, divided per industry and size. Second, the Digital CFO was defined as the financial C-level executive updated and aligned with the evolving digital environment and digital technologies, as Artificial Intelligence, Big Data & Analytics, Cloud Computing, Robotics Process Automation. Third, the evaluation of the managerial function's psychological wellbeing through JD-R framework revealed an overall positive mental effect brought by the introduction of digital technologies, estimating a reduction of CFOs' turnover intention. Fourth, the results from AMO model have identified in motivational construct the key determinant of Digital CFO attitudes. This factor is promoted by digital abilities of CFO and opportunities offered by the firm and the Finance department.

3 EXECUTIVE SUMMARY

This research has the objective of exploring the evolution of the Chief Financial Officer within the Industry 4.0 paradigm. Therefore, the main research topics are focused in the definition of determinants, characteristics, and psychological impact of the new professional role.

The manuscript is divided into three main sections: (1) Theoretical background; (2) Empirical research; (3) Conclusion.

The **Theoretical background** explains how the systematic review of the literature has been brought forward and describes the results of the existent knowledge.

As first step, the analysis of literature was aimed at understanding the current knowledge regarding CFO's role and in gathering information about the state-of-the-art of the new industrial paradigm.

The selection of the literature is structured as a 4-stage funnel driven by exclusion and inclusion criteria.

The literature review allowed to identify three different moments in CFO's evolution of the role: the Accountant; the Business partner and the Value owner. These moments highlight different professional characteristics required to CFOs. For each moment, first, the external contingency factors and disruptive forces are clarified; then, the CFO's responsibilities, tools, tasks and skills are described. The external contingency factors represent global historical and economic events and global digital trends considering as significant impacting over CFO's role.

The *Accountant* identifies the early stage of CFO's history. The accountant mainly performed between 1930s and 1990s. This period was characterised by stability, establishment of auditing regulations, financial analysis based on past information and indicators such as RI and ROI (Howell, 2006). In this stage, CFO was considered mainly as a "bean counter" and "cop", responsible of the financial health of the organization (International Federation of Accountants, 2013). In this stage, activities were mainly supported by non-technological tools.

The *Business Partner* was born after 1990s and was the result of the growing complexity affecting the business environment. Globalization and volatility of stock market created uncertainty. Tools such as Balanced Scorecard and ERP together with computer revolution marked the electronic revolution (Hiebl, Gärtner & Duller, 2017). In this period, CFOs started acting as a fundamental advisor to CEO and the board. CFOs were involved in strategy deployment, investor relations, performance management, business reengineering processes and decision-making processes (Davies & Huey, 2017; Favaro, 2001; Goretzki, Strauss & Weber, 2013; Zorn, 2004). The business partner CFO started leveraging and managing IT to improve value creation in Finance Function (Favaro, 2001).

The *Value Owner* is the latest evolution of the Chief Financial Officer. The environment is characterised by growing relevance in business impact over social and environmental issues. Moreover, the importance of flexibility, agility, forecasting, data-driven business models is rising. In this period, one main contingency factor is characterised as disruptive for the role. In fact, the value owner is moving in a new environment consisting in the fourth industrial revolution: Industry 4.0.

Industry 4.0 is the new industrial paradigm aimed at improving industrial efficiency, productivity, safety and transparency (Boyes, Hallaq, Cunningham and Watson, 2018). Machine-to-Machine communication, Internet of things and Cyber-Physical systems allow the creation of Industry 4.0. This new paradigm enables automation, flexibility, integration and data exploitation (Fettermann et al., 2018; Brettel, Friederichsen, Keller & Rosenberg, 2014; Xu, Xu & Li, 2018). Within this new environment some digital tools are rising in relevance and might represent the future of businesses. Cloud Computing, Big Data and Analytics, Artificial Intelligence, and Robotics Process Automation have been identified as the tools which will majorly affect finance function due to their data-driven orientation and capabilities in extracting meaningful insights from datasets (Accenture, 2018; O'Keeffe, 2017).

From the merging between Industry 4.0 and the Value Owner, the *Digital CFO* (DCFO) eventually was born, which represents the focus of this study. The DCFO is a technically competent executive, able of managing IT, strategy, data analysis and digital technology. It is a professional able of creating strong amount of value thanks to the

exploitation of digital technologies and voluminous datasets. DCFO has been defined in terms of responsibilities, skills, tools and wellbeing.

The two remaining topics of this study are investigated through two research questions. The first one wants to determine if the level of strain and motivation, caused by the introduction of digital technologies, lead to a reduced psychological wellbeing of the individual. The second one is concerning the definition of Digital CFO's determinants, thus, understanding under which conditions and forces a "traditional" CFO is pushed toward a digital revolution.

Therefore, a second step of literature review was required in order to identify the theoretical frameworks to answer the research questions. Thus, from behavioural and psychological literature, two frameworks were chosen: Job Demands-Resources (JD-R) model and Ability-Motivation-Opportunity (AMO) model.

JD-R model was aimed at measuring the psychological effects of introducing digital technologies within the professional role. From literature review, JD-R is considered a key tool to understand employees' wellbeing in working environment. The theory behind JD-R model hypothesizes that the creation of strain (energetic process) or motivation (motivational process) related to the working task is due to the balance between the demands the job requires and the resources available to the employee. Job demands and job resources are defined according to the specific working activity. The choice of the model was driven by the high flexibility and completeness of the framework in studying the psychological wellbeing issues (Schaufeli, 2017; Schaufeli & Taris, 2004). The model defined is measured through standard questionnaires, e.g. COPSOQ (Kristensen et al., 2005), QWI (Spector & Jex, 1998), UWES (Schaufeli & Bakker, 2004), OLBI (Demerouti et al., 2001). Thus, the JD-R model was adapted to the research study and the following constructs were chosen:

- Relevance of Digital Technology. Measured through the use of digital technologies (Cloud Computing, Big Data and Analytics, Artificial Intelligence, Robotics Process Automation) in day-to-day activities;
- Job Demands. Measured through Workload and Burnout;
- Job Resources. Measured through Autonomy and Professional development;
- Burnout. Measured through Exhaustion and Disengagement;

- Work Engagement. Measured through Vigour and Dedication;
- Turnover. Measured through turnover intention.

Eight hypotheses were designed within the research framework in order to study the relationships between the constructs. These relationships were supposed to assess if the adoption of digital technologies were related to an increasing or decreasing of the turnover intentions of the CFOs.

AMO model was selected in order to explain what determinants push and enhance the digital behaviour of the CFO. This model is a well-established framework which provides a theoretical basis for the explanation of work performance of the employees (MacInnis & Jaworski, 1989). More in detail, the framework tries to explain specific behaviours starting from basic concepts of psychology: Ability – skills and capabilities useful to exploit opportunities; Motivation – the impetus toward a behaviour; and Opportunity – contextual constraints and opportunities relevant in enabling a certain behaviour (Hughes, 2007; Egmond & Bruel, 2007). The model was finally customised to correctly address the issue of psychological state in the digitalization process of the CFO.

- Ability: defined as the capability in using digital technology throughout the Information Management Process.
- Motivation: measured through the perceived impact of digitalization;
- Opportunity: defined through the level of digitalization of the environment;

Five hypotheses were drawn within the research model in order to understand determinants of digital behaviour of the CFO.

The **empirical research** involved the development of a research questionnaire. The survey was addressed to CFOs belonging to companies running their operation in Italy. The targeted population was selected inside the Italian medium-large manufacturing and service provider business network. The population referred to MBRES Italian medium-large companies selection 2018. While the theoretical background focuses on global events and trends, the empirical research focuses just on

the Italian business network, in order to analyse how much the Italian study case is consistent with the current global digitalization trend.

In total 336 CFOs were contacted but, unfortunately, just 41 useful observations were obtained after the conclusion of survey delivering process.

The questionnaire proposed consisted of 67 questions divided into three main sections: (1) Control variables; (2) Digitalization of the CFO; (3) Psychological wellbeing. The questions inside the questionnaire were structured as closed-ended questions fulfillable through Likert scales ranged from one to seven. The questionnaire went through a vetting process which ensured absence of bias of the measurement tool as: (1) Non-response bias; (2) Social desirability bias; (3) Common method bias.

The survey research nourished three analyses: the descriptive analysis of the CFO's actual state, JD-R (Demerouti et al., 2001), and AMO (MacInnis & Jaworski, 1989).

The descriptive analysis followed a framework aimed at holistically assessing the current digitalization of CFOs. To do so, digitalization of CFO, Digitalization of the Finance Function, Digitalization of the firm were considered. After that, the use and spreading of digital technology was measured.

The descriptive analysis unveils a positive correlation between age and tenure, busting, at least for the Italian case, Ehrenhalt and Ryan (2007) thesis of CFO's high turnover due to psychological pressure ($\boldsymbol{\beta}$=0.5779, p-value=0.019). Moreover, it has been assessed the Digital CFO's attitudes in holding and acquiring knowledge and capabilities, defining digital those CFOs which are competent and "hungry" for new skills.

The analysis of the firms uncovers the level of digitalization of industries and firms. A relevant insight comes from the relationship between involvement in Industry 4.0 projects and the turbulence of the environment. The more the turbulence is perceived, the more industry 4.0 paradigm is applied ($\boldsymbol{\beta}$=0.4629, p-value=0.049).

Eventually, the use of digital was observed through different perspectives: day-to-day activities, information management process, data exploited, and levels of investment. This analysis unveils that Big Data and Analytics represents the main digital technology exploited by CFOs. Immediately after Cloud computing seems to play a key

role in CFO's everyday activities. After that, Artificial Intelligence and Robotics Process Automation come. The former is not fully exploited yet and its applications seem limited to fields such as forecasting and sensitivity analysis. The latter is mainly used to improve efficiency of processes.

JD-R and AMO models were analysed through PLS-SEM methodology using SmartPLS 3 as main applicative analytical tool. PLS-SEM is a method for structure equation modelling (SEM). This methodology works efficiently with small sample sizes, complex models and makes no assumptions about distribution of data set. Therefore, this approach allowed to test hypotheses between the constructs at the base of the two research frameworks. The study of the models consisted in two main parts: (1) Validation of the measurement model (outer model); (2) Validation of the structural model (inner model) (Hair, Hult, Ringle & Sarstedt, 2016). The former is assessed through internal consistency reliability, convergent validity, and discriminant validity. The latter is assessed through collinearity, structural model path coefficient, R^2, f^2 Q^2. Moreover, the bootstrapping procedure within PLS-SEM provided statistical significance of the models.

Through the PLS-SEM analysis some considerations can be drawn. First, both the research frameworks resulted reliable and validated from measurement model evaluation perspective. Second, most of the research hypotheses were accepted.

In the JD-R research model, five out of eight research hypotheses are verified at 10% significance level. Particularly, the adoption of digital technologies has a positive effect to job resources ($\boldsymbol{\beta}$ = 0,564; p-value = 0,000). Job resources negatively influences burnout ($\boldsymbol{\beta}$ = -0,651; p-value =0,000) and positively enhances work engagement ($\boldsymbol{\beta}$ = 0,558; p-value = 0,000). Finally, turnover intention of CFO resulted affected positively by burnout ($\boldsymbol{\beta}$ = 0,253; p-value = 0,067) and negatively by work engagement ($\boldsymbol{\beta}$ = -0,697; p-value = 0,000). Overall, from these results, an increase in digital technologies adoption seems to reduce CFO's turnover intentions.

The AMO research model confirmed three out of five research hypotheses at 10% significance level. Motivation resulted the only determinant positively enhancing CFO's digital behaviour ($\boldsymbol{\beta}$ = 0,374; p-value = 0,060). Ability and Opportunity seem to have not a direct impact toward CFO's attitude but just with its motivation. Therefore,

Ability ($\boldsymbol{\beta}$ = 0,392; p-value = 0,001), and opportunity ($\boldsymbol{\beta}$ = 0,485; p-value = 0,000), positively influence motivation.

In **conclusion** section the results and future research direction are drawn. This research presents some relevant and innovative insights. Firstly, it has been discovered a gap in academic literature regarding the current revolution of CFOs. After that, the history and evolution of CFO have been structured according to its impact and relevance within the enterprises, identifying three main roles played. The digital technologies (Cloud Computing, Big Data and Analytics, Artificial Intelligence, Robotics Process Automation) have been systematically studied in relation to CFO working activity with the aim of starting a standardisation process in their use. The new profile of CFOs has been demarcated, providing definition, skills and responsibilities.

For the very first time, the psychological wellbeing of CFOs has been studied through the application of Job Demands-Resources model (Demerouti et al., 2001) and PLS-SEM analysis. The results showed that the adoption of digital technologies does not impact over the energetic process of the CFO, thus it is not linked to the development of burnout. On the other hand, digital technology fosters the motivational process increasing engagement and reducing burnout. The overall results show a positive impact over CFO's psychological wellbeing, estimated in organizational stability provided by CFO's longer tenure.

Through the use of AMO model (MacInnis & Jaworski, 1989), it has been proved that motivation acts as the only determinant in CFO's involvement toward digitalization issue. Hence, nor the environment, nor the actual capability represents a constrains to CFO's digitalization. However, the environment and CFO's capability represent a key source to pull motivation.

Eventually, some main statistics regarding the actual situation of digitalization in Italian market have been provided. These show the advancement in digital adoption in different industries and the main applications of digital technologies.

Even if this research provided several meaningful insights, it is affected by some limitations. The low number of observations obtained, the absence of previous studies in psychological assessment and digitalization determinants, the use of subjective measures, the possible impact of non-response bias and social desirability bias, the

limited number of technologies considered, and the focus on the Italian business environment represented a limitation in exploiting the full potential proper of this topic.

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5 INTRODUCTION

5.1 BACKGROUND

The term **Chief Financial Officer** (CFO) commonly refers to the senior executive leading the financial department. It is in forefront of enterprise tasks such as: strategic investment, decision-making, communication, and auditing, assuring company's economic sustainability not only by a financial viewpoint but also from innovation, reputation and growth perspectives.

In the last decade, the advent of the latest industrial revolution and technological advancement, better known as Industry 4.0 paradigm, brought along many changes in business environment. Business models, professionals, skills and tools established after the introduction of computers and microelectronics seem to be destabilised in favour of new models and tools driven by digitalization, customer obsession, flexibility and predictive analysis.

The digitalization trend, which is now evolving with a growing pace and severity world-wide, is shaking the business environment and the managerial and operative function within organizations. One of the most hit function seems to be Finance. Indeed, this function is characterised by strong data-driven attitudes and demand for effective communication.

The CFO, being in charge of the Finance Function and as the second most important C-level manager after CEO, cannot overlook the opportunities and trends brought by the digital disruption.

5.2 RESEARCH OBJECTIVES AND MOTIVATION

In this research, the CFO's role is thoroughly analysed with the goal of answering to these fundamental questions:

- Who is the CFO and why digitalization promises destabilization of the role?
- How will the role change in the next future?

- Which are the technologies that will feature CFOs in a digitalised environment?
- How will be the psychological sustainability of the role changing due to the introduction of digital tools?
- Which are the determinants driving CFO's evolution?
- Which is the current digital state of Finance in Italian firms?

In order to achieve a complete and satisfactory answer to these questions, the whole research cycle was applied: from the systematic and structured analysis of the literature, to the development of research frameworks and research hypotheses testing.

The review of extent knowledge allowed to highlight two gaps in the literature. In order to cover these gaps, two research questions have been defined within the study. The first one wants to determine if the level of strain and motivation, caused by the introduction of new digital technologies, impacts over CFO's psychological wellbeing. The second one is concerning the definition of Digital CFO's behavioral determinants, aimed at understanding under which conditions and forces a "traditional" CFO is pushed toward a digital revolution.

Therefore, the output of this study is going to provide a comprehensive picture about CFO's digital evolution from a behavioural perspective. Particularly, this study might support the future development of CFO's professional role, it may better target initiatives aimed at standardising the use of the innovative digital tools lately available, it may foster the research in optimising and matching the job requirements with skills, knowledge and frameworks and might offer a starting point for managerial psychological wellbeing assessment.

Several elements might be suggested to support the significance of this study. Firstly, due to the relevance and responsibilities covered by CFOs, it is important to assure its alignment to cutting-edge tools and current trends. Moreover, as main CEO's adviser, it is important to assure CFO's attachment and good mental state while working. After that, it is commonly accepted that the use of digital technology will help in creating significant amount of value from the exploitation of data (Accenture, 2018; Fluchter, 2015; Iqbal, Doctor, More, Mahmud & Yousuf, 2017; O'Keeffe, 2017; Wright, 2010),

which might determine the sustainability of the business (Nalchigar & Yu, 2017). Eventually, the study focuses on the determinants and leverages, which might be exploited to trigger the changing process and to establish a digitalized environment.

5.3 STRUCTURE OF THE MANUSCRIPT

This manuscript is divided into three main sections: (1) Theoretical background; (2) Empirical research; (3) Conclusions.

The former is concerned about the systematic literature review and it is aimed at gathering the necessary knowledge regarding CFO, environment, and models to support the empirical research. More in depth, the research of the literature is divided into four main sections concerning: CFO evolution; Industry 4.0; Job Demands-Resources model (JD-R); and Ability-Motivation-Opportunity (AMO) model.

Successively, the empirical research takes place. The empirical research consists of a survey research nourishing the JD-R model and AMO model. In this section, initially the models chosen and discussed within the theoretical background (JD-R; AMO) are applied in order to answer to the research questions of the study. After that, the methodology and tools used to run the empirical research are exploded. Particularly, the research frameworks are evaluated through the use of a survey research and the application of PLS-SEM methodology.

Eventually, the conclusions, implications, limitations and suggestions for future researches and for practitioners are discussed. In this last section, the achievements and discoveries of this study are holistically analysed to provide to the reader the full picture of this research.

As regards the topics undertaken in this paper, the CFO is analysed throughout the whole digitalization process: from the sources of the change to their final impact. This process is made up by three stages:

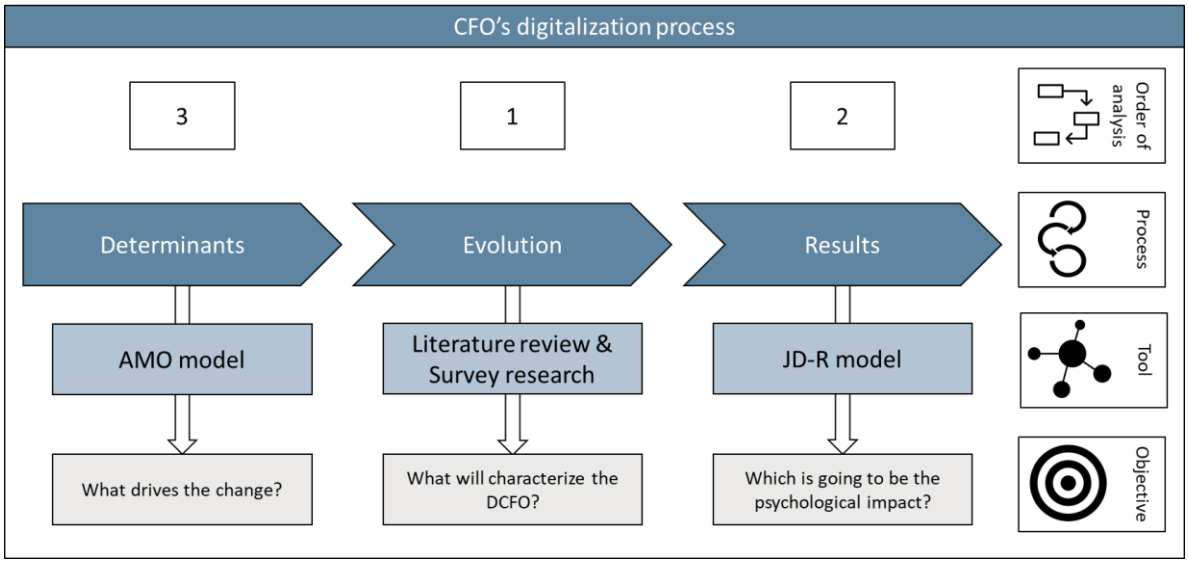
- **Determinants**: determinants are the factors driving CFO's digitalization and are assessed through the AMO model;

- **Evolution**: this stage describes how the CFO is evolved in term of tools used, skills required and responsibilities. This stage is supported by the literature review and the survey research;
- **Results**: eventually the effects due to the disruption brought by the digital technologies is going to be explored through the JD-R model in order to assess the psychological sustainability of the role in its digitalization stage.

This structure allows to draw the full picture about the CFO, tackling all the relevant aspects which characterise the changing process.

The structure of the manuscript does not follow the CFO's digitalization process. Indeed, firstly the evolution of the CFO is analysed and discussed. Doing so, it is possible to gather the required material to build the empirical research and the research models. After that, the impact of the digitalization is discussed, defining if the role is psychologically sustainable. Once assessed the positive impact of digitalization of the role, the determinants and leverages which can be exploited to support CFO's digitalization are provided.

Picture 5-1 summarises the topics treated and the order of analysis.



Picture 5-1: CFO's digitalization process

6 METHODS FOR LITERATURE REVIEW

In this section of the paper, the way by which the methodological research has been brought forward is going to be described and discussed. The aim of this chapter is to provide to the reader the tools required to proof, repeat and vet each step of the research.

The systematic literature review started with the definition of the core aspects and topics necessary to support and sustain the successive empirical research. This issue was faced by the use of an organized method based on a breakdown structure. Indeed, each topic has been exploded to comprehend all the elements necessary to fully describe it and eventually, each element was linked and organised in a hierarchical structure identifying relationships and connections.

In the end, five key topics were identified and deepened. These are: Chief Financial Officer; Environment; Tools; Psychological wellbeing; Behavioural determinants.

The study of the academical progresses was aimed at finding **lacks**, **overlooked trends** and **inconsistency** in the literature about the digitalization of the Chief Financial Officer professional role. With this goal in mind, five main questions were identified, and the literature review has been immediately targeted to find the answers. The five questions are:

1. Who is the Chief Financial Officer?
2. Is the role facing a digital disruption?
3. Why is the environment leading to a digital disruption?
4. Which are the main technologies, tools and profiles involved?
5. How the role will cope with this disruption?
6. Which is the psychological impact of the digital disruption?
7. Which are the determinants leading toward this digital changing?

6.1 SELECTION OF THE LITERATURE

Once defined the objectives of the research, it is necessary to set the right principles to assess the relevance of each academic paper ensuring objectivity. In particular, two principles were settled. The former is concerned about *inclusion and exclusion criteria*. These ones represent the metric to include or exclude the collected papers. The criteria have been designed to be as clear and unequivocal as possible. Table 6-1 extensively gather and explain the criteria used.

Table 6-1: Exclusion and Inclusion criteria

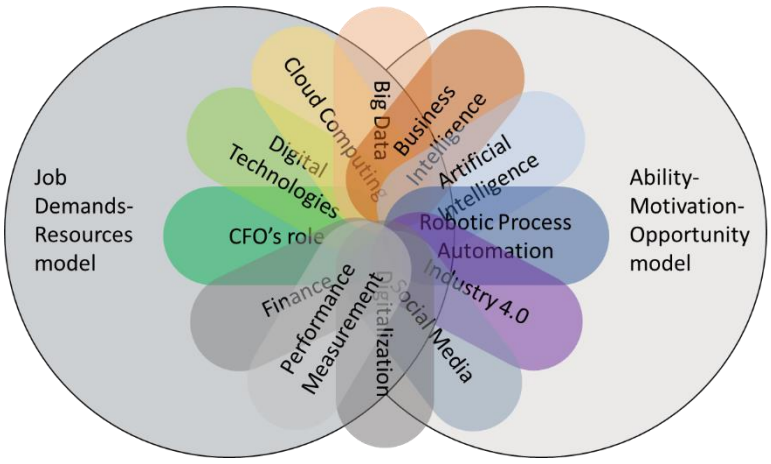
I/E	Criteria	Criteria Explanation
Exclusion	Lack in accessibility [E1]	A paper not fully available to the authors. A paper with only its title, abstract, key words or extracts of the research.
	Wrong language [E2]	A paper not written in English language.
	Obsolete [E3]	A paper not reliable or up-to-date anymore because too old.
	Low quality [E4]	A paper published in low quality journals. The quality of each journal is defined through specialized organization (AiIG; SJR; ABS). The minimum requirement is a "Bronze" according to AiIG; "Q3" according to SJR; "2 2" according to ABS. If the paper is not evaluated according these three organizations, it will be evaluated through the number of citations in the global academic literature with a minimum bar of 20.
	Law, norms and unethical behaviour [E5]	A paper mainly focused on legislation and ethical behaviour of the professional role.
	Not found [E6]	A paper not found within the first 30 results during the research using the keywords chosen.
	Non-Related [E7]	A paper non-related to CFO, digital technologies, psychological state of individuals. A paper where the main topics are used just as examples or citation.
Inclusion	Related [I1]	A paper facing issues of: CFO professional role; CFO evolution, Digitalization; Digital technologies; Industry 4.0; Decision Making; Psychological analysis of working activity; Behavioural analysis.
	Quotes [I2]	A paper reporting relevant witnesses, definitions or quotes.

The second principle consists of *double-check review*. Double-check review implies each paper is examined by both authors in order to ensure alignment with the previously mentioned criteria. In case of opposite opinions, for sake of completeness, the paper will be included in this research.

6.2 DATABASES AND COLLECTION

The collection of the material has been made through the use of four databases: **Google Scholar**, **EBSCO**, **Scopus** and **Science Direct**. On each database were searched the same keywords, which were (Picture 6-1): (1) CFO's role; (2) Digital Technologies; (3) Cloud Computing; (4) Big Data; (5) Business Intelligence; (6) Artificial Intelligence; (7) Robotics Process Automation; (8) Industry 4.0; (9) Social Media; (10) Finance; (11) Performance Measurement System; (12) Digitalization; (13) Job Demands-Resources model; (14) Ability-Motivation-Opportunity model.

The keywords were also combined through the use of "and" or "in" logic operators.



Picture 6-1: Keywords canvas

Moreover, part of the research was conduct through the review of the last five years of specialized journal such as: (1) Accounting Review; (2) Accounting Organization

& Society; (3) Journal of Accounting and Economics; (4) Journal of Accounting Research; (5) International Journal of Productivity & Performance Management.

Furthermore, due to the strong attention to this topic paid by consulting firms such as Ernst and Young, Accenture, and McKinsey, some articles were extracted from studies conducted by them. Because of the professionality and the world-wide recognition of these firms, these sources have been considered as suitable.

The research was conducted from February 2018 to October 2018, thus all the bibliography beyond October 2018 is not included in this research.

6.3 THE FRAMEWORK: FUNNEL

The framework followed in literature review can be visualized as a **funnel**. The papers went through each section of the funnel where a "test of consistency" defines if the paper might be relevant to the study or not. More in depth, this process consists in a multi-stage funnel, where, at the beginning of each funnel's section, a filter sorts the paper.

In particular, the funnel is focused on the paper which passed the first selection brought forward through the previously described criteria. Thus, once assessed that a paper is accessible and eligible for this study, it is filtered once again in order to assess its alignment to this research.

The funnel is made up by four levels: (1) Level-0, this stage collects all the papers found and it filters them through inclusion and exclusion criteria; (2) Level-1, it receives the eligible papers coming from Level-0 and let it pass just those which treat relevant aspects of the topics discussed in this research, thus removing the off-topic ones; (3) Level-2, it receives the on-topic papers from Level-1 and discarded those papers considered as not relevant; (4) eventually, Level-3, it holds the papers considered as relevant for this research.

Once discussed the logic behind the funnel, some clarifications might be required. In particular, it is important to clarify what is intended with off-topic (filter in Level-1) and what relevant aspects mean (filter in Level-2).

The former (off-topic) gathers all the papers which study the CFO's professional role, the digitalization topic or the psychological well-being with a perspective not aligned or non-complementary with this study. With this, it is intended papers which are mainly focused on the study of peculiar examples of the topic in a particular organization or geographical environment. Moreover, papers which are focused on the development of theoretical models and frameworks take part to this category.

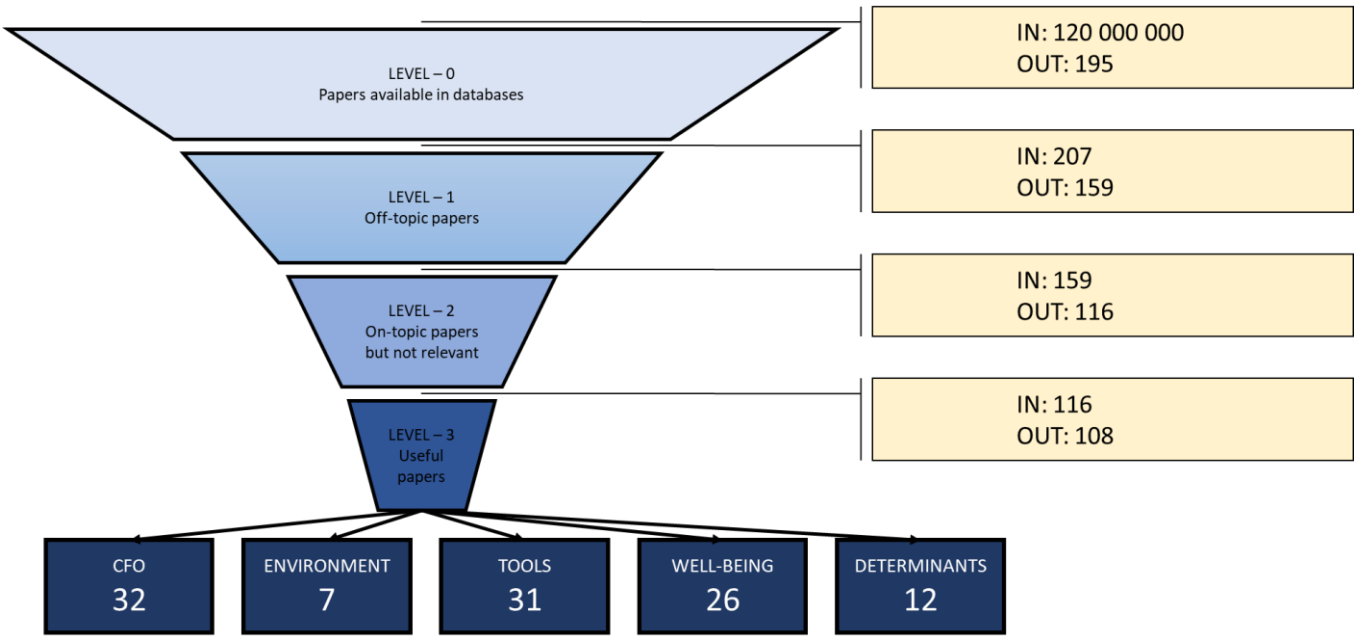
As regard the lack in relevance, it is intended the presence of overlapping researches or on peculiar aspects of the CFO which have nothing to do with the digitalization trend.

In conclusion, Picture 6-2 represents the funnel framenwork and the relative stages of the litterature review and paper selection. In the picture it is possible to see a figure many times the order of magnitude repect to the others (120 000 000). Indeed, this is the input of Level-0. This number is given by all the results displayed by the different databases when seeking for the keywords previously described. Thanks to exclusion criteria, such as E1 – Lack in accessibility, E6 – Not found and E7 – Non-Related, a strong, effective and efficient rought-cut of the retuned papers was possible.

After that, the more the direction of the reseach became clear, the stricter the selection of the papers was. Alignement, consistency and originality were strongly considered as drivers for the paths of the litterature throughout the funnel and eventually for the collection of the papers considered as useful (Picture 6-2).

From each database, the number of papers retrieved in the first place is: Google Scholar (44); EBSCO (112); Scopus (34); Science Direct (17).

In the end, 108 papers were hold, divided among the five core topics: 32 related Chief Financial Officer; 7 about the Environment; 31 concerning Digitalization, tools and frameworks; 26 as regard psychophysical well-being; 12 discussing about the behavioural determinants.



Picture 6-2: The funnel

For each paper included, several data were recorded: (1) authors; (2) title; (3) keyword; (4) database; (5) journal of belonging; (6) date; (7) evaluation AiIG; (8) evaluation SJR; (9) evaluation ABS; (10) link to the original website; (11) type of publication; (12) aim of the publication; (13) topic; (14) perspective.

6.4 ANALYSIS OF THE PAPERS INCLUDED

In this section, some statistics about the characteristics of the papers collected are going to be showed and analysed with the aim of providing the full picture concerning the element considered during the analysis of the literature. Eventually, the main features and lack will be summarised and presented in order to support the upcoming research.

6.4.1 Framework and classification

Before starting analysis, it is important to explain the characteristics considered during the collection of the materials and defining the key values. It has been considered 6 main features:

1. **Year of publication**: according with the aim of using just up-to-date knowledge and researches, many papers were discarded because thought as obsolete. This approach returned a distribution of paper pending toward the latest 5 years;

2. **Authors**: the authors' record was made to understand which the main players in the literature about the topics analysed are. This type of analysis was useful to reveal insights about the possibility of bias given by common school of thought and helped in selecting papers from different authors in order to have many perspectives on which make the reasoning;

3. **Aim of the publication**: the aim of the publication's variable explicates which is the aim of the resource studied. More in depth, five types of goals have been identified and here defined:
   - **Book**: A book is a resource consisting in a complete and considerable collection of information, definitions, methods, models and framework about the topic treated. It presents both extensive review of the literature and explanation of original models.
   - **Divulgation**: A resource with the aim of divulgation collects the existing knowledge regarding a certain topic and spreads it toward its reader. In this type of resource, original materials as data collection or models is not present, but there are a critical reviews of the actual knowledge. Usually this type of publication came from magazine, company reports and conferences.
   - **Research**: A research is a paper exploring a lack of the literature or analysing an existing issue trying to find an original solution or an original way to cope with it. It presents a description of the problem, the research and results following the scientific methodology.

- **Review**: A review is a resource analysing the current state of the research about a certain topic. It provides a clear picture about the topic, the number of articles developed, authors and type of analysis brought forward in each one with the aim of guiding the future research.
- **Survey**: A survey is a research aimed at understanding the actual situation of a phenomenon through the direct involvement of the people experiencing it. This type of resource is characterised by a strong data collection through interview and questionnaire and the use of statistical analysis to unveil relevant insights.

In the authors' mind, all these types of publication hold different perspectives and relevant original information to better tackle the issue of CFO's digitalization;

4. **Type of publication**: this variable describes the type of publisher of each resource in order to better understand the type of analysis brought forward and the eventual presence of bias and application of an academical approach. Seven main types of publication have been identified and here listed:
   - **Academic Journal**: An academic journal is a paper published under a peer-reviewed and approved periodical publication in which scholarship relating to a particular academic discipline.
   - **Association**: in this category, they are collected all the resources published by professionals' association which conduct independent research to foster knowledge spreading within their category.
   - **Book**: a book is a resource which extensively treats a specific topic and it is issued by a publisher.
   - **Company report**: A company report is a paper developed by a firm which conduct independent studies.
   - **Conference**: A conference paper is a paper developed after a recognised conference of professionals discussing about a certain topic.
   - **Magazine**: A magazine is a periodical publication not peer-reviewed which discuss about topics targeted for their readers.

- **Report**: A report is an independent publication of an author discussing about a certain event and summarising his/her discoveries.

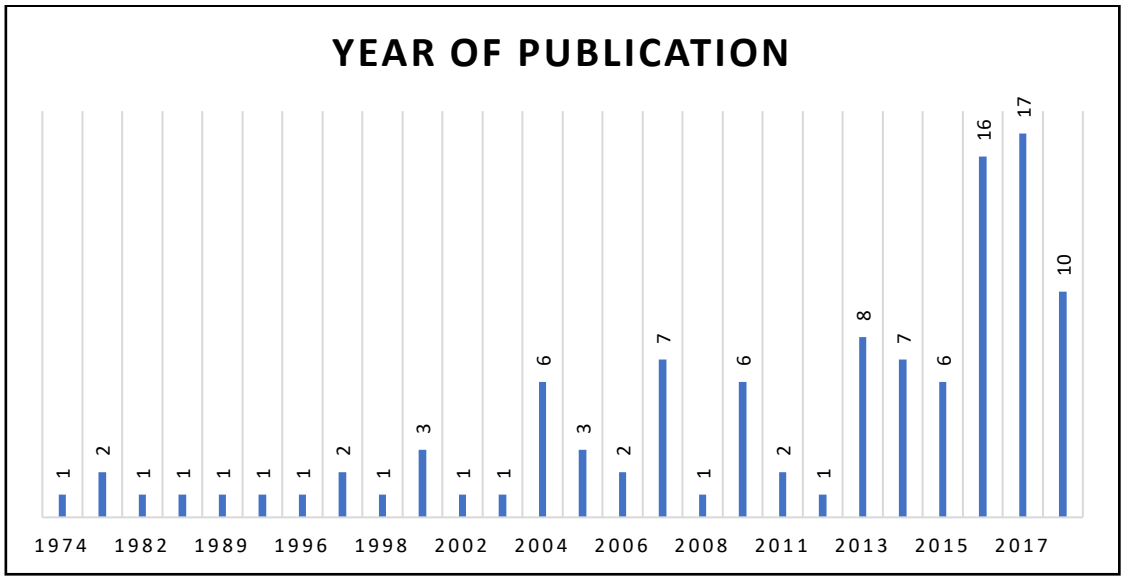
5. **Journal**: this variable explicits the journal or the publisher of a certain paper with the aim of supporting the validity and quality of the resource selected;

6. **Topic**: this variable specifies on which of the five topics previously identified, the paper is concerning about. These are:
   - **Chief financial officer**: in this category, all the papers which extensively refers to the professional role of the Chief Financial Officer are gathered.
   - **Environment**: the environment describes the external context and forces which acts on the digital transformation of the CFO. More in depth, this collects papers about Industry 4.0 paradigm.
   - **Tools**: when talking about tool, it is referred to the digital technologies or methodologies which the CFO might use in his/her job.
   - **Psychological wellbeing**: well-being refers to the resources treating the psychophysical state of the professional role.
   - **Behavioural determinants**: this topic refers to the resources treating the determinants driving individuals' behaviour.

7. **Perspective**: this variable is used to better understand under which perspective each topic is analysed in a way making the paper better characterizable.

According to these variables, it has been possible to statistically analyse the papers used. In the following chapters, the statistical analyses run are described.

6.4.2 Year of publication



Picture 6-3: Year of publication distribution

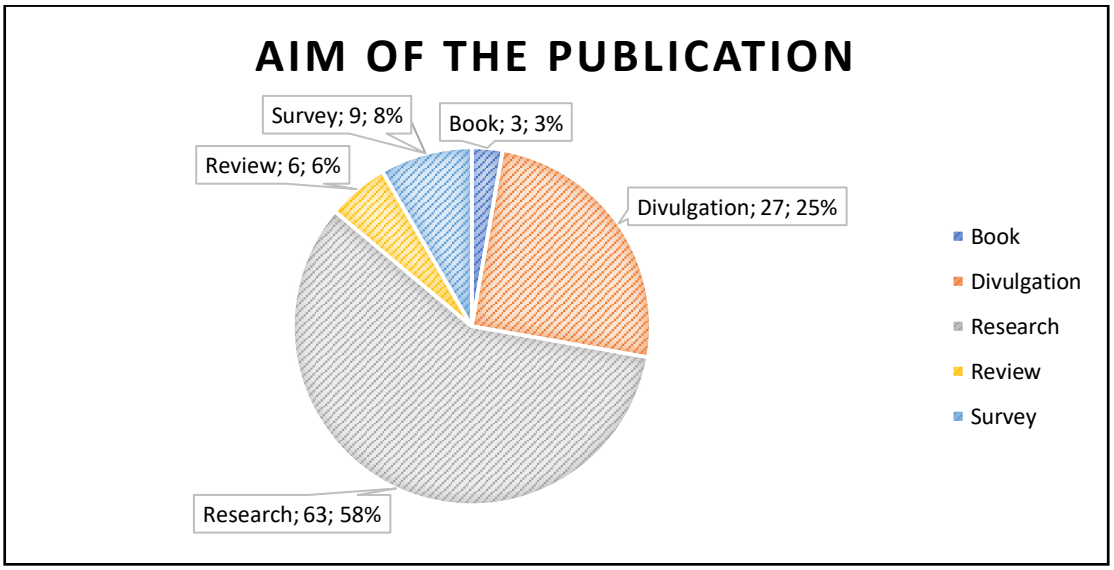
According to the aim of being up-to-date, the majority of the papers selected were published in the last five years (54.2%). These are mainly about the new digital technologies and Industry 4.0 as well as the transformation and new role of the CFO (Picture 6-3).

As far as the oldest paper used are concerned (1974 – 2001), they were considered as valid because they discuss the models used to analyse the psychophysical wellbeing of the professional role and digitalization determinants. The model used is the Job Demands-Resources developed by Demerouti *et al.* (2001) and based on standard and validated questionnaires such as the Maslach Burnout Inventory (Maslach *et al.*, 1986). Moreover, to enable the discussion about the variables of the models, it has been referred to highly recognised-psychological studies treating specific stressors and motivational factors (e.g. Turnover intention (Porter *et al.*, 1974)). Similarly, the Ability-Motivation-Opportunity (AMO) model (MacInnis and Jaworski, 1989) brought along some elder papers.

In conclusion it is possible to appreciate the consistency of the research, which preferred nearly published articles to discuss the tools and digitalization trend which gain meaningfulness just if up-to-date. Instead, when discussing about specific model of analysis,

it has been referred to the original models avoiding bias of application in other fields or with different goals than the original one.

6.4.3 Aim of publication



Picture 6-4: Aim of publication distribution

From the pie chart displayed in Picture 6-4, it is possible to appreciate the distribution of the papers according to their aim. The majority of papers (58%) are aimed at researching new models or framework to tackle their issue. 25% of the material used is coming from divulgation-oriented articles. Respectively 8%, 6% and 3% of the papers are survey-oriented, systematic review of the literature and books.

It is possible to find a logic within this distribution. The divulgation materials and books were used to have a broad perspective of the problem which eventually has been deepened through: the use of researches, when discussing about topics; reviews, when seeking for lacks; and survey, when the actual situation has to be empirically assessed.

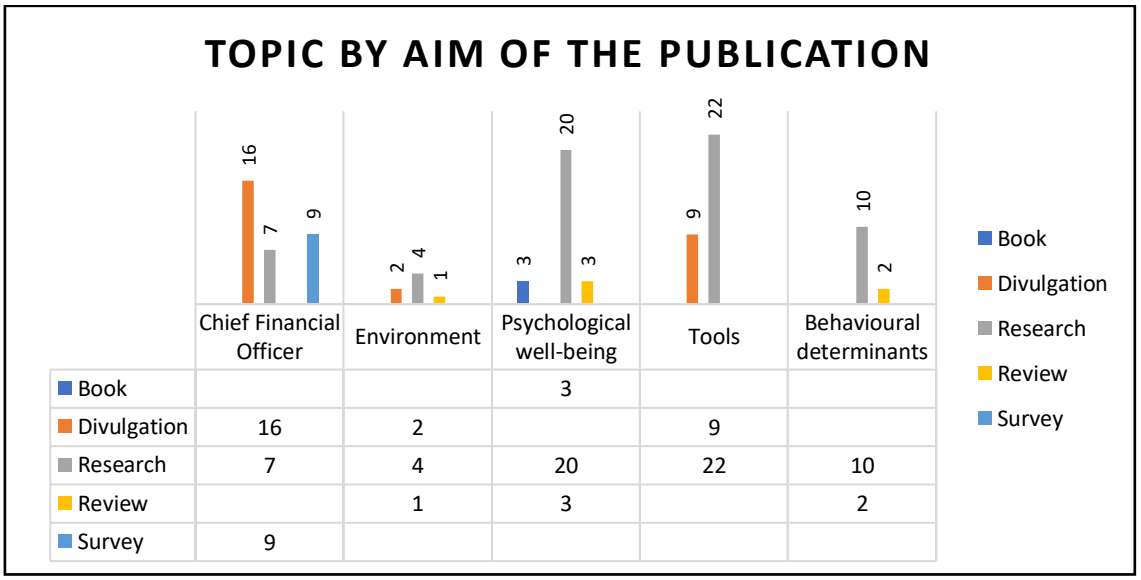
Some relevant insight might be found when splitting up the different aims with the topic issued (Picture 6-5). It is interesting to notice that as regard Chief Financial Officer's topic, 50% of the material face the issue of spreading existing knowledge. Thus, the same effort is put in spreading the discoveries and in creating new knowledge. Being the topic highly practical and with a wide audience of professionals, it might be consistent to have many papers focused just on training the professional role.

The environment has a good balance between research, divulgation and review of the literature. A peak can be found in research studies, being Industry 4.0 a hot topic for academic and practitioners.

As regard the psychological wellbeing, it presents far many research papers than the other categories. The reason of that can be found in the development of a reliable model through a deep study of the Job Demands-Resources model itself and each of its components as well as the standard questionnaire used to measure the variables of the model. No material has been found with a divulgation aim. The reason of that is the total absence, to the best of available knowledge, of any application of the Job Demand-Resource model to the CFO's professional role.

As far as the tools are concerned, the majority of papers found (71%) were focused on research's goal. This is consistent considering the exploration trend toward new digital technologies (Cloud Computing, Big data and Analytics, Artificial Intelligence, and Robotics Process Automation).

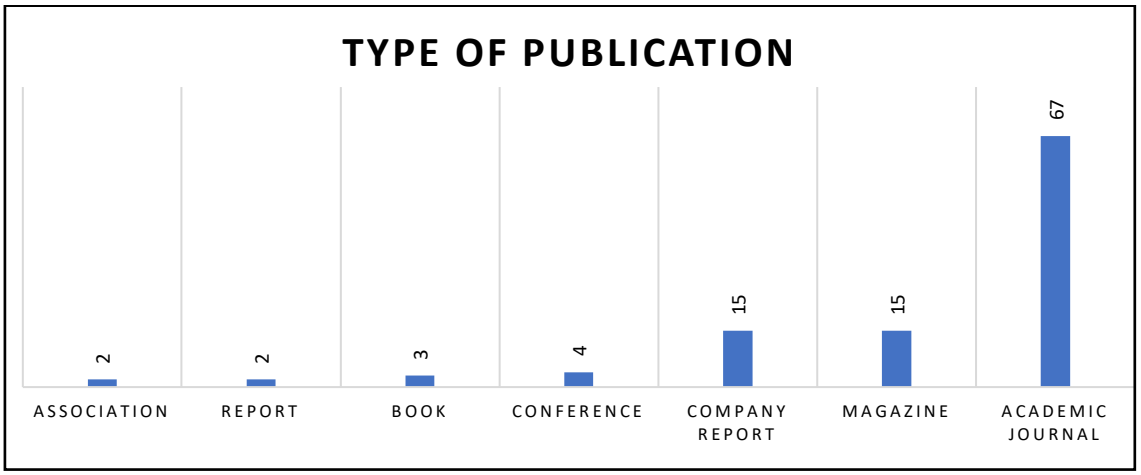
Eventually, accordingly with the sought experienced in model building for psychological wellbeing, also behavioural determinants present a high majority of research material (83%) aimed at correctly developing the research model.



	Chief Financial Officer	Environment	Psychological well-being	Tools	Behavioural determinants
Book			3		
Divulgation	16	2		9	
Research	7	4	20	22	10
Review		1	3		2
Survey	9				

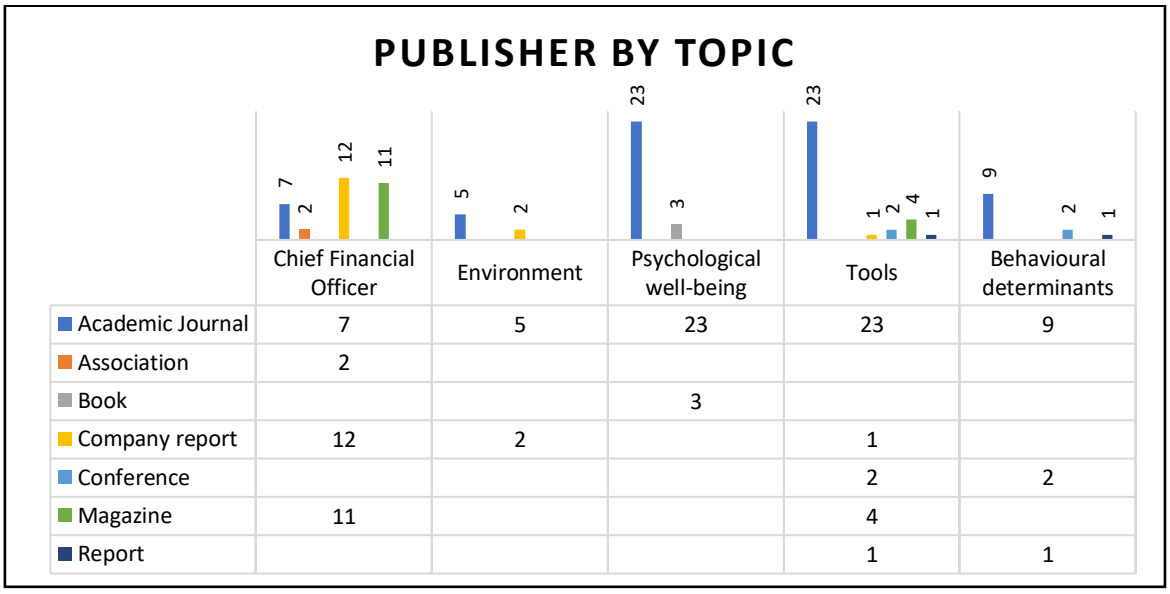
Picture 6-5: Topic by aim of the publication

6.4.4 Type of publication



Picture 6-6: Type of publication

According to the type of publication (Picture 6-6), 62.03% of the material used is coming from academic journal. Following, it is possible to find magazine and company report, both at the second place with 15 papers each (13.89%). Eventually in a decreasing order, there are respectively: conference (3.7%), book (2.7%), association (1.85%) and report (1.85%). Once again, some relevant insights might come looking at the topic by type of publication, as showed in Picture 6-7.



	Chief Financial Officer	Environment	Psychological well-being	Tools	Behavioural determinants
Academic Journal	7	5	23	23	9
Association	2				
Book			3		
Company report	12	2		1	
Conference				2	2
Magazine	11			4	
Report				1	1

Picture 6-7: Publisher by topic

As regard the Chief Financial Officer, 78% of the material used come from non-academic journal. Indeed, just 7 academic papers were found and was aimed in fostering the development of the professional role. The other 25 papers used were independent studies brought forward by companies (e.g. EY; McKinsey), specialized magazines (e.g. Business Horizons; Financial Executives) and professionals' association. This reveals a particular interest in the topic for practitioners more than academics.

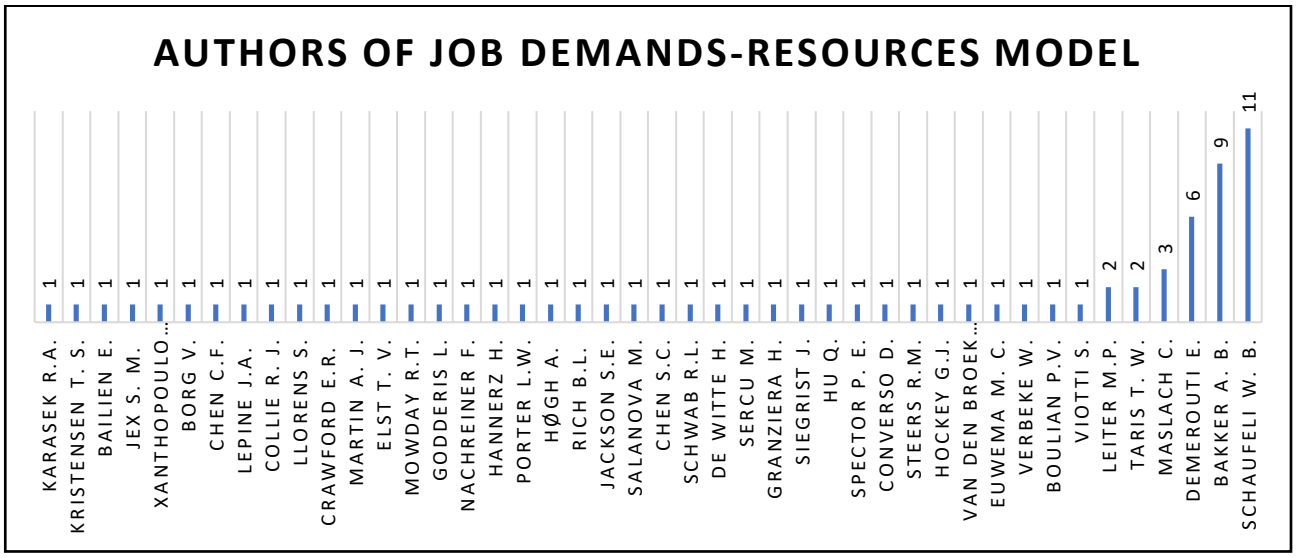
A cross-feature analysis highlights that all the papers coming from the literature review were aimed at researching activity, while the private firms and associations focused more on divulgation of the knowledge and assessing the current situation through surveys.

As regard the environment topic (Industry 4.0), five resources out of seven came from an academic journal. The other two, are a company issue, uncovering the interest of private firms in exploiting and spreading the knowledge about Industry 4.0.

About the psychological wellbeing, all the material found comes from academics, both journals (88.5%) and books (11.5%). The main reason of that is, to the best of our knowledge, the absence of studies about the psychological well-being of CFOs. In this case, the seeking for information was focused on Job Demands-Resources models, relevant variables and standard questionnaires, topics extensively treated within the academical literature. Similarly, behavioural determinants presents 75% of the material coming from academic journals while the rest of sources regard independent reports and conferences.

As far as tools are concerned, almost 75% of all material was found within the academical literature with a small presence of company report, magazines, conference and independent reports.

6.4.5 Authors of psychological well-being



Picture 6-8: Authors of Job Demands-Resources model

It can be quite interesting analysing the authors of the topic with the highest number of academic journals used about a single issue (Picture 6-8): the psychological well-being. Indeed, the research made resulted in a wide number of papers coming from the same authors.

Schaufeli W. B. produced, by its own and in collaboration with peers (mostly Bakker A.B and Demerouti E.), eleven academic papers about the job demand job resource model, tacking extensively and deeply the development and application of the model. Schaufeli W.B. takes the first position in number of presences in the material used to develop the model.

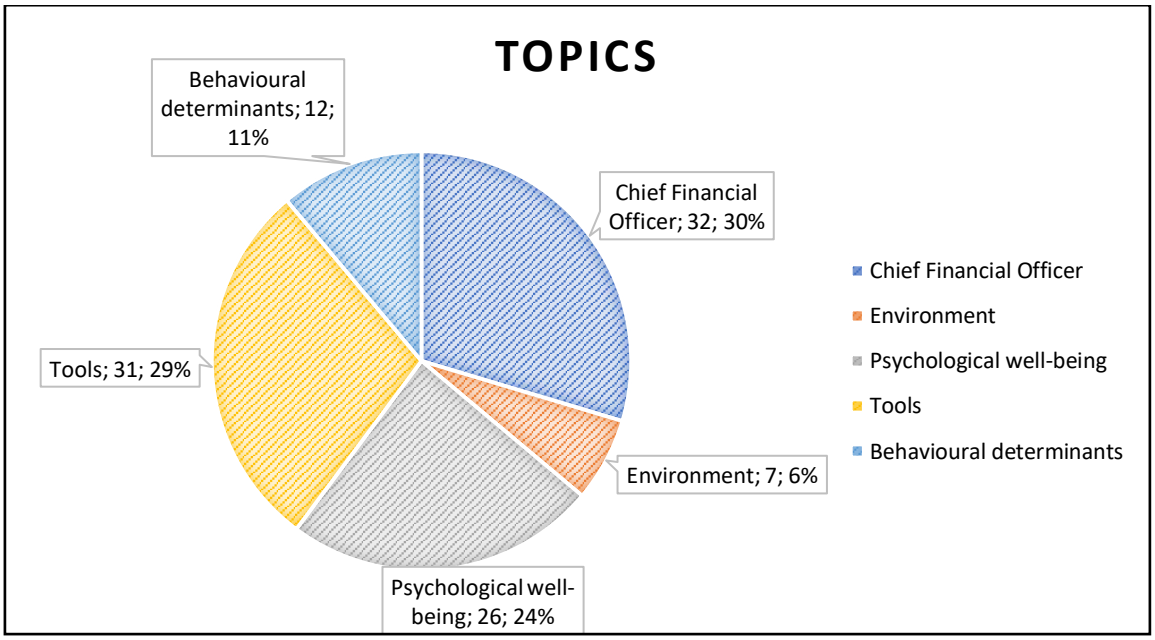
Immediately after Schaufeli W.B., it is possible to find Bakker A. B. with 9 presences followed by Demerouti E., who covers the third position with 6 papers selected.

It is interesting to notice that the first three authors (Schaufeli W. B., Bakker A. B. and Demerouti E.) are the developers of the Job Demands-Resources model in 2001 (Demerouti *et al.*, 2001). Thus, it is consistent that their presence within the analysis of this topic is particularly heavy.

Together Demerouti E., Schaufeli W. B., Bakker A. B. represent almost the 37% of the authors about the psychological wellbeing topic. They took care of several aspects about the Job Demands-Resources model; from the development, to validation, to adaptation for different aims and applications of the model.

The other authors can be connected to papers discussing the application of Job Demands-Resources model (e.g. Chen & Chen, 2018; Collie, Granziera, &Martin, 2018; Van den Broek *et al.*, 2017) or the development of standard questionnaires such as the Maslach Burnout Inventory (Maslach *et al.*, 1986) or the COPSOQ (Kristensen *et al.*, 2005).

6.4.6 Topics



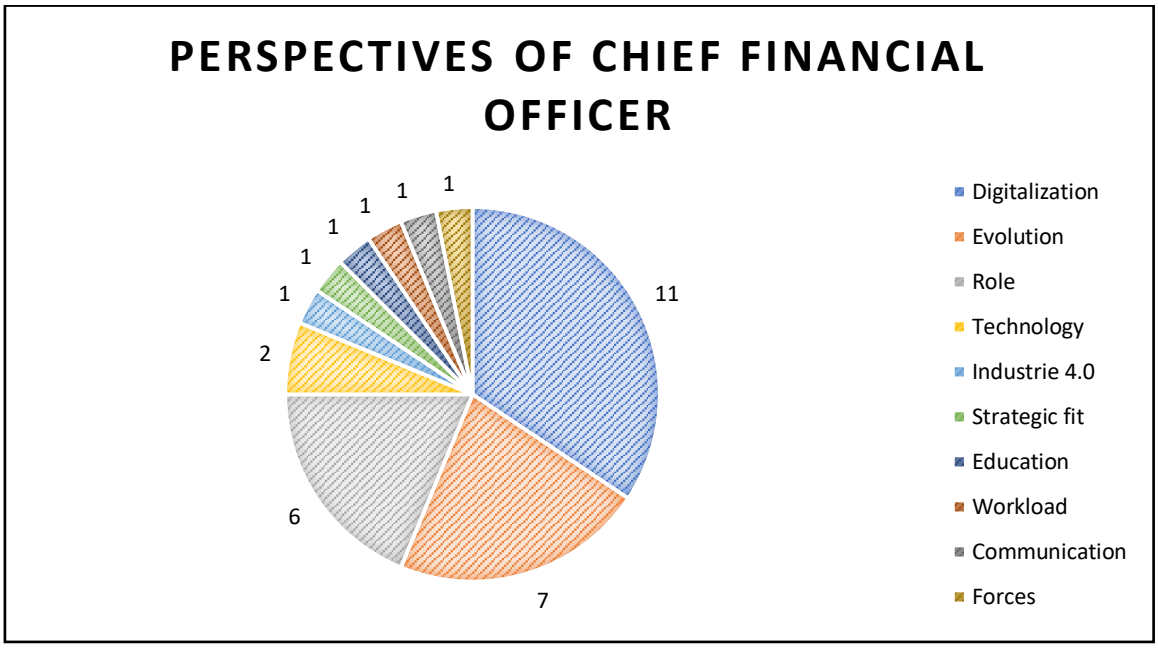
Picture 6-9: Main topics of the literature review

As discussed during the explanation of the funnel, the literature selected was divided into five main areas (Picture 6-9): Chief Financial Officer; Environment; Psychological wellbeing; Tools; and Behavioural determinants. In this classification, it can be found a good balancing of all five areas with almost an even number of papers selected per each area. Environment and Behavioural determinants represent an

exception given by the narrowed topic analysed consisting respectively in Industry 4.0 and AMO model.

Once defined the different main areas, it is required a step further in order to have a better understanding of the literature used. Thus, each topic will be described using the different perspective it provides to the issue.

The environment will not be discussed because it consists of just one perspective given by the Industry 4.0 paradigm. For the same reason, the behavioural determinants are not going to be exploded. Indeed, in behavioural determinants just the AMO model was explored.

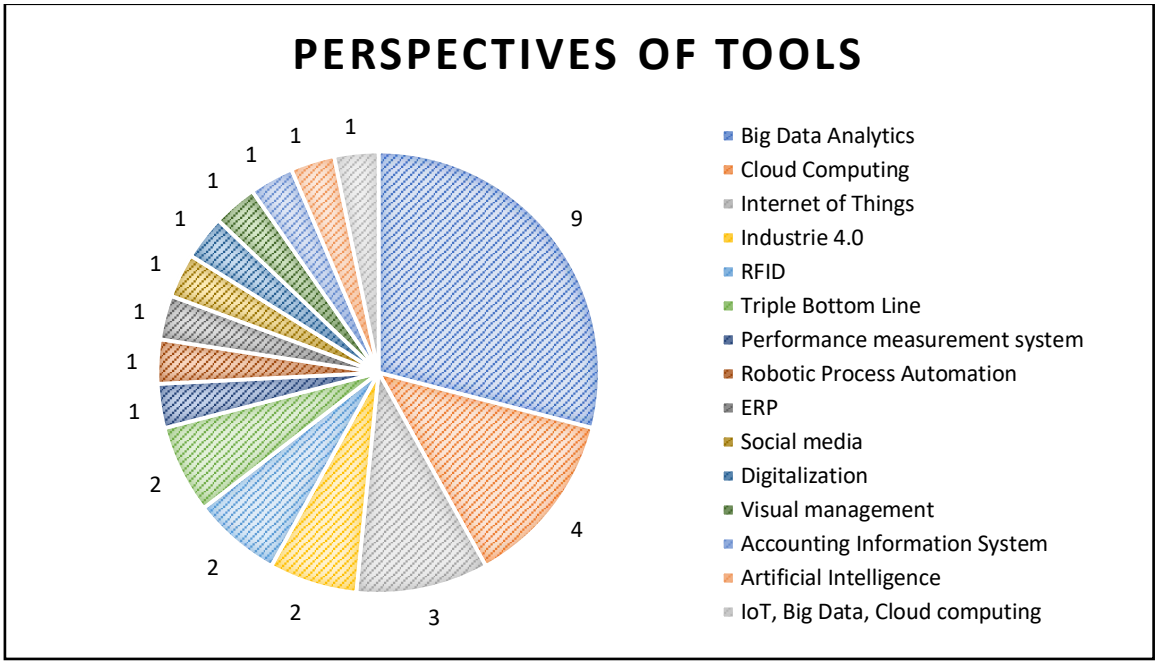


Picture 6-10: Perspectives of the Chief Financial Officer

As regard the Chief Financial Officer, 34% of the literature used discusses about the digitalization of the role, consistently with the aim of this research. Seven papers tackle the issue of the continuous evolution of the CFO's professional role and six papers were selected to holistically explain the CFO's role.

Furthermore, the remaining 8 papers discuss about: (1) the technology used by the CFO; (2) How the CFO is reacting to Industry 4.0; (3) the strategic fit of the CFO within the organization strategy, goals and environment; (4) the education characterising CFO's

forma mentis; (5) the workload pressing CFO's, topic used to apply the Job Demand-Resource model; (6) the expansion of CFO's responsibilities over firm's public relations; and eventually (7) the forces pressing CFO toward the new shape of the Digital CFO (Picture 6-10).



Picture 6-11: Perspectives of tools

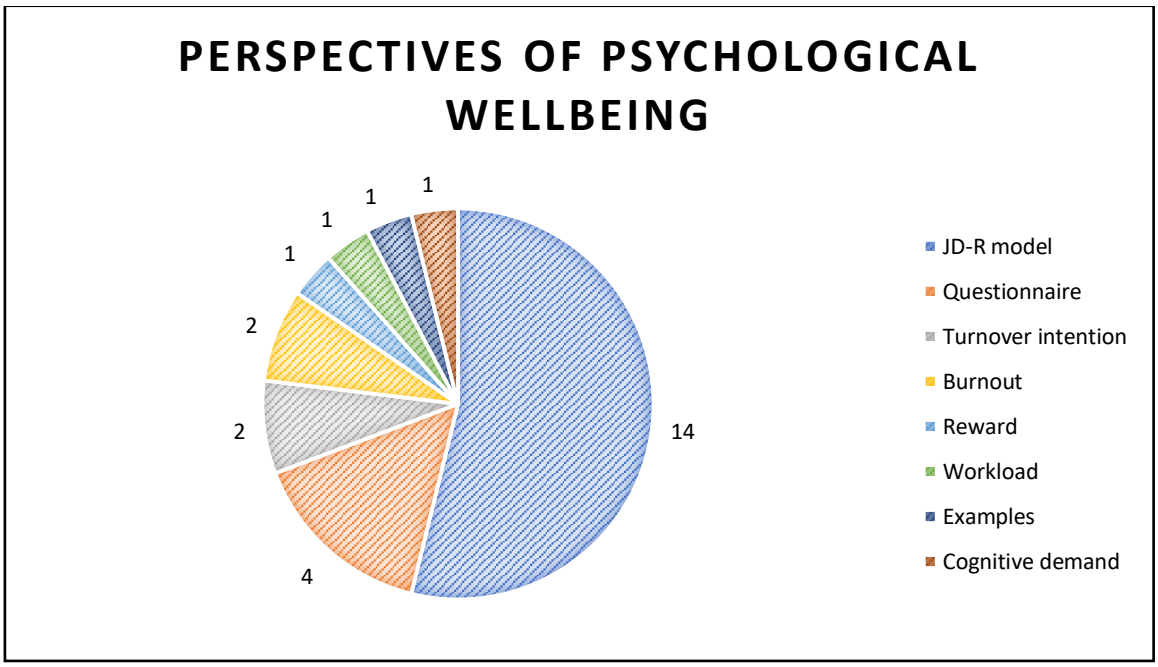
As far as the tools are concerned (Picture 6-11), many elements were considered. The four Digital Technologies discussed in this study cover the majority of the material used (51%): Big Data Analytics (10); Cloud Computing (5); Artificial Intelligence (1); Robotics Process Automation (1).

From these numbers it might be seen a flaw toward Big Data Analytics and Cloud Computing against Artificial Intelligence and Robotics process automation. However, this is just a classification issue, indeed, due to the high correlation among these four technologies, it is impossible to discuss each one independently, and the overall 16 paper in different ways tackle all the four technologies.

Another key topic within tools consists of the technologies (Internet of Things; RFID; Industrie 4.0) enabling Industry 4.0 paradigm which covers the 22% of the material collected. The percentage of resources tacking Industries 4.0 raises over 73% if the

digital technologies previously mentioned were considered as enablers of Industry 4.0 paradigm.

The other topics considered within Tools umbrella are: (1) Triple Bottom Line; (2) Performance Measurement System; (3) Enterprise Resource System; (4) Social media; (5) Digitalization; (6) Visual Management; (7) Accounting Information System.



Picture 6-12: Perspectives of Psychological wellbeing

Eventually, the psychological well-being was analysed through eight perspectives (Picture 6-12). The majority (53%) of the material used is about the Job Demand-Resource model. The other material used is about the assessment of the models' variables (i.e. Questionnaires, 4 papers) and the detailed analysis of each determinant used in the model (Turnover; Burnout; Reward; Workload; Cognitive Demand).

6.5 CONCLUSION ABOUT THE SYSTEMATIC REVIEW OF THE LITERATURE

In conclusion some main insights can be highlighted from the process of systematic review of the literature.

Firstly, some lacks might be found when discussing about the academical focus on Chief Financial Officer. Indeed, the majority of the material found was not academically-developed but coming from studies brought forward by practitioners and consulting firms. This shows that, albeit the topic is highly requested from the people involved within this field, the academics tend to overlook the professional role and its transformation. For this reason, a systematic study of environment, tools and CFO's professional role might be relevant.

After that, it seems that there is a strong lack in studying CFO's psychological wellbeing. Indeed, no material has been found about this issue. This lack can be considered as relevant because CFO strain continues to grow, and the sustainability of the role might crack if this problem is not faced. Due to the paramount importance that CFOs cover in today industry, the wellbeing and optimal mental state of the role should be a prerogative of organizations and managers.

Similarly, with Psychological wellbeing, no papers were found regarding the analytical analysis of the determinants pulling CFO's digitalization. Indeed, this topic is mainly treated in a qualitative way.

In Annex 1 it is possible to look at the literature database used.

7 THE EVOLVING ROLE OF THE CHIEF FINANCIAL OFFICER

In general and practical words, the **Chief Financial Officer** can be defined as the responsible of the Finance Function and the most senior executive role with leading and directing financial strategy and operations inside the organization.

In recent history, due to contingency factors, this role has been continuously stretched, changing his/her responsibilities, area of influence and competences required.

In this section of the research, the evolution of the professional role of the Chief Financial Officer is examined reporting the main results from the review of the available literature, which showed a positive trend that resulted in a growing and expanding role.

From the research, three different professional stages have been identified during the evolving path: **the accountant, the business partner and the value owner**. Since the role deeply changed, these three different concepts were adopted to give insights about what they are concerned of. Even though the clear distinction of three different stages within the role of the Chief Financial Officer represents an innovative approach, it was allowed and supported thanks to the existent and available literature.

For each CFO's stage, the review begins with the description of some contingency factors, and then the focus moves to the understanding of the responsibilities of the role, the main skills and tools adopted in that phase. The contingency factors are those global and historical events whose financial and economic impact over the performances of the enterprises have been considered to have a significant influence on the evolution of the Chief Financial Officer role.

The path described starts chronologically with the first definition of the role in the early 1930s and ends in the context of the fourth industrial revolution, better known as Industry 4.0.

The purpose of this part of the research is aimed to provide a clear picture of how and how much the role of the Chief Financial Officer is changed and to define

general guidelines about the current state of the role. Therefore, a particular attention is paid the third stage of the Chief Financial Officer: the value owner.

About this last stage, a deeper analysis has been performed in order to define: (1) the context, (2) the disruptive forces which led to the current digital evolution, (3) the main aspects of the role and of the Financial function, and (4) the new digital technologies and tools introduced.

To define the environment surrounding the "value owner", Industry 4.0 has been considered as the main historical event having an impact on the role. For that reason, a brief chapter will describe the main pillars regarding the fourth industrial revolution. The disruptive forces will focus on how the historical events have affected the role. Finally, new definitions for the role and for the function in the new era of digitalization are provided: **Digital Chief Financial Officer** and **Digital Finance function**.

7.1 THE ACCOUNTANT

In the first stage related to the evolution of the role, the Chief Financial Officer is identified mainly with the professional figure of the **accountant**. In order to report a brief and chronological overview of the role in this first stage, the analysis and the perspective (e.g. American context) developed by Howell (2006) for Financial executive are considered as main reference points for this part of the research.

7.1.1 Contingency factors

The audited financial statements and external financial reporting were not mandatory until **1933**, when the New York Stock Exchange started the requirement for audited financial statements of listed companies. It represented the first proof of public financial documents. In the same period, the market leader of automotive industry, General Motors Corp., was setting its prices based on its own costs, investments and volume projections to achieve a desired long-term ROI. Its **ROI system** quickly spread

beyond the automotive industry, as the idea of relating profits to investment levels became generally accepted (Howell, 2006)

During the **1950s**, companies like General Electric Co. (GE) had reached a size that pushed them to reconsider how they were structurally organized. As a consequence, many of them moved to a new **decentralized structure**, creating a set of divisions and below them, the operating departments. Each one governed by its own general manager responsible for the business unit. GE established a "measurement project" — including market share, productivity, product development, personnel development, community relations and financial performance — based on **residual income**, in order to determine how to evaluate the performances of each business unit.

By the late 1950s, senior financial executives were responsible for the accounting and control of their companies or, in the decentralized model, for operating departments. The external economic environment was characterized by generally good economic conditions with low level of competition and banks and large financial institutions as primary sources of capital for companies.

From an internal perspective regarding enterprises, the utilization of capital was generally measured by ROI or, in the case of GE and other companies with decentralized structures, also by residual income. Planning was relatively short-term oriented and tactical, and the concept of **net present value of future cash flows** was in its early stage, particularly in industries with large investments and long payback periods, such as the oil companies. Moreover, companies had to report their financial results quarterly and audited results annually; companies did not have to provide guidance or earnings estimates (Howell, 2006).

In the **1960s**, most large companies were beginning to produce five-year plans, starting to develop a long-term orientation. However, spreadsheet programs were not yet developed and financial calculations were mainly manual. In 1964, Bruce Henderson started the Boston Consulting Group, one of the most important strategy consulting firms. In the late 60s, GE began to modify its long-range planning practices toward a more strategic orientation. In the same years, Michael Porter started writing about strategic planning (and later published his masterpiece, “Competitive Strategy”). **Strategic planning** was becoming an integral part of management practice.

Three other major economic factors were also underway. First, **Globalization** was well underway for the first time, starting the global market phenomenon. This phenomenon was caused by the Marshall plan undertaken to recover the war losses (Howell, 2006).

Second, following the post Second World War economic prosperity, companies began to review their customer bases as more national and heterogeneous, thus decided to offer greater product variety. This resulted in a **proliferation of products and market segmentation strategies,** which had significant implications for the finance executive. More products and market segmentation needed to determine specific product costs and profitability and generated shorter product life cycles, higher research and development costs, higher advertising and marketing expenses. Investment and operational analysis became more critical. Therefore, management accounting, as well as financial accounting, became critical to the financial executive's responsibilities (Howell, 2006).

The third major trend was the emergence of the **non-correlated portfolios** among the corporate strategies. Until the 1960s, companies tended to perform in relatively narrowly defined and correlated business categories, such as steel, automobiles, textiles, retailing and banking. Then, many leaders of the markets started to acquire different small and growing companies in order to diversify their acquisitions and their businesses. Integrating the acquisitions was not emphasized yet, as each acquired unit was evaluated only on its own performance (Howell, 2006).

As a consequence of the increased size of markets, products, businesses, markets and customers proliferation, the complexity of the financial executive's responsibilities grew. Domestic and foreign competition was increasing, and longer-range, strategic planning and stronger measurement and control of internal operations had become more significant. The senior financial executive was starting to play a central role in planning, measurement, control and reporting processes within the organization (Howell, 2006).

The **1970s** was a period when senior financial executives had to consider, more than ever, the broader economic environment in which the firm operated, rather than just the narrow internal managerial accounting and financial reporting responsibilities.

Factors as globalization, increased competition, financial volatility and uncertainty were making the Chief Financial Officer's responsibilities much more complex and challenging. For financial executives, management of the firm's balance sheet had an increased importance since cash and short-term assets lost their value if excessive and not turned quickly. Hence, management of working capital became more important (Howell, 2006).

In the **1980s,** Toyota Motor Co. promoted a new production model, known as **Lean approach**. The Japanese method provided feedbacks from operations very quickly, at the end of each shift, rather than waiting for weeks or months. Moreover, results tended to be more operational than financial. For instance, throughput measures of speed and quality levels became more important than detailed costs.

Many U.S. manufacturers moved in an opposite direction, applying Activity Based Costing (ABC) for the cost analysis development. However, simple methods of cost assignment, often using single overhead rates to assign costs to products and customers, led to inaccurate cost determination, product profitability and strategic direction. Moreover, ABC approach only moved costs around without reducing them, and prevented U.S. manufacturers from improving their competitive position (Howell, 2006).

Even the impact of **regulatory agencies and new accounting rules** was considered significant in the evolution of the Chief Financial Officer. The predominant managerial concern was that applying the new methods would have led to a more- or-less relevant sudden drop in reported income and rates of return. Therefore, in his academic research, the author Zorn (2004) argued that all types of American firms, threatened by potential repercussions of the regulatory change, increased the popularity and the power in the hands of Chief Financial Officers.

7.1.2 The accountant role

This first stage of the evolution of the role can be considered as concluded. From the literature review, the **accountant** acted mainly as a "*bean-counter*", a functional specialist who was responsible of the financial health of the organization (International Federation of Accountants, 2013), overseeing and implementing adequate financial control infrastructure, bookkeeping of financial transactions, preparing tax statements and financial reports, monitoring debt and capital structures, creating the budget in order to allocate financial resources, measuring and evaluating past financial performances (e.g. cost analysis, financial indicators...).

The tools adopted for measurement systems were not supported by technology and were aimed to the evaluation of past financial performances.

The skills required were mainly related to the purely financial and management domains. The accountant had to provide stewardship, having to ensure business integrity to legal and regulatory requirements, financial health and control of performances.

The data processed were related to past financial performances. The accountant had mainly a past and reactive orientation to something that was already happened inside the organization. Instead, the decision-making processes were dominated by the operational mangers of the different functions inside the organization, from manufacturing to sales and marketing (Zorn, 2004), while the corporate strategy definition was manly responsibility of the Chief Executive Officer.

As far as the Finance function role, it passively supported the management and the other business units with detailed numbers and figures.

The low relevance of the Chief Financial Officer within the top management in the organization can be explained considering the "times of certainty" that characterized years from 1930s to 1990s. The word economies were stable and the global competition was low since the globalization and the economic liberalization for the adoption of open markets were not common yet. These economic aspects made an overall low pressure in the hands of the Chief Financial Officer.

7.2 THE BUSINESS PARTNER

In the second stage, the role of the Chief Financial Officer evolves from being an accountant professional to becoming a **business partner** and advisor to the top management of the organization. In this context, the key global events that impacted on the role transformation were identified.

7.2.1 Contingency factors

In the 1990s, the third Industrial revolution, known also as **ICT revolution**, marked the shift from mechanical and analogue technology to digital electronics. The adoption and proliferation of computers and the accessibility to the World Wide Web through the Internet connection deeply changed communication processes, information management and storage within the organizations.

During this period, **ICT functions** started becoming a source of competitive advantage and playing a relevant role inside the companies, charged with establishing, monitoring and maintaining Information Technology systems and services.

As an example of the impact of this "first" digitalization, in these years, early Accounting Information Systems started to be designed. The **Accounting Information Systems** had the objective of collecting, storing, and processing financial and accounting data used by decision makers. Among these systems, **Enterprise Resource Planning (ERP)** system was developed and rapidly adopted in many large companies. This type of system allowed an efficient integrated and centralized management of business processes. In many cases, ERP adoption and implementation were considered responsibility of the Chief Financial Officer due to their expertise and influence on investment decisions (Hiebl, Gärtner & Duller, 2017).

The Chief Financial Officer started expanded the influence area toward strategy implementation and monitoring areas. In 1992, **Balanced Scorecard** was developed by Kaplan and Norton (Richins, Stapleton, Stratopoulos & Wong, 2017) as a new strategy performance management tool used by managers to keep track of the execution of

activities by the staff within their control and to monitor the consequences arising from these actions. The implementation and execution of strategic objectives through the constant monitoring of financial and non-financial performances shifted the focus of Chief Financial Officer from bottom line spreadsheets to financial strategy (Howell, 2006).

As reported by Howell (2006), during the 1990s there was considerable interest directed toward the idea of "the changing role of the Chief Financial Officer". It was suggested that the Chief Financial Officer and financial executives as primarily involved with transactions as "cop" or controller did not go far enough, nor create as much value for the firm as performing as the "**business partners"**. The view that financial information flowed from the units to the central office, rather than from the central office to the units, was seen as failing to capitalize on the center's financial expertise.

The practice of **reengineering** emerged as a management emphasis. The idea behind was that there was a lot of inefficiencies in many American companies, of which a good percentage could be eliminated or reduced applying a deep analysis of business processes. After acquisitions or decentralization of business units, companies found themselves with duplicate and overlapped activities. Thus, they started to eliminate those considered as unnecessary, centralize common activities and outsource non-core activities to third-party providers. As regards the Finance Function, many companies standardized IT platforms adopted within the firm in order to simplify and accelerate consolidation processes, improve comparative analysis and create shared services centers to centralize activities that had been organizationally dispersed. Finance executives were frequently at the center of these reengineering efforts (Howell, 2006).

In 1993, the European Single Market deal was approved and launched, eliminating economic barriers for the free movement of goods, capital, services and labor among European nations. This trend toward **globalization of capital and markets** impacted on financial performances and on business strategy definition of the companies since it increased competition, enhanced larger economies of scale, allowed goods and factors of production to move toward areas with lower costs of resources.

The **"**dot-com bubble" burst during the first quarter of 2000 caused many of the high-flying dot-com companies to go out of business. The bubble led the Congress of

United States to the approval of the Sarbanes–Oxley Act, which set new or expanded requirements for all U.S. public company boards, management and public accounting firms. One requirement of the law was that the Chief Executive Officer and Chief Financial Officer had to certify their companies' financial statements, and second, that they had to certify that the company's internal controls over financial statements were adequate (Howell, 2006).

Moreover, the economic crisis spotlighted the **volatility and the uncertainty of stock markets** due to the positive trend in financial speculation. As a consequence, both shareholders and stakeholders increased their **pressure on requirements and compliance**, asking for fair disclosure and clarity of financial reports.

All these factors together started rising the **complexity** around the role of Chief Financial Officer. The pressure on compliance and disclosure of financial reporting, the increased global competition on financial performances, the adoption and management of digital tools as competitive advantage, the financial risks related to volatility of stock markets were the main factors rising environment complexity.

7.2.2 The business partner role

In the second stage of the professional transformation, the factors described expanded the role toward becoming a **business partner**. The adoption of the definition of business partner to the Chief Financial Officer is gained through the review of many previous authors, who introduced this concept to set a gap from the professional features that characterized the role until the years 1990s.

This trend toward broadening the Chief Financial Officer role, which began with the advent of formal strategic planning and the emphasis on information management, was resulted in having a larger range of responsibilities. The Chief Financial Officer was no longer viewed as a mere functional specialist, but as a member of top management, having good information from all business levels. In fact, executives started focusing on finding Chief Financial Officers who not only had financial acumen and analytical skills, but who could be a true “business partner” to the Chief Executive Officer. In that period,

Chief Financial Officer had to advise the Chief Executive Officer on corporate strategy development, lead the company's information management efforts, act as the day-to-day investor relations with the investment community, provide leadership on managing internal processes and initiatives, support and actively influence decision-making processes. The Chief Financial Officer was expected to enhance business value, not simply to keep score of it (Favaro, 2001; International Federation of Accountants, 2013).

In this sense, the traditional bean-counter stereotype (what has been called “the accountant stage”), characterised by routine work such as recording, data inputting, and reporting seemed to have been replaced by the “business partner”, that had been depicted as willing and capable to provide more added value to the decision-making and control with a management orientation (Goretzki, Strauss & Weber, 2013).

Furthermore, the promotion of the former treasurer to the rank of a Chief Financial Officer signaled a fundamental redistribution of managerial roles, with greater relevance of financial considerations built into the executive structure and the decision-making process. Thanks to the enhanced visibility and power, Chief Financial Officers gained a critical say in key strategic and operational decisions, from evaluating business unit performances, creating new ways to leverage capital, managing acquisitions and divestitures, and pushing back hostile takeover attempts, to serving as the company’s primary ambassador of investors and financial analysts (Zorn, 2004).

As a business partner, the Chief Financial Officers were involved in four important areas of the business. First, they had exemplary strategic management capabilities. Second, they were able to provide line management with detailed, real-time information of current performance that improved the quality of strategic decision-making and execution. The Chief Financial Officers started working closely with business unit management to understand the strategic forces, underlying the creation of economic profit and how to manage these forces. CFOs support enhanced the business units in the development of alternative strategies to maximize value. Third, they transform the traditional investor-relations function into a source of competitive advantage. And fourth, their leadership transcended the finance function and carried over into all areas of the company (Favaro, 2001).

As with the strategy discipline and decision-making involvement, much of the responsibility for **leveraging IT** was fallen on the Chief Financial Officer's shoulders. The Chief Financial Officer was being called upon to make recommendations on a broad range of critical IT investments, from whether or not a company should invest in broad technology platforms to how business units can build systems to serve “markets of one”. There were two particularly important abilities required to the Chief Financial Officer for an effective IT management. First, a Chief Financial Officer needed an intimate knowledge of where within a company's activity chain the firm can establish profitable differences, defining its core business and competitive advantages. The second IT-related ability the CFO needed to possess was how to manage and integrate the growing array of information systems in the company (Favaro, 2001).

In fact, when managed properly, business information software allowed to connect Finance with every function, actively informed every strategic decision and adopt timely and accurate metrics for the evaluation of performances, becoming the nervous system and analytical core of the modern enterprise. One thing quickly became clear: IT became deeply enmeshed in the Finance Function. In this way, Chief Financial Officer was involved in key decisions and played a driving role in creating an **Information Management strategy**. Information Management involves mature, executive-sponsored practices to address how information serves a business and how a business serves its information. This requires a top-down strategy, seeking to glean the value from IT and not support IT for the sake of IT. It starts with a focus on determining specifically what information is key to the success of a business. (Green, 2007; Schmidt, 2016).

Furthermore, Chief Financial Officers started playing a major role in reengineering process and **business transformation**. Such transformations are large-scale efforts that run the full span of a company, challenging the fundamentals of every organizational layer with the aim of facing the external competition. Their expertise was needed in order to provide a correct benchmark of the performances, measure and enhance long-term value creation respect to short term profits, set priorities in allocating the resources among the different initiatives, boost coordination among the business units, lead and implement the transformation. Chief Financial Officers and the Finance function could help companies successfully deliver on the full potential of a

transformation. To do so, they had to be judicious about which activities truly add value and embraced their roles in leading the improvement in both performance and organizational health (Davies & Huey, 2017).

From a lower organizational perspective, beyond the core responsibilities of financial reporting, audit and compliance, planning, treasury, and capital structure, Chief Financial Officers are playing a stronger role in **corporate portfolio management** and capital allocation (Agrawal, Goldie & Huyett, 2016). This strategy has become relevant in risk management in order to manage effectively financial resources and to face a dynamic business environment. It was often based on a broader financial analysis of the opportunities, including projects selection, allocation of resources and budgets, monitoring of performances and the progress. In this sense, Chief Financial Officers had a broader and data-driven perspective that allowed them to drive the business process improvement. In addition, they could help establish corporate wide guidelines to define a standard disciplined, structured approach to measure and report project benefits and performances across the entire company (Wince, 2010).

As result of the expanding role of the Chief Financial Officer, **Finance Function** became a place where business strategy, process and information combine and cross-pollinate. It was playing a role in developing responsive management architectures and governance structures, supporting strategic and operational functions and the delivery of business objectives, providing greater visibility and understanding of performance, increasingly serving as a key integrator across the organization of process, technology and people. Finance function was responsible for providing business units with the information and knowledge they need to drive competitive advantage. This challenged the function to focus on obtaining better information, providing insightful direction to executive management, predicting and managing change, building relationships both internally and externally, taking a global perspective and, of course, continuing to reduce costs (Couto & Gray, 2004).

In order to fulfill this more demanding role, the CFO was asked to possess or acquire **new skills**, which were no more focused only on financial or and accounting competences but toward a strategic orientation. In some cases, finance organizations had set up coaching programs to help upgrade the skills of their professionals. Some

leading companies systematically rotated their finance staffers through the business units in order to gain greater understanding of the business from an operating perspective. This may, in fact, be a driver and enabler of finance's greater alignment with line functions (Couto & Gray, 2004).

7.3 THE VALUE OWNER

The, **value owner** represents the latest and current stage of the evolution of the professional role of the Chief Financial Officer. Due to the growing interest and relevance of this topic and to the lack in the available literature, the understanding and deepening of what concerns this last stage, accounts as a core part of this research.

In order to provide a clear picture about the last stage, the contingency factors, the internal and external disruptive forces, the role, its skills required, its technologies and tools adopted, the Finance function are going to be defined and described in different subchapters.

First, among the contingency factors **Industry 4.0** will be described separately, since it is considered as the main disruptive event that lead and drive this final transformational of the role.

Second, the **disruptive forces** that resulted from the contingency factors and events are presented and divided into external and internal ones. The forces are aimed to explain how the contingency factors impacted on the role of the Chief Financial Officer.

Third, in order to put a gap with the previous role, a new professional figure and a new organisational function are defined, as evolutions of the previous ones: the **Digital Chief Financial Officer** and the **Digital Finance Function**. The new definitions provided in the research will represent one of the main contributions to the literature.

Finally, the new **digital technologies** available with the paradigm of Industry 4.0 are described. In particular, the focus laid toward those technologies and their

application that are considered to support significantly the Chief Financial Officer in the upcoming years.

7.3.1 Contingency factors

In early 2000s, the concept of **triple bottom line** was coined for the first time. Quickly many organizations adopted the triple bottom line framework to evaluate their performances in a broader perspective to create greater business value. The framework involved the economic, social and environmental perspective. The idea behind was that a corporation's ultimate success or health had to be measured not just by the traditional financial bottom line, but also by its social/ethical and environmental performance. This paradigm began the diffusion of the trend toward sustainability issues that characterized the companies in the years after (Norman, 2004).

During the 2000s, the **social media** were developed and rapidly spread among the users. In short time, they disrupted how people communicated, shared their opinions and influenced each other's. From a business point of view, social media had a strong impact on how companies could analyze customers' needs and interests with new marketing strategies and tools. For example, sentiment analysis was developed in order to identify, extract, quantify, and study affective states and subjective information available online. All the data coming from social media represented a new source of information (Sidorova, Arnaboldi & Radaelli, 2016).

In 2001, some authors, members of the Agile Alliance, published the *Manifesto for Agile Software Development,* which provided the definitions of agile values and principles. The Agile software development approach was aimed to develop solutions through the collaborative effort of self-organizing and cross-functional teams and their customers/end-users. This kind of approach supports adaptive planning, evolutionary development, early delivery, and continuous improvement, and it encourages rapid and flexible response to change, applying incremental and iterative work sequences. Within a short time, this approach influenced on the implementation of project management. In fact, although it was designed originally for the software industry, many industries started to use **agile methodology** when developing products and services. In order to answer to fast paced and changing environment, this methodology allowed increasing

flexibility and adaptability to change, more rapid deployment of solutions, reduction of waste, increasing collaboration (EY, 2016a).

The **financial crisis** of subprime mortgages in 2007-2008 impacted almost over all global economies and lead to period of general economic downturn known as "Great Recession". Europe and United Stated were the most affected economies by the crisis. Once again, the financial breakdown increased the pressure from regulatory institutions over the financial markets and financial documentation. This event started a period of global economic instability and economic stagnation. Uncertainty moved the attention of boardroom conversations toward forecasts, profitability, risk management and strategic decisions related to supply chains, pricing and production. Therefore, Chief Financial Officers had to pay close attention to some core factors, such as managing liquidity and the capital agenda, controlling cost, maintaining internal control and delivering robust financial to stakeholders (IBM, 2010).

The other identified contingency factor is the paradigm of **Industry 4.0**. It has been considered the main disruptive event which led to the digital transformational of the role toward the third stage. Due to its relevance, Industry 4.0 is going to be presented separately.

7.3.2 The environment: Industry 4.0

In the last decade, the new digital paradigm which is radically changing how manufacturing companies make their own business has been recognized under the term "**Industry 4.0**". The aim of industry 4.0 is the improving of industrial efficiency, productivity, safety and transparency (Boyes, Hallaq, Cunningham and Watson, 2018).

The term Industry 4.0 usually refers to the Fourth Industrial Revolution based on the disruption of Information and Communication Technologies through innovative digital technologies which enables automation, networking capabilities and connectivity. More in depth, Industry 4.0 takes advantage of **machine-to-machine communication** (M2M), **Internet of Things** (IoT), **Cyber-Physical Systems** (CPS), **Cloud Computing** and **smart devices** to create an environment where virtual space and

physical world merges, developing a new generation of ICT systems and disrupting firm's organization in both internal and external environment (Xu, Xu & Li, 2018).

Industry 4.0 (I4.0) as emerging paradigm in every industry is disrupting business models, organizational structures and professional roles. Indeed, the exploitation of automation and digital technologies enables a whole world of new opportunities for every organization both in manufacturing and services industry. I4.0 extensively exploits automation and digitalization in order to create new working environment characterised by strongly interactive and automatized physical and virtual dimensions (Xu, Xu & Li, 2018).

Industry 4.0 innovations are aimed to address different customer benefits and their implementations is going to have a considerable impact upon today's value chain and business models. The pillars of Industry 4.0 are aimed at meeting the new market requirements, such as: customization, lowering of prices, increasing of quality, fast time-to-market and low product lifecycle through the use of **flexible**, **automated**, **data-driven** production. As a consequence, these concepts have a strong influence on the operative and strategic performance management of production-related value creation processes (Lasi, Kempe, Fettke, Feld & Hoffmann, 2014).

The term Industry 4.0 is used in different contexts and lacks an explicit definition. Currently, there are a significant number of widespread definitions. From the literature definitions (Moeuf, Pellerin, Lamouri, Tamayo-Giraldo and Barbaray, 2017; Sauter, Bode & Kittelberger, 2015), it can be assumed that Industry 4.0 represents the vision for the industrial production of the future. In this transformation, sensors, machines, workpieces, and IT systems available in the "smart factory" will be connected along the value chain beyond a single enterprise. These connected systems (also referred to as Cyber-Physical Systems) can interact with one another (M2M interactions) using standard Internet-based protocols and analyse data to predict failure, configure themselves, and adapt to changes. Industry 4.0 will make it possible to gather and analyse data across machines, enabling faster, more flexible, and more efficient processes to produce higher-quality goods at reduced costs. This in turn will increase manufacturing productivity, shift economics, foster industrial growth, and modify the profile of the workforce.

7.3.2.1 History

Industry 4.0 was initially introduced in Germany, at the Hannover Fair, in 2011, and in 2013 officially announced by the German government as a strategic initiative (High-Tech Strategy 2020 Action Plan) aimed at pioneering the digital evolution in manufacturing sector (Boyes, Hallaq, Cunningham and Watson, 2018; Xu, Xu & Li, 2018). Kagermann, Wahlster & Helbig, (2013) published a report summarizing the recommendations for the implementation of Industry 4.0 emerged during activity done at the Hanover fair 2013.

To better understand how it was possible to touch Industry 4.0 paradigm and why it is addressed as the new industrial revolution, it is necessary to briefly recap the manufacturing paradigms path through their main steps (Xu, Xu & Li, 2018) (Picture 7-1).

Initially, the first "industrial revolution" took place at the end of the eighteenth century and significantly changed the way items were produced. Indeed, the introduction of mechanical facilities powered by water force or steam power allowed for the first time to structurally overcome the physical boundaries of human force (Xu, Xu & Li, 2018).

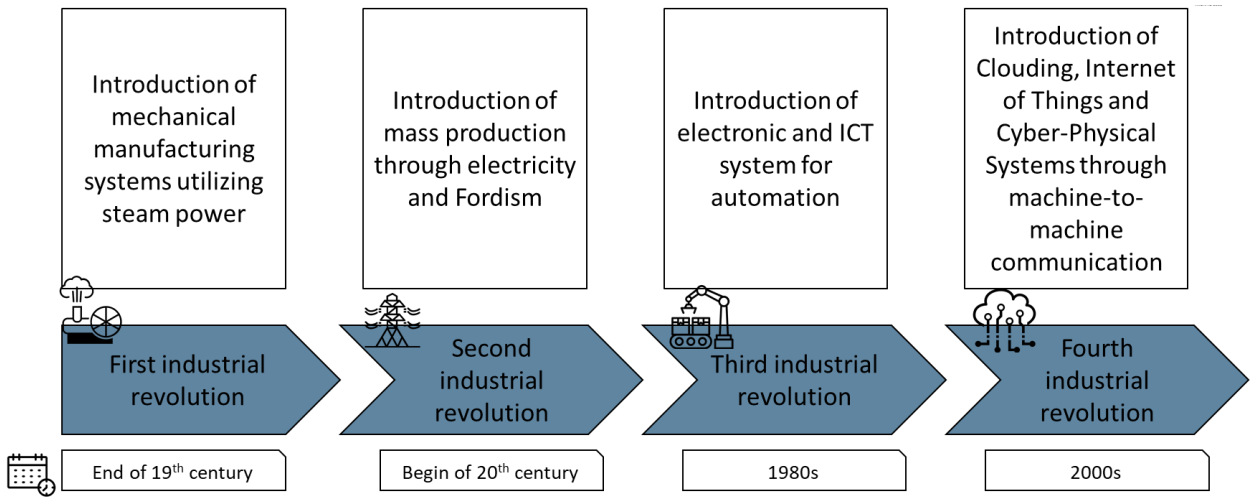
After that, at the beginning of the twentieth century electricity was released, and machine power become independent respect to the presence or not of water and sturdily improved their productivity enabling mass production, exploitation of new materials and labour specialization. This is addressed as the "Second Industrial Revolution" (Fettermann, Cavalcante, Almeida & Tortorella, 2018; Xu, Xu & Li, 2018).

Successively, during the '80s the "Third Industrial Revolution" occurred when computers spread out and electronic and information technologies were introduced within the manufacturing process and programmable logic controllers were applied to automate manufacturing processes (Fettermann *et al.*, 2018). At this stage, human mind constrain was overcome for the first time in human history. In fact, computers defined a whole new approach to the data management, where the complexity of mathematical quantitative analyses over copious datasets were possible. In this stage the application of microelectronics to manufacturing processes brought some breakthrough as

Computer Numerical Control (CNC), flexible manufacturing systems (FMS), Computer Aided applications (CAx) (Xu, Xu & Li, 2018).

The latest revolution taking form in this last decade is the Industry 4.0 paradigm enabled by Internet and Digital Technologies characterised by a deep cyber-physical connection of manufacturing processes (Fettermann *et al.*, 2018).

There is a reason why Industry 4.0 developed in Germany. This can be found in the increasing competition on both quality and production costs. Germany industry suffers of high labour costs and relocation of facilities in other countries. The companies producing in high-wages countries should solve the economies of scale-scope dilemma through individualization, virtualization, hybridization and self-optimization, all these areas are strongly linked to Industry 4.0 issue. Indeed, quality has not associated anymore to a growth of revenues and customers are not willed to pay more for a quality over the actual bar. Thus, improvement came from Agile Manufacturing and Mass Customization brought a higher collaboration among the supply chain. To run highly integrated process, it was required to implement virtualization of process and supply chain to ensure smooth inter-companies' operation and real-time communication and material flows. In this way, company boundaries started fading and autonomous systems data exchange gained relevance among the entire value chain (Brettel, Friederichsen, Keller & Rosenberg, 2014)



Picture 7-1: Evolution of the industrial paradigms

7.3.2.2 Advantages

Industry 4.0, also known as the smart manufacturing and cognitive manufacturing (Fettermann *et al.*, 2018; Xu, Xu & Li, 2018), makes possible the exploitation of the massive volume of information created during the day-to-day operations. Industry 4.0 is enabled by a combination of **intelligent sensors**, **data analytics** and **fast communication**. Due to the rate of new data creation and the heterogeneity of this one, data sharing, and analysis might be complex and specific targeted systems might be developed to fully exploit the potentiality of Industry 4.0 paradigm. Data science and analytical models with real-time communication and high degree of automation are the main tools used to extract insights from data.

It is widely accepted that the impact of Industry 4.0 on the organizations working environment will go beyond the mere evolution of the current ICT systems. **New business models**, **new professional roles**, **new partnerships**, **new capabilities** are going to emerge at both inter- and intra- organizational level (Xu, Xu & Li, 2018).

One of the main advantages of Industry 4.0 is the creation of a truly **integrated environment**, where the geographical boundaries fade away and different plant in different geographical regions are going to be interconnected and integrated creating a single environment which proliferates of heterogenous and voluminous amount of data sources, applications, platforms and standards (Xu, Xu & Li, 2018). Thus, Business Process Management (BPM) will play a fundamental role in this ongoing changing. In fact, BPM might support the organization strategic goals aligning resources within the company and across its supply chain, pulling toward an **integrated**, **flexible**, **automated**, **efficient** and **effective** management of daily operations (Fettermann *et al.*, 2018). Indeed, the goal of Industry 4.0 is the enlargement of horizontal, vertical and end-to-end digital integration among organizations.

According to Xu, Xu and Li (2018) **Horizontal Integration** refers to the "integration of the various IT systems used in the different stages of the manufacturing and business planning processes within a company" (p. 2952). As far **Vertical Integration** is concerned it is defined as the "integration of the various IT systems at the different hierarchical levels" (p. 2952).

Eventually, regarding **End-to-End Digital Integration**, it is the

"integration throughout the engineering process so that the digital and real worlds are integrated across a product's entire value chain and across different companies, whilst also incorporating customer requirements" (p. 2952).

In conclusion, the implementation of Industry 4.0 brought several improvement to company processes such as: (1) advanced communication thanks to the Cyber-Physical Systems; (2) higher consistency among the product-process system thanks to the increasing in data utilization and digital engineering of products; and eventually (3) rapid product innovation thanks to modular simulation and modelling techniques and decentralized flexible production units (Brettel, Friederichsen, Keller & Rosenberg, 2014).

In addition, other benefits can be identified. According to Sauter, Bode and Kittelberger (2015) and Lasi *et al.* (2014), the main potential benefits for the users of I4.0 applications are:

- **Cost reduction** is achieved mainly through an increase of automation and improved efficiency;
- **Flexibility** allows to companies to react optimally to fluctuations in orders and capacities;
- **Intelligent** (or predictive) maintenance concepts are aimed to optimize stability and quality assurance;
- **Increased turnover** through opening up new markets with appropriate products and services or improved sales processes

The above-mentioned authors underline also how the operative changes brought by Industry 4.0 have a great impact on the future operative and strategic performance management of companies. As demand becomes both increasingly flexible and volatile, this can result in **planning** and **budgeting** processes becoming less relevant, while the focus is going to shift more to **prognoses** and **forecasts**, allowed by extracting information from data collected.

In the field of **reporting**, machine-to-machine communication enables the approach for real-time portrayal of production and current machine states through automated real-time feedback. Operative and financial performance management can take place more directly thanks to new methods and procedures, and the time loss from data collection to data provision and the subsequent reaction will be reduced significantly.

In order to provide a quantitative understanding of the potential worldwide impact of Industry 4.0, the authors Rüßmann, Lorenz, Gerbert, Waldner, Justus, Engel and Harnisch (2015) analyzed the outlook for manufacturing in Germany and found that the fourth wave of technological advancement will bring benefits in four areas:

- **Productivity**. It is predicted, during the next five to ten years, an increasing of productivity across the German manufacturing sector by €90 billion to € 150 billion.
- **Revenue Growth**. The demands of Manufacturers for enhanced equipment and new data applications, as well as consumer demand for a wider variety of increasingly customized products, will drive additional revenue growth of about €30 billion a year.
- **Employment**. The growth will lead to a 6 percent increase in employment during the next ten years in Germany. However, different skills will be required. Indeed, there will be a lower request for repetitive, low-skilled works while it will surge the demand for IT experts and mechatronics.
- **Investment**. Adapting production processes to incorporate Industry 4.0 will require that German producers invest about €250 billion during the next ten years (about 1 to 1.5 percent of manufacturers' revenues).

7.3.2.3 Challenges

Even if the advantages and opportunities Industry 4.0 brings along, many companies are still unable to fully exploit the potential of Industry 4.0 initiatives. This might be given by several reasons as technical challenges: (1) **non-mature ICT** infrastructure to support integration and digitalization; (2) **scalability of data**, which

enormous volume might be difficult to manage; (3) difficulties in **implementing effective data analysis** techniques; and (4) **lack of a standard approach** of integration (Xu, Xu & Li, 2018).

Beside these, some other elements should be taken into consideration such as the **investment** required. Indeed, as reported by Fettermann et al. (2018), implementing Industry 4.0 paradigm requires relevant capital expenditure to install the necessary technology, thus reducing its attractiveness.

Moreover, the security issue has to be considered. **Cybersecurity** is becoming more and more relevant in Industry 4.0 context, where confidential information is shared, and items are controlled remotely (Xu, Xu & Li, 2018).

Furthermore, the development of an evolved **culture and mindset** throughout the organization may be difficult and might represent a potentially destabilizing drawback (O'Keeffe, 2017).

Eventually, the business side should not be overlooked. The development of **reliable and stable information systems** and business processes which substitute the actual, consistent and vetted information system might represent a high barrier to overcome. Complexity and risks in this process might be unacceptable and costly, slowing down or blocking the company innovation process (O'Keeffe, 2017).

7.3.2.4 Characteristics

In order to implement Industry 4.0 applications and concepts, so called enablers are required. These enablers are mainly software innovations or combinations of software and hardware developments. These new technologies are going to be explained in the next chapter. More in depth, firstly the main building blocks of Industry 4.0 are going to be describes. These are Internet of things and Cyber-Physical Systems.

7.3.2.4.1 Internet of Things

Internet of Things (IoT) is a new technology trend which is gaining significance attention in the last decade and it is defined by International Telecommunication Union as:

> "a global infrastructure for information society enabling advances services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies" (ITU, 2012).

Thus, IoT is a network of physical objects which exploits the integration of objects and items with intelligent and communicating sensors. This paradigm, thanks to the capability to gather, process and share data, enables **flexibility**, **scalability**, **agility** and **ubiquity** in fields of massive scale multimedia data processing, storage, access and communication (Kobusinska et al, 2018; Stergiou, Psannis, Kim & Gupta, 2016).

The IoT core innovation process consists of combining physical and digital components to create new products and business models. Thus, each "thing" now evolves beyond its physical function and embrace an IT enhancement which allows a global accessibility to it, furthermore, even more value can be created if the object is now capable of integration with a broader network of Things (Wortmann and Fluchter, 2015).

The latter case consists of a basic principle of IoT, which is the connection of single items to a network in order to work both individually and in a broader environment. Thus, the system is based on M2M (machine-to-machine) communication characterized by automation and decentralization (Stergiou et al, 2016).

IoT is majorly empowered by three types of technologies: RFID, Wireless Sensor Networks and Ubiquitous Computing.

Internet of Things is directly connected to the use of **RFID** (Radio Frequency IDentification) technology. Indeed, through the connection of the RFID reader to the internet it is possible to track in real time an object by its tag identification (Tsao, Linh & Lu, 2017; Landt, 2005; Xu, Xu & Li, 2018).

The **Wireless Sensor Networks** (WSN) might be considered as the evolution of RFID systems. In fact, they consist of radio frequency receivers and transmitters, as RFID, but with networking, communicative and cooperating capabilities which boost the opportunities provided by IoT.

Eventually, **Ubiquitous Computing** consists of the seamlessly integration of virtual computer model with physical objects. This technology is enabled by smart devices which are capable of integrating devices, organizations and data for data sharing, data exchange and real time monitoring (Xu, Xu & Li, 2018).

IoT presents itself a highly technological, autonomous and complex environment where different types of integration are allowed, and several systems works together.

IoT can be considered as the new major step in technology, promising disrupting functionalities in several sectors, from private to business. In this review, the focus will rest on the business application of IoT. Even if the IoT paradigm is still on its infancy, many applications are yet a reality or they are easily foreseeable for the next future as: **traceability, intelligent transportation, automation, smart manufacturing** and **process management**. Its applications embrace sectors such as: health, transport, production, home automation, etc. (Stergiou *et al*, 2018; Wortmann and Fluchter, 2015).

As stated by Wortmann and Fluchter (2015), executives cannot ignore the opportunities and threats brought by IoT and the way it is going to reshape the boundaries of departments, of the company itself or eve the whole industry. Indeed, at operational level strong challenges are going to be faced because of hardware-software integration, as: After-sale support will probably be disrupted by the characteristics and new operations allowed by connected products; Marketing will face the arising of new tools and levers given by the higher communication allowed; R&D will strongly influenced by the integration sensors and communication systems in their products following new design principles and with a deep integration between physical and digital entities.

It is arguable that even the finance department will not pass untouched by IoT revolution. Real-time communication and monitoring and new performance management systems might strongly transform the actual finance department and CFO's role and way of doing.

7.3.2.4.2 Cyber Physical Systems

Cyber-physical systems (CPS) are the state-of-the-art cloud-based architecture. CPS can be defined as hierarchical architectures where physical objects communicate with computing in a cyber layer. The interaction involved in CPS requires Big Data operations as sensing, storing and processing massive and heterogeneous data (Iqbal, Doctor, More, Mahmud and Yousuf, 2017).

In cyber-physical systems environment physical and software components deeply intertwine and virtual space and physical reality are deeply connected. As a result of this process, new type of agents will be required (physical, software, human) merging though technical and business functions (Xu, Xu & Li, 2018).

The CPS is a direct consequence of the integration of objects with sensors and software, thus the implementation of Internet of Things. Indeed, the elements of IoT constitute the Cyber-physical system (Boyes, Hallaq, Cunningham and Watson, 2018).

The difference between IoT and CPS might seem fuzzy, confusing and overlapping. Thus, it is necessary to uniquely identify each other.

When talking about IoT is intended the network of items, machines and products working together and individually addressable (Calvaresi, Marinoni, Sturm, Schumacher & Buttazzo, 2017; Xu, Xu & Li, 2018).

As far CPS is concerned, it is defined as the twining systems of physical components and their virtual twin. It involves a real-time communication between physical and virtual environment enabling automation and high degree of control (Boyes, Hallaq, Cunningham and Watson, 2018; Calvaresi *et al.*, 2017; Xu, Xu & Li, 2018). In conclusion IoT is an enabler of CPS and CPS is an enhancer of IoT potential.

What really differentiate Cyber-physical system from traditional ICT is the real-time communication between the physical and digital environment, indeed the focus of CPS is the control of physical processes (Boyes, Hallaq, Cunningham and Watson, 2018). The CPS is monitored through the use of Industrial automation and control systems which differentiate form the traditional control systems by the degree of integration with the whole system.

Because the finance department plays a key role in company's performance monitoring and management, the implementation of real-time highly-informative systems should be a CFOs' prerogative.

Cyber physical systems suffer of two main issues: safety, due to the information involved during the transactions and energy consumption. Big Data analytics and computational intelligence might effectively tackle these problems (Iqbal, Doctor, More, Mahmud and Yousuf, 2017). Thus, the best response from a digitalized environment is given when the concurrent exploitation of several systems and techniques is applied.

7.3.2.5 Tools

Once defined the main building blocks of Industry 4.0, it is possible to discuss the tools involved in the creation of value within this paradigm: Cloud Computing, Big Data and Analytics, Artificial Intelligence; and Robotics Process Automation.

7.3.2.5.1 Cloud computing

Cloud computing is a computing paradigm enabling ubiquitous convenient on demand access thought internet to a shared pool of configurable resources (Kobusinska *et al*, 2018*).* It is a network-based environment which allows the sharing of data regardless their physical location (Subramanian & Jeyaraj, 2018). In cloud computing paradigm, data are stored, managed and processes through services enabled by software, infrastructures and computing platforms.

Cloud computing is characterised by four deployment models (Hybrid, community, private and public) and three service models (PAAS, IAAS, SAAS) (Subramanian & Jeyaraj, 2018). The deployment models define the accessibility to different users; for instance, a private cloud service is available just to an organisation while the public cloud service is open for public use. As regard the layers, they define the type of resource make available from the server provider. In IAAS (Infrastructure as a Service) it is possible to manage the hardware resource of the systems, e.g. storage

capacity. In SAAS (Software as a service) it is possible to use programs and applications remotely, e.g. Word online.

Cloud computing is aimed at providing access to the information and data from anywhere at anytime with a restricted or absent use of hardware equipment. More in detail, cloud computing allows to mobile devices to be more powerful in terms of storage capacity, power, memory, energy and context awareness (Stergiou, Psannis, Kim & Gupta, 2016).

In modern companies, where availability of information is a key resource for decision making process, cloud computing represent a solution for data exchange and storage, providing accessibility to large amount, heterogeneous and up-to-date information (Xu, Xu & Li, 2018).

According to Ogiela (2015), financial data management in the cloud has the following advantages:

- Streamlining the management process and accessibility of classified data;
- Reduction of costs;
- Remote working opportunity;
- Better data collection.

Furthermore, according to Xu, Xu & Li (2018), the cloud computing paradigm offers high performances and low cost in computational performance and data management.

One key issue of clouding is given by cybersecurity (Xu, Xu & Li, 2018; Stergiou, Psannis, Kim & Gupta, 2016). As Subramanian and Jeyaraj (2018) argue, cloud computing is still incomplete regards cybersecurity, and both data stored and data transmitted are subjected to threats. This issue is not negligible considering the fact that companies might rely on cloud to manage valuable and confidential information which corruption or theft might mean heavy loss for the firm.

In fact, as affirmed by the Eng. Solbiati (Managing Director at Accenture and interviewed as expert advice), “Cloud computing technology may be considered as less relevant within Finance function due to reluctance toward this technology since there are worries related to the security of data exchanged”.

As Ogiela (2015) states, personal data, financial information, strategic data, competitive market data, new technology information are exposed to leaks and corruptions due to lack in data security. To solve this issue, data protection algorithm uses cryptographic protocols to secure information, however, the solution applied not always guarantee the data security.

Other issues, more than cybersecurity, that might affect cloud computing, such as (Stergiou, Psannis, Kim & Gupta, 2016):

- **Delay** as the latency between the time involved in offloading the computation and the cloud returning the results;
- **Privacy**, indeed confidentiality and authentication mechanism reliability are one of the main drawbacks when switching to the cloud;
- **Performances** might be inferior respect to the original application;
- **Internet connection** reliability.

Thanks to the introduction of Cloud Computing technologies it will be possible to replace the outdated, fragmented, and inflexible legacy systems of record introducing standardization, flexibility, cost reduction and centralization. CFO should proactively be involved into the Cloud computing development process to correctly introduce standards, manage flows and face cybersecurity risk (O'Keeffe, 2017).

7.3.2.5.2 Big Data and Analytics

In the modern world, data are generated at an incredible and always growing rate. As sustained by Willcocks, Lacity and Craig (2015), social media, business analytics, mobile and clouding are proliferating at an accelerating rate fit.

"Big Data is the next natural resource" is the iconic sentence said by IBM CEO Ginni Rometti in 2013 (Iqbal, Doctor, More, Mahmud and Yousuf, 2017). Indeed, nowadays data are generated in every sector involving the use of information technologies and they might allow the creation of considerable value for the user.

Big Data includes not only internal data, but also external data (possibly made available in real time) that could help to provide the forward-looking information necessary for predictive and prescriptive analyses (Huerta & Jensen, 2017).

For this reason, due to the massive volume of data produced, for example, by IoT, firms' interest in Big Data as a mean to manage and analyse the enormous amount of data from different sources is surging (Kobusinska *et al*, 2018). As argued by Xu, Xu and Li (2018), just the heterogeneity and volume of data produce by manufacturing plants makes them complicated not only to exchange but mainly to process. In this sense, Big Data anlysis is becoming paramount for the creation of value from the data collected. To monitor, manage and process these data elements as confidentiality, data verification, authorization, data mining, secure computations and Big Data tools are becoming always more relevant (Kobusinska *et al*, 2018).

The main features of a Big Data system can be defined by the five Vs (Iqbal *et al,* 2017):

- **Volume:** it refers to the massive amount of data managed;
- **Velocity:** it refers to the speed at which data are managed;
- **Variety:** it refers to the various types of data collected (sources and structured vs unstructured);
- **Veracity:** it measures the degree of confusion or noise in the data collected;
- **Value:** it refers to the value created by the data.

A Big Data system is made up by two major components: Big Data and Big Data Analytics. As stated by Chen, Chiang and Storey (2012), the term **Big Data** usually refers to the stage, processing and management of large and complex datasets which requires peculiar techniques. **Big Data Analytics** refers to the techniques used to process Big Data and extract meaningful insight. Big Data Analytics take advantage of several techniques and algorithms with the aim of identify hidden patterns and correlations among dataset characterised by high level of complexity. For example, statistical model such as multivariate statistical analysis, regression, factor analysis, clustering, and discriminant analysis that have been used successfully in various business applications (Chen, Chiang

& Storey, 2012). **Machine Learning** approaches, **Computational Intelligence**, **Deep learning** and **Evolutionary algorithms** are some example of the techniques which are gaining relevant attention in the last few years from practitioners and academics (Iqbal *et al.,* 2017).

The data harvested by Big Data comes from a broad range of sources and types: from e-mails to pictures to psychological data, this allows to run analysis as the one discussed previously which were inconceivable at the beginning of the new millennium.

Big Data and Big Data Analytics are one of the major concerns of several organisations. For instance, businesses can take advantage of this data to better target customers and identify hidden demands and preferences, doing so, better and more satisfying product and services might be deployed. In this direction, **Sentiment analysis** is a very useful techniques aimed in improving product and services by identifying user's opinion, evaluation and affective state. As reported by Iqbal *et al*. (2017), Sentiment analysis is aimed at "facilitating the processing of high-volume data in order to automatically identify the user's evaluations and feelings towards specific products and services" (p.9). Data coming from Facebook and Twitter hides huge amount of information about cognitive and emotional state of users.

The complexity surrounding the Big Data is very high and depends on several factors: the complexity of causal-effect relations, the request for high performance communication system to synchronise data and computational power to analyse them simultaneously, the unavoidable level of imprecision and uncertainty of data. Indeed, as Iqbal *et al.* (2017) states, Big Data are affected by several noise and disturbs coming from the data sources. This noise might create high levels of uncertainty and outliers. Big Data Analytics techniques should consider these challenges and handle them effectively. For instance, **Fuzzy systems**, based on natural language fuzzy rules, have proven their ability to deal with this challenge.

Big Data Analytics techniques are changing the way data are treated, and techniques as data management, which are used to collect, process and store data, are evolving toward **Smart Data Management** which integrates the precedent processes with cognitive analysis. **Cognitive analysis** serves to determine the meaning of the analysed dataset through the interpretation of their semantic content. These kinds of

analyses are brought forward to understand when the data are defined as relevant for the company development or not. Because the cognitive analysis leads to the process understanding, it is more exposed to the risk of theft (Ogiela, 2015).

In conclusion what happens in cognitive financial data management is the analysis of data interpreting its meaning. This process is supported by computer intelligence.

Furthermore, Big Data has fueled the growth of **visualization tools** adoption due to their ability to communicate the results of complex analyses in a language that managers can quickly comprehend. In comparison to tabular results, a visualization is worth a million numbers. Visualizations have enabled the transformation of Big Data into actionable, decision-relevant knowledge with data driven orientation (Bendoly, 2016; Huerta & Jensen, 2017).

One of the strongest potential growth among options for big data analytics is projected for **Advanced Data Visualization** (ADV). ADV is a natural fit for big data analytics. ADV can scale its visualizations to represent thousands or millions of data points—unlike standard pie, bar, and line charts. ADV can handle diverse data types and then present analytic data structures that aren't easily flattened into a computer screen (Russom, 2011).

Thus, as easily predictable, it is possible to suppose a strong impact of Big Data and Big Data Analytics in finance department and CFO's function, new type of analysis and insight might be discovered through the availability of more data and the use of innovative techniques to analyse them.

Moreover, it is necessary to consider the big picture made up by the whole range of digital technologies emerged and emerging in the last few years to fully exploit the possibility given by Big Data. For instance, technologies such as Cloud Computing enable Big Data benefits though the storage and processing capabilities for Big Data Analytics. Indeed, better performances were reached when cloud computing is used to run Big Data Analytics (Chang & Wills, 2016). Furthermore, Artificial Intelligence and Machine Learning is used to support decision making from the information extracted (Jarrahi, 2018).

7.3.2.5.3 Business Intelligence and Analytics

When talking about Business and Industrial Analytics (BI&A) usually it is referred to "the techniques, technologies, systems, practices, methodologies, and applications that analyse critical business data to help an enterprise better understand its business and market and make timely business decisions" (Chen, Chiang & Storey, 2012, p. 1166). thus, BI&A include business practices and methodologies applicable to different departments, form e-commerce to market intelligence.

BI&A was born in 1990s and passed through three main stages from the so called BI&A 1.0 to the BI&A 3.0 that it is possible to see today. The different stages are characterised by the type of data used and techniques exploited to support business operations and decision making. BI&A 1.0 started in the '90s and viewed a period of collection of structured data from the various company's sources. As discussed by Lee, Kao, Yang (2014) the collection of historical data about the industrial environment can be harvested through big data and transformed into usable information through predictive analysis and visualization tools. Reporting tools and graphics were simple but effective way to visualize key performances of the firms. Statistical analysis, clustering, regressions and predictive modelling were the main techniques applied in this stage.

Successively, a revolution happened in 2000s when internet became a relevant aspect of businesses and direct contact with customers was possible. Here BI&A was born 2.0 and in this period raised methodologies as web intelligence, web analytics and social media analytics to collect unstructured content about the crowd though web applications and website. In this stage Google Analytics represents a key tool to track online activities of users and customers.

During the raising of mobile devices, RFIDs and internet-enabled devices started a new period in BI&A: the BI&A 3.0. this new stage begun during 2010s but many applications and techniques to fully exploit the potentiality of this stage remain unknown and the focus of practitioners and academics is yet on this aspect (Chen, Chiang & Storey, 2012).

Today the interest about BI&A is focused into five critical areas: Big Data Analytics, Text Analytics, Web Analytics, Network Analytics and Mobile Analytics (Chen, Chiang & Storey 2012).

Key aspects for the development of a useful analytical system are (Nalchigar & Yu, 2017): (1) Selection of the right algorithm; (2) Criteria to evaluate the algorithm; (3) Data setting; (4) Objective of the analytics; (5) Data selection; (6) Resource allocation.

These aspects are thought as key because of the strong impact they have on scalability, understandability tolerance to noise and missing values of the system.

Moreover, BI technology enables operational business intelligence, which is focused on measuring and monitoring performance of business operations in real time. In fact, most operational BI implementations collect **data in real time** to refresh real-time management dashboards (Russom, 2011).

BI&A might bring considerable value to the firm, especially where decision making processes are run. However, the advancement of analytics and machine learning might bring to difficulties in designing analytical solution because of lack in expertise, thus it is fundamental to develop the right capabilities to manage BI&A systems (Nalchigar & Yu, 2017).

The author Wright (2010) includes Business Intelligence in the main technology trends a CFO must know. Since the era of assessing financial performance only on an annual basis and checking the numbers just when someone gets back to the office is gone, today executives, and increasingly key finance personnel, need the numbers at their fingertips anytime, anyplace, anywhere. Therefore, the adoption of mobile reporting and/or mobile business intelligence allows to deliver this data in a consumable format to sophisticated devices such as the iPhone, BlackBerry and other personal digital assistant (PDA) devices.

Data analytics techniques are fundamental to finance department to add significant values for the organizations. Indeed, the insights coming from BI&A and Big Data might help in **predicting outcomes** and better **understand correlations** among variables. Because of this paramount importance, it is required to finance department to master analytics capabilities and Big Data techniques (O'Keeffe, 2017).

7.3.2.5.4 Artificial Intelligence

When talking about Artificial Intelligence, it is usually referred to a wide world of many variation and applications which have in common the basic feature of being intelligent systems with the ability to think and learn. The AI family technologies is seen as an unstoppable disruption in automation of human tasks, and the decision-making process might be the most influenced field (Jarrahi, 2018).

One of the main AI system developed today is Watson IBM. Its applications vary and its influence in some sectors (i.e. Health care) is surging (Jarrahi, 2018). AI systems possess an exception ability to learn and improving themselves, because of that their application in knowledge-based sector, once proper to just human mind, is widely spreading (Jarrahi, 2018).

As proved by the partnership between Ksparov and IBM Deep blue in 1980s, AI and human mind are different in reasoning and complementary for the achievement of a better decision making. This is also proved in health care sector, where the integration of humans and AI brought in reduction in diagnosis error rate (Jarrahi, 2018).

To better understand how it is possible to improve the decision-making process through the collaboration of human mind and AI, it is necessary to understand how they process information and data, thus, how they "think", and what kind of reasoning is involved during the decision-making process.

The decision-making process is often dived into two main categories: **analytical** and **intuitive** reasoning. The former is characterised by logical reasoning, modelling, data collection and data analysis and it is more suitable for AI. On the other hand, the decision-making process is not always driven by logical reasoning, instead it presents itself as a subconscious breakthrough, the so-called intuition. Intuition is given by many factors among which, imagination, sensitivity, ruination and creativity. It is the capacity of transcending the ordinary-level logical thinking (Jarrahi, 2018).

AI systems better support analytical decision making, while they are less capable in unpredictable and uncertain situation. While AI reaches remarkable results in logical thinking, human mind is unbeatable when common sense and intuition should be used to face an uncertain situation. When uncertainty is present means that cause-effect

relationship is not clear due to a lack of information. AI can support decision making processes in uncertain environment through the predictive analysis. The predictive analysis is an anlysis based on probability and data-driven statistical inference aimed at generating new information for the decision maker (Jarrahi, 2018).

While humans are superior in intuitive decision making, driven by experience, creativity and personal attitude which are paramount in situation of high uncertainty, AI has overtaken human in case of highly complex problem where the amount of data to consider and process is massive and beyond the human capabilities. AI might help in better defining the cause-effect relationships (Jarrahi, 2018).

Given all these factors, it might be argued that synergising the AI superior speed in data analysis and human intuitive judgement and insight is it possible to obtain great improvement in decision-making quality.

AI exploits a series of tools, technique and algorithms which give birth to neural networks, pattern recognition, deep learning (natural language processing, machine learning and machine vision) and machine learning.

Iqbal *et al.* (2017) defines **Machine Learning** (ML) as an approach to model data in order to manage unforeseen events. Machine learning techniques consist of: regression techniques, clustering approaches, density estimation methods and dimensionality reduction approaches.

An interesting subclass of Machine Learning is given by **Computational Intelligence,** a term used to identify information process systems aimed at mirroring the human reasoning. The importance of Computational Intelligence is given by the capability of these systems in solving high complex and uncertain problems. To do so, Computational Intelligence takes advantage of techniques which are nature-inspired and resulted effective in solving problems where traditional analytics failed (Iqbal *et al*, 2017).

Machine Learning and computational intelligence approaches might be used for multipurpose intelligent data analysis and as decision support systems for several business applications characterised by massive amount of complex information.

Another algorithm which is gaining attention is **Deep Learning**. Indeed, this approach, inspired by biological behaviour, provides computational modelling techniques for addressing speech perception and object recognition. Deep Learning can offer tools to model large datasets with significant dimensionality and spatial and temporal correlation.

In a world where Big Data relevance is growing and where the real nature of data, correlations and cause-effect relationships are highly complex and not clear, the development of a system to effective model data and patterns to understand the current and future situation of a system, adapt to new situation (including new accounting or tax regulations) is crucial to run a business (O'Keeffe, 2017).

7.3.2.5.5 Robotics process automation

Back office has challenged many sectors, from telecommunication to financial services, to reach performances and cost efficiency. Usually, back office issue has been faced through five main levers: centralisation, standardisation, optimisation, relocation and technology enablers. A sixth lever has been recently added: Automation.

This last one is gaining a high attention in the last few years and **Robotics Process Automation** (RPA) seems to be one of the prominences.

RPA is a software-based solution and its application consists of software "robots" able to do the work previously done by people. RPA is well suited to replace humans in those activity which requires collection of inputs, processing of the data and elaboration of a record. Thus, standard and routinized activities seem to be the best point of arrival of this technology.

RPA interacts with several computer systems to reach predefined objectives. The robot, as observed in many other sectors, can do the work better, faster and cheaper than the one done by employees. Moreover, the implementation of RPA brings to the liberation of employees from routinized tasks allowing a focus on non-routinized and more value-added tasks (O'Keeffe, 2017; Willcocks, Lacity and Craig, 2015).

RPA technology is defined as a "lightweight" IT system, which stands on existing systems without the need to create, replace or modify existent platforms. Its interaction with the firm's computer systems happen only through the user interface, just as the operator does, the interacting software are not touched by a programming logic viewpoint (Willcocks, Lacity and Craig, 2015).

Respect to RPA, BPM requires strong investments and programming capabilities. RPA is thought to integrate BPM and thanks to the high accessibility due to low investment and capabilities required, it allows a higher spread throughout company's processes than BPM does (Willcocks, Lacity and Craig, 2015).

Willcocks, Lacity and Craig (2015) proved that the RPA was able to solve the better, faster for less dilemma in several sectors where it has been applied such as: Telecommunication, Oil & Gas and Pharmaceutic.

RPA might be applied in finance department to develop information from the rough data coming from the different sources, allowing employees and manager to focus of just on strategic consequence of the results.

In a world characterised by Industry 4.0, it has been observed a reduction of finance department dimensions. Indeed, the roles inside it are going to deeply change, routine and repetitive works will disappear thanks to the introduction of Robotics Process Automation while high-wage and knowledge intensive workers will increase their presence, adding always more value to the function enabling better business, partnerships and strategies (O'Keeffe, 2017).

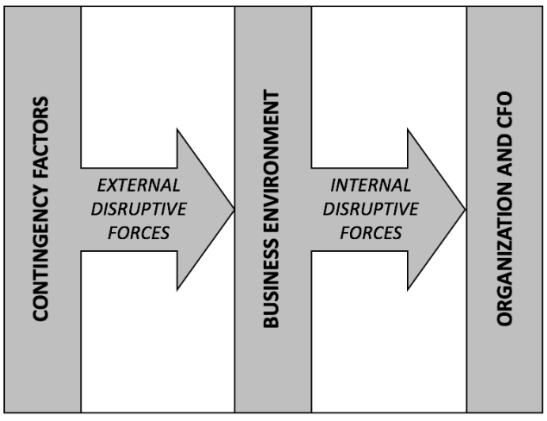
7.3.3 Disruptive forces

In this chapter, the disruptive forces are going to be described. The disruptive forces aim to explain how the contingency factors impact on the role of Chief Financial Officer. If the contingency factors can be considered the root causes, the evolving role and its consequences can be considered as the effects. Therefore, the **disruptive forces** want to analyse the logic behind this cause-effect logic in order to provide a better comprehension of this research.

A further step has been developed in order to go more in depth with the analysis. The disruptive forces have been divided into external and internal ones. The **external disruptive forces** underline how the contingency factors have impacted over the external markets, industries and business environments. Thus, these disruptive forces are supposed to have an indirect effect toward the expanding role of CFO. **The internal disruptive forces** outline how the external markets, industries and business environments have directly impacted over the internal structure, professional roles, responsibilities, skills within the enterprises.

In this sense, the disruptive forces represent the bridge connecting historical events (contingency factors) to the evolution of the professional role (organization and CFO).

This following classification of disruptive forces starts from the assumption that internal organizational transformations are moved by external factors and events. This is not always completely true, but it has been assumed in order to provide a causal relationship between external and internal factors (Picture 7-2).



Picture 7-2: Forces' flow

Therefore, in the following chapter the forces, originated by contingency factors previously described, are provided in order to complete the picture of the context in which the CFO evolved toward the last stage.

7.3.3.1 External disruptive forces

In a 4.0 world, the **evolution of digital technologies** offers huge opportunities for organizations to enter new markets, transform existing products and define new business models. Therefore, organizations have to take the impact of digital into consideration in developing strategy, including understanding where opportunities and threats lie. The corporate strategy delivery needs to be supported by digital technologies, in order to improve efficiency and enhance performances. Particularly, finance leaders who are focused on growth seem to be embracing digital faster than the rest (Schmidt, 2016; Kraus, 2016).

The new technologies have led to a **proliferation of data** from different and new sources of information. New huge volumes of data have increased the relevance of processes related to Information Management, such as data collection, data analysis, data usage, data storage. As they upgrade technology and move to cloud-based systems, thus, finance departments have access to more data than ever before (Kraus, 2016).

One new source of data is represented by the social media. The **explosion of social media use** generated a large quantity of data that companies can exploit to measure and manage their performance, addressing the need for a new performance measurement system. Indeed, social media indicators provide additional information respect to the traditional sources adopted in performance management systems (Sidorova, Arnaboldi & Radaelli, 2016). As affirmed by the Eng. Solbiati, "it is correct to suppose the application of data from social media by CFOs. For example, the value of the enterprise or the product itself could suffer the impact of social media".

Therefore, the world we live in is much more connected than before. However, **hyper-connectivity** generated by new technologies should be well managed, since a data breach can lead to a disastrous domino effect on the enterprise value (Kraus, 2016).

Therefore, managers have to focus on how to tackle new **cyber-threats** in order to protect valuable data assets and systems of their organizations (Kraus, 2016; McKinsey, 2017).

Moreover, Big data is not a clear and transparent source of information. Therefore, in order to face **uncertainty around data**, managers within organizations have to develop new skills and capabilities for data mining (Goretzki, Strauss & Weber, 2013).

The development of new skills allows the management and particularly the accountant profession to be resilient and to face the **process automation** diffusion. In fact, continuous progress in artificial intelligence and machine learning, coupled with a growing ability to analyze Big Data, has increased the threat that a large part of jobs will be computerized in the future (Richins, Stapleton, Stratopoulos & Wong, 2017).

Due also to other factors such as rapid changes in customer preferences, shortened product life cycles, increased competition, organizations have responded to these challenges through multiple operational and supply chain practices and strategies such as lean manufacturing, pull processes, and customization practices. Even though these practices are aimed at increasing the responsiveness and cost efficiencies of companies' operations, they have also led to an increasing **complexity of the business environment** from management perspective (Wiengarten, Ahmed, Longoni, Pagell & Fynes, 2017).

The complexity of the business environment resulted increased also as a consequence of new **challenging and volatile markets** after financial crisis in 2008, which led to turbulent and dynamic business environments. In fact, the increased volatility of the business environment makes systematic strategic planning and the development process of a performance measurement system more difficult than before, asking for higher flexible and reactive systems to market changes (Barsky, CMA, CPA, & Catanach, 2013; Howell, 2006; Pekkola, Saunila & Rantanen, 2016).

In the context of new financial markets, stakeholders increased their pressure over the organizations. On the one hand, new **regulatory reforms** were developed by regulatory agencies in order to improve standards and regulation of financial compliance and disclosure. Managing the increasing scrutiny and complexity of the regulatory environment will be as much about management of relationships as it is capability.

On the other hand, the **growing relevance of corporate social responsibility** is going to escalate as a major issue for companies, as they respond to new interests of regulators, customers, employees and investors related to triple bottom line paradigm (Kraus, 2016).

7.3.3.2 Internal disruptive forces

The new technologies allow the improvement of **effective communication with every function** within the organization in order to enhance data collection and data exchange processes among the different departments. Particularly, technology connects Finance with the other functions (Schmidt, 2016).

Moreover, communication is improved also vertically within the company. Therefore, **closer collaboration between managers and accountants** is boosted for strategy alignment and decision-making support (Goretzki, Strauss & Weber, 2013).

In fact, Finance Function is considered as willing and capable to provide more added value to the decision-making and control. Therefore, a **higher request for support in decision making** and a **higher request of control** of business performances are expected by accountants (Goretzki, Strauss & Weber, 2013).

Businesses that emphasize prudent and new Information Management practices can make more effective, informed decisions simply because of the utility and validity of their information. Better access to better information sources leads to more efficient business processes and a higher likelihood of profitability. In this way, organizations have to improve and enhance their **competitive advantage related to information management** (Green, 2007).

More in general, new accountants need to **focus on value-added activities,** eliminating or reducing the non-value added ones. In fact, the latter are going to be computerized by the process automation trend in the next years (Sharma & Jones, 2010).

New accountants are also requested to take part in strategic oriented activities and processes.

In order to exploit new digital opportunities and protect the organization from new players and agile incumbents, finance leaders need to transpose and embrace a digital business model (Kraus, 2016). While the process of transforming business models requires that customer experience, consumer segments and distribution channels be reviewed, the introduction of innovative business models poses also new requirements to employees' competences (Altukhova, Vasileva & Yemelyanov, 2018). Therefore, they become actively involved in **re-evaluation and innovation of business models.**

In fact, from a corporate level perspective, organizations need to be flexible and to adapt their strategy to changing competitive dynamics, differing customer needs, emerging technologies and a changing regulatory environment. In short, they need the **definition of an agile strategy** (Kraus, 2016).

Finally, the **integration of data and performance management to business strategy** is required in order to be holistically aligned among the different departments within the company (Kraus, 2016).

7.3.4 Road towards digitalization

The contingency factors and their impact through the above-mentioned disruptive forces introduced the enterprises toward the digitalization of their processes and operations. In this subchapter, the consequences of digitalization within organizations are described.

The trend of digitalization increased the relevance and the focus over the management of the **Information Technology function** and its resources within the organizations. The management of IT function and the impact of digitalization on business processes are going to be presented with a bottom-up perspective, from a functional and business level to a corporate one.

Today's business environment is turbulent and is subjected to rapid changes. In this environment, more accounting information is required on an ad-hoc basis, in a timely manner, and with various levels of detail. This provides explanation on why companies have started investing on IT resources like the implementation of proper

Accounting Information Systems. In fact, it represents an important resource for any organization and its outputs relating to financial performance contribute to setting tactical and strategic directions for the organization. This dynamic environment also requires organizations to adjust continually their Accounting Information System to maintain the fit to the real world. Indeed, the accounting processes are becoming more complex, and capturing the accounting events and activities of the real business environment is becoming increasingly challenging.

In order to face these challenges, the authors Prasad and Green (2015) suggest in their research that organizations need to develop a dynamic Accounting Information System capability. It can be developed through the synergy of three main competencies: having a flexible Accounting Information System, a complementary Business Intelligence system, and accounting professionals with IT technical competency. A dynamic Accounting Information System capability is an organization's ability to integrate, build, and reconfigure its competencies to reorganize swiftly the accounting activities and processes.

However, the implementation needs to follow a holistic approach. In fact, Accounting Information Systems need to be considered as part of co-specialized resources of the organization rather than standalone ones.

Organizations need to have a flexible Accounting Information System, which they can reorganize quickly to adjust to changing business requirements. To achieve this, investments in the AIS need to be a continuous activity. There is a need to shift the focus from a routine reactive system to a proactive system that contributes to the strategic intent of the organization. This change would require an Accounting Information System to be integrated with other resources that extends and improves the key functionalities of transaction processing, information reporting, and managing the control environment.

Moreover, the technical IT skills of accounting professionals can provide an important competency that ensures an organization's Accounting Information System keeps aligned with the changing business environment.

Since a dynamic Accounting Information System capability is more responsive to a dynamic and turbulent business environment, it has been demonstrated that

developing a dynamic Accounting Information System resource can add value to an organization, having a positive impact on overall firm performances. This outcome is possible because a dynamic Accounting Information System capability through its improved analytical competencies and technically competent accounting professionals, can improve the management of the control environment.

This example from existing literature showed the positive impact on performances and the need to face today's challenges of continuous investments in IT. Moreover, the resources within the IT function should be shaped in order to pursue flexibility and integration with the accounting resources and capabilities in a holistic approach.

Furthermore, in many cases investments and decision-making in IT are driven and responsibility of the Chief Financial Officer.

Particularly, when there was no board-level Chief Information Officer, many **Chief Financial Officers** took board-level **responsibility** for their firm's IT, with IT managers had to report to the them and not directly to their Chief Executives Officers. In these case, Chief Financial Officers usually exerted great influence not only on finance and accounting systems, but also on strategic IT decisions, such as ERP system adoption, especially when taking responsibility for IT at the board level (Hiebl, Gärtner & Duller, 2017).

More in general, Chief Financial Officer have increased its role in technology decisions to such a degree that Chief Information Officer most often had to respond to the Chief Financial Officer. This relationship demonstrates the need for Chief Financial Officer to be educated and trained in technology. Chief Financial Officers need to be proactive in making technology decisions for all finance applications, ensuring that they have a financial system that supports the strategic objectives of organizations. The main **financial areas of improving** with technology adoption are related to these main processes: facilitating analysis and decision making, monitoring business processes, creation of an information sharing environment, quality of the data collected, performance measurement, financial reporting and consolidation, budgeting, planning and forecasting (Decker & Sinnett, 2013).

From a corporate perspective, the organizations have to establish a new strategy for IT investments, which responds to the desire of the business to adopt technology to establish sustainable differentiation and drive innovative new processes, while providing a secure and cost-effective environment support to core business processes. Nevertheless, the adoption and the implementation of technology often leads to **two main concerns**: the correct measurement and assessment of IT related projects impact; and the alignment between business and IT strategy (Decker & Sinnett, 2013).

The change has been brought about by the increasing importance of intangible assets such as brands, patents, IT and know-how. However, the **intangible nature of many of the benefits of technology investments** makes it hard to have an accurate estimate of their potential return (Cheryl de Mesa Graziano, 2002). As a consequence, in many cases the minimum ROI requirement for IT projects is not defined and it gives the biased appearance of not meeting business case requirements (Decker & Sinnett, 2013). The expertise of the Chief Financial Officer is required to improve and to drive a better investment evaluation and prioritization. As affirmed by the Eng. Solbiati, "In the context of digital technology, it is required to evaluate their **non-financial impact** rather than their merely financial value". In this sense, Chief Financial Officers are required to assign financial values to qualitative costs and benefits of mitigating compliance risk, considering the overall competitive advantage gained with the investment. Therefore, IT systems are increasingly measured on more general and value-oriented business metrics in terms of quality, responsiveness, business value, end customer's satisfaction, cost efficiency, time-to-market, strategic fit (Willcocks, Lacity & Craig, 2015).

The second IT concern is related to the **integration of business and technology**. IT systems should enable and support strategic decision-making, particularly in light of the current economic downturn where resources may be limited. However, as a result of the increasing relevance of digital impact, the definition of an IT strategy is not enough in this third stage of CFO's evolution. In order to use IT resources more efficiently, the IT organization must be tightly connected with the rest of the company. This is achieved, first and foremost, by establishing an IT strategy that is fully aligned with the overall corporate strategy and business plan. To better merge business strategy and technology, priority-setting and resource allocation remains one of the top IT issues for many Chief Financial Officers (Graziano, 2002).

IT alignment continues to be an important topic in information systems research and practice because it has been shown to positively impact performance. Alignment may be even more challenging today as contemporary organizations, in response to environmental dynamism and digital innovations, undergo tremendous change in their operational and strategic models. In particular, organizations have increasingly digitized their operations and processes. This has important implications for alignment. It is no longer just a matter of alignment between IT functional strategy with the firm's business strategy; instead, there is a blurring of the distinction between business and IT strategies, leading to a fusion between them in the form of **digital strategy**. Digital strategy explicitly recognizes the embeddedness of IT throughout the organization and that IT strategy is integrated with business strategy. Thus, digital strategy is inherently trans-functional, as IT is pervasive in functions such as operations and marketing. Hence, researchers argue that there is a fusion of IT and business strategies, in contrast to the traditional view of IT as a "functional level strategy that must be aligned with the firm's business strategy". The dynamism and complexity of the business and technology environment suggest that digital strategy is emergent, iterative, and influenced by evolving organizational capabilities (Yeow, Soh & Hansen, 2017).

From a higher perspective, the digital strategy adoption requires and involves major changes within the organization. In fact, a holistic approach is required in order to spread the digitalization within the whole company, from function to corporate level, and to enhance it along the supply chain.

In this sense, dynamic changes in public attitudes and approaches toward information and digital technology imply that companies constantly revise their core business activities and transform them into digital ones. Therefore, the process of transforming business models requires that customer experience, consumer segments and distribution channels be entirely reviewed. The **digital transformation** is increasingly approached as the major factor for the successful development of enterprises. Key trends in digital transformation include the growing significance of customer experience (customer-centricity) and the attribution of a personal nature in the interaction between the customer and the brand (personification); the transformation of operation models into flexible ones to respond to changing market conditions and new cutting-edge technologies (hyper intelligence, informed decision

making, fast implementation); the Internet of Things as a key driver of digital transformation; the introduction of digital thinking in corporate culture (Agile and cross functional teams); the establishment of multi-channel ecosystems which reflect customers' personal values after analyzing customer needs and preferences (Altukhova, Vasileva & Yemelyanov, 2018).

As a result, the literature review showed the necessity of organizations of implementing digitalization, from functional to corporate level, from processes to strategy definition and alignment among them. Moreover, the Finance Function and the Chief Financial Officer emerged as one of the more involved components within the organizations.

7.3.5 The Value Owner role

In a 4.0 world, business environment has become more complex, interconnected, fast paced and unpredictable than ever.

As seen previously, digital technologies will reshape industry and business models, companies are going to implement digital strategies, product life cycle is reducing, bargaining power of customers in going to increase, automation may substitute manual work while creating new types of jobs and sectors, large amount of data is going to provide insights for value creation, stakeholders asks more transparency and disclosure from financial reporting.

In this new context, the Chief Financial Officer cannot be stuck while the business is changing its nature, digitalising operations and processes. Successful Chief Financial Officers will be those who proactively shape their role and adapt to the increasingly complexity. Chief Financial Officers should re-evaluate their own competencies, the organization's strategic direction, and carefully assess the external forces shaping the business environment.

The Chief Financial Officer as value owner is going to be described in four subchapters which will highlight the main traits to be taken into consideration and which will help in defining the new role and new Finance function.

What is emerged is that Chief Financial Officer role has been disrupted by digitalisation and the adoption of digital technologies. As a consequence, financial leader has to act no more as only a business partner, but as the owner of the value of the organisation. Their leadership attitude and proactive behaviour will drive the management of all resources of the company toward higher performances.

The identification of the role as a value owner within the enterprise takes inspiration from the definition provided by IBM in 2010. In their research, IBM described the new evolving role of the Chief Financial Officer in the era of digitalisation as a value integrator.

In their research, value integrators are described to excel in two main areas: **Finance efficiency** and **business insight**. That concept underlines on the one hand their capability to reduce the complexity of financial operations, implementing common processes across Finance and standardizing data and metric definition; on the other, how their insights help to drive operational efficiency, spot market opportunities, react faster and predict changes in the business environment, through greater levels of information integration and analytical capabilities. From this perspective, Chief Financial Officer is described as driving the integration of information within the organization (IBM, 2010).

In this research, concept of **value owner** has been adopted.

This concept is aimed to focus on the root causes of the growing relevance of the role of Chief Financial Officer. The role is expanding because the Chief Financial Officer owns the value of the organization. This is an intrinsic feature of the nature of the role itself. In Finance function, it is common to go through with details, to understand primary causes of financial performances, looking backword and deeply into the processes. Therefore, the Chief Financial Officer owns data about the value of the enterprises. The financial leader occupies a critical position in any organization, holding the financial reins of the business and ensuring that resources are used wisely to secure positive results. In this way, the value owner has a clear and comprehensive picture of where the value is generated, how it is streamed among the different processes and departments and along the whole supply chain, and how the value has to face competition in the external market.

Therefore, while the contingency factors have recently increased the complexity around Chief Financial Officer, they have also underlined the fundamental importance of the role.

7.3.5.1 Digital impact

More data is available than ever before. It is flowing from more sources, including vast networks of partners, increasing numbers of intelligent devices across the value chain, and expanding process automation (IBM, 2010).

In the digitalisation era, after years of moving beyond their traditional "back office" duties, Chief Financial Officers are positioned to be powerful digital guardians, who use data to drive value, improve efficiency and enable strategy (Accenture, 2018).

Therefore, today's Chief Financial Officers have to embrace new technological advances, taking into account these main consequences.

Automating non-value-added activities. In the near future, new digital technologies and analytic techniques are going to replace many of the tasks traditionally performed by accountants. The digitization of Finance processes needs to focus on the automation of non-value-added activities. These activities are repeatable, standardized, or logical operations, such as routine accounting (for example, processing financial transactions, posting and collection of accounts receivable), control and compliance tasks (for example, external reporting, auditing). The automation of processes is aimed to cost reduction, productivity improvement and allows employees to focus more on value added activities. Indeed, as accounting and other routine tasks are going to be automated, Chief Financial Officer will be involved in more meaningful activities, such as leading digitalization transformation, increasing competitive advantage and enhancing value creation (Richins, Stapleton, Stratopoulos & Wong, 2017; Davies & Huey, 2017; Accenture, 2018; Huerta & Jensen, 2017).

Getting insights from data. In fact, digital technologies represent an opportunity for accountants to play a leading role in problem-driven analyses of structured and unstructured data and to support data scientists in exploratory analyses to create value.

This is explained from two different aspects: accountants have the advantage of understanding business, and they are already accustomed to working with structured datasets and performing data analysis (Richins, Stapleton, Stratopoulos & Wong, 2017; Huerta & Jensen, 2017).

As a result, finance leaders are increasing their focus on value creation, relying upon for higher-level thinking, harnessing the power of data, gaining insights from data analysis, better understanding business complexities. However, they are requested to develop new skills and competences, in order to understand and embrace the emerging technologies.

In this way, Chief Financial Officers play a critical role in the digitalization of their enterprises. Their new data analytics capabilities can help them make decisions about **investing in technology** across the organization based on economic value. Moreover, the ability to capture, structure and make better use of data in order to increase the efficiency and effectiveness of both Finance Function and the whole company is considered the Chief Financial Officer's greatest area of potential strength (Accenture, 2018).

Finally, new developed capabilities to synthesize large and complex data sets providing detailed analysis of potential investments let them assess plans and strategies objectively (Accenture, 2018).

Designing digital business models. From a strategic and corporate perspective, Chief Financial Officers are increasingly asked to spread the digitalization within the whole organization, enhancing the adoption of new technologies to change business models and unlock new revenue streams. In this way, the Chief Financial Officer can be a driver of the application of data analytics techniques in many of other business decision processes areas (e.g. procurement, supply chain, operations), acting as a catalyst for encouraging and driving the use of analytics outside core finance (Accenture, 2018; EY, 2016a).

Managing cybersecurity. With the growing relevance of data and consequently rising of cyber threats, it is considered a critical issue to protect organization's valuable data assets and information systems. In most of the cases, Chief Financial Officers have

become responsible of cybersecurity management, within risk management activities. As part of their risk agenda, Chief Financial Officers have to work together with the Chief Information Officer to define a governance framework for identifying potential digital risks, prioritizing and protecting digital assets, and mediating across functional technology silos to create an integrated approach that drives value creation (Davies & Huey, 2017; EY, 2017; Accenture, 2018; Chartered Global Management Accountant, 2016)

As a consequence, today's Chief Financial Officers are responsible much more than finance and their role has been disrupted by digital innovation, changing their skills and their focus.

7.3.5.2 New set of skills

The challenges facing Chief Financial Officers in their changing roles raise the question on how prepared today's finance leaders are in fulfilling these expanding expectations. What emerged previously is that Chief Financial Officers are required to build new competences and skills in order to manage large volumes of datasets and new digital technologies.

Competences enlargement. In today's dynamic business environment, companies are seeking finance leaders who have more than just accounting backgrounds (EY, 2017; Johnson, 2015). They need to build capabilities in key areas in addition to finance, such as operations, customer and commercial focus, risk management, business partnering, strategy and transformation in order to enhance business performances (Chartered Global Management Accountant, 2016; EY, 2016a; EY, 2017).

Technical skills. In addition to this process of competences enlargement toward other areas of the business, Chief Financial Officers have to develop new competences to exploit new digital opportunities. They require a stronger technology skill set to face current challenges. Therefore, data managing and advanced analytics are considered to be a critical capability for tomorrow's Finance Function (EY, 2016a; EY, 2016b; EY, 2016c;

EY, 2016d; EY, 2017; Huerta & Jensen, 2017; Schmidt, 2016). New sophisticated analytics, such as complex scenario planning and predictive models, will provide a forward-looking orientation and sharp forecast accuracy. In this way, predictive capabilities applied to operational systems will improve responsiveness of the business to a dynamic and changing environment (IBM, 2010). Moreover, their background and expertise allow them to turn value from data analytics into measurable performance gains and actions, and to align them with business requirements (EY, 2016a).

In order to develop tech-savvy accountants, who will be resilient to automation, Chief Financial Officers will have to focus on the following areas: developing business analytic capabilities, they will be able to identify and extract appropriate data, clean and transform the data, perform data analysis, interpret results in the context of the problem, and communicate business implications to stakeholders. They will have to learn to work with structured and unstructured data of large size using tools (e.g., SQL, Hadoop, MongoDB, R, and SAS) that are designed to analyze Big Data; finally, understanding principles of programming (e.g., an introduction to programming languages like Python) could help them to develop the ability to learn new emerging technologies in the future and be able to communicate with data and computer scientists (Richins, Stapleton, Stratopoulos & Wong, 2017).

In the research provided by Accenture in 2018, Chief Financial Officers recognized the upcoming importance of new digital skills and showed a positive attitude in learning attending effective upskilling programs.

Leadership behavior. Eventually, the expanding role moves the Chief Financial Officer into top positions of the organization. Moreover, in a time of uncertainty, volatility and fast paced change, leadership becomes increasingly significant in providing vision, direction and inspiration for the Finance function. As recent theories suggest that great leaders are more often those that practice leadership behaviors (rather than who are born with leadership traits), and that these behaviors can be taught, learned and cultivated, this skill needs to be acquired and trained by the Chief Financial Officer (EY, 2017).

7.3.5.3 Strategy orientation

Therefore, the implementation of new digital technologies and the development of new data analytics skills make the Chief Financial Officer a strategy player for the definition of new strategies across organizations while influencing and guiding existing business units (Accenture, 2018; Agrawal, Gibbs, & Monier, 2017; EY, 2016a; EY, 2016b; EY, 2016c; EY, 2016d; EY, 2017). In fact, new digital technologies provide Chief Financial Officers an opportunity to fill a strategic role by enabling their organizations to become more data-driven (Huerta & Jensen, 2017). From a corporate hierarchy perspective, Chief Financial Officer can be considered second importance only to the Chief Executive Officer (Hoitash, Hoitash & Kurt, 2016).

However, as Chief Financial Officer are going to expand their range of strategic responsibilities, this may lead to encounter challenges and conflicts from some traditional strategy leaders, such as Chief Strategy Officers and business-unit heads.

What is clear is that Chief Strategy Officers and Chief Financial Officers each have to bring insights to create a better link between resource allocation and strategy in the corporate strategy development. On the one hand, Chief Strategy Officer expertise can provide understanding of regulation, innovation, and microeconomic industry trends, while on the other hand, Chief Financial Officer supports the understanding of cost and revenue, capital allocation, and stakeholder issues.

This collaboration allows creating a distinct corporate or portfolio strategy process among different business units (rather than just aggregating business units plans); enhancing more frequent conversations among small groups of senior leaders, rather than annually or every three to five years; ensuring that the corporate strategy and budgeting processes are well aligned with capital allocation processes (including M&A and divestment strategies).

These insights let Chief Financial Officers and Chief Strategy Officers better placed to go beyond Chief Financial Officer's traditional duties in portfolio management, moving toward deployment of long-term growth opportunities, setting objectives for organic growth, expanding in new markets and planning strategies for M&A.

As a consequence, this comprehensive view of strategic direction and resulting allocation of corporate resources requires closer collaboration between finance and strategy (Agrawal, Gibbs, & Monier, 2017)

7.3.5.4 Investor relations

The global financial crisis and the hyper connected 4.0 world have spotlighted issues of trust in business. Therefore, today's companies are under growing scrutiny by stakeholders, such as regulators, customers, employees and investors. Moreover, due to the complexity of components of value that are measured, increased regulatory and accounting requirements are driving more complex reporting. The external stakeholders are increasingly looking for future trends in new areas such as strategy, sustainability issue and how risks are being managed (EY, 2017).

As leaders in performance management, Chief Financial Officers are going to become the "*voice of the company*" both in investor relations and in communications to the board (Agrawal, Goldie & Huyett, 2016).

As a consequence, they need to pay close attention, not only to the organization's legal compliance, but also to its corporate and social responsibilities in order to satisfy stakeholders requirements. This requires a greater emphasis on leading indicators of performance (for example, the number of customers month-on-month, how they were acquired, acquisition costs per customer and so further) in addition to the conventional activities of analyzing past variances (EY, 2017).

Moreover, the adoption of innovative finance processes will meet more effectively the investor mind-set. For example, Chief Financial Officer should focus on moving away from a typical, annual capital-budgeting process toward a more agile one, with flexible budgets, quick decision making, and a performance-management system to match. In this way, the enterprise is able to answer to external requirements and business changing in a proactive way (Davies & Huey, 2017).

Therefore, Chief Financial Officer will play the role of bridging the gap between the information requirements of both internal and external stakeholders, in order to

provide greater transparency on the resources used by the organization in the value creation process and allow better communication with stakeholders on the long-term vision and strategy (EY, 2016a; EY, 2016b; EY, 2016c; EY, 2016d; EY, 2017).

7.4 DIGITAL CFO

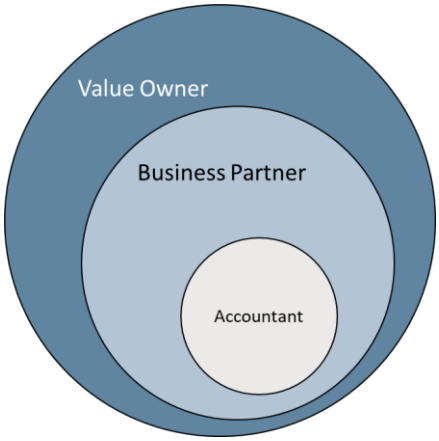
The value owner embeds previous stages and expands furtherly its influence (Picture 7-3).

In the **first stage**, the accountant knows how to get the numbers in order to compile the financial statements. The competences are mainly related to financial and accounting area.

In the **second stage**, the business partner reports the numbers to the Chief Executive Officer. A strategic orientation is required in order to provide insights for supporting top management in decision making.

In the **third** and last **stage**, the value owner is in the best position together with the Chief Executive Officer to lead the innovative, sustainable and profitable growth of the company. The new sources of data and the digital tools adopted push the Chief Financial Officer at the bottom of the organization. Chief Financial Officer moves from business partner to business leader position. The value owner is no more just supporting the strategic decision-making, but is leading it toward creation of new value. In the previous stages, Chief Financial Officers were familiar with historical data, but in today's environment looking backwards is no more sufficient for bringing value to the rest of the enterprise. Predictive analytics tools and a proactive attitude are required to exploit data and understand how the business climate will play out across each business area (Accenture, 2018).

Therefore, in a 4.0 world the successful modern Chief Financial Officer is someone who thinks broadly and strategically about the business, develops new digital competences in order to turn strategy into actionable plans, and possesses the skills to communicate the strategy across the organization and to external stakeholders.



Picture 7-3: CFO's evolution

As affirmed by the Eng. Solbiati, "The role of the Chief Financial Officer is changing. Through innovation, CFO becomes custodian of the value of the company and guarantor of approval of IT investments. The digital technologies can be considered as enablers of the evolving role of the CFO. CFO no more plays the role of business partner within the company, but can be considered as value partner or value creator, therefore as owner and enabler of company's value".

In order to set a gap with professional figure of previous stages, for the third stage, the definition of **Digital Chief Financial Officer** has been implemented. The word "digital" has been adopted to provide a clear and direct insight of the current state of competences and responsibilities related to the role and empowered by the adoption of digital technologies.

The Digital Chief Financial Officer is the value owner of his/her own enterprise.

Finally, the literature review has allowed to define a comprehensive framework about the expanding the role of Chief Financial Officer. As contribution to the literature, the review related to the Chief Financial Officer ends with a new definition for the Digital Finance Officer. The definition is aimed to deliver a holistic and insightful picture of the new professional figure.

Therefore, the following definition has been provided "*the **Digital Chief Financial Officer** is an innovative and technical-skilled professional figure able to understand,*

align, merge and optimize the traditional processes of Finance function (budgeting, risk analysis, reporting, cost analysis, …) through a harmonic and holistic exploitation of digital technologies such as Big Data, Cloud Computing, Artificial Intelligence and Robotics Process Automation. Digital Chief Financial Officer is proactively involved in company digital business strategy definition, enhancing firm's digitalization".

7.5 Digital Finance Department

As a consequence, the Finance Function is directly and positively involved in the expansion of the role of Chief Financial Officer, moving from a controlling, backward-looking function, to a more strategic, forward-looking one (EY, 2017).

As far as Digital Chief Financial Officer, to help lead change, Finance Function will need both better data and the competences to make sense of it (EY, 2016a; EY, 2016b; EY, 2017).

The new **digital competences** assigned to the Digital Chief Financial Officer are required to be spread in the whole Finance Function. In this way, exploiting appropriate analytical capabilities spanning process, technology and talent, Finance can turn these large volumes of financial and operational data into business insights for business units. The developed sophisticated analytics can help Finance Function uncovering correlations among seemingly unrelated pieces of information and find patterns nearly impossible to detect manually. This requires that they have to focus on obtaining better information, providing insightful direction to executive management, predicting and managing change, building relationships both internally and externally, taking a global perspective. Adequately equipped, Finance can contribute to significant enterprise value creation (IBM, 2010; Couto & Gray, 2004; EY, 2017).

Finally, the percentage of Finance function devoted in technology is supposed to rise in next years. Thus, the growing prominence of technology in Finance function will require an increasing collaboration between Finance and IT function (De Mesa, 2002; Schimdt,2016). A top down collaboration starting from Finance requirements will allow to have better and proper **data**.

As far as Chief Financial Officer, in order to make a distinction with previous and more traditional function, a new definition have been provided: "***The Digital Finance Function*** *is the evolution of the traditional finance department, which, led by a Digital Chief Financial Officer, is embedded with digital competences and improves process performances exploiting digital technologies in order to efficiently and effectively meet its day-to-day activities and achieve its organizational goals*".

8 PSYCHOLOGICAL WELLBEING

The second part of this research aims to address and to define the psychological impact of the recent digital disruption over the CFO.

The digitalization is transforming how companies do their business within Industry 4.0 environment and how people communicate and share information with the advent of social network. As a consequence, C-level roles like CFO are subjected to significant changes from organisational and professional perspective. As mentioned in the previous section of the paper, the analysed daily tasks, supporting tools, stakeholders, sources of data are no more the same in most of the cases. However, it might be argued that changes can have positive or negative effects on people mental state affecting the way people work.

Therefore, in this section the perspective moves from the organisational to the psychological one.

In particular, the psychological work environment, as one of the main issues in the current work environments, is going to be assessed. In fact, being exposed to job stressors might result in musculoskeletal disorders, cardiovascular diseases, mental disorders, stress, burnout, reduced quality of life, sickness, absence, labour turnover and decreased motivation and productivity (Kristensen, Hannerz, Høgh, & Borg, 2005).

Due to the supreme importance of personal wellbeing, a **psychological analysis** is brought forward through the use of one of the most recognize model in current psychology: the Job Demands-Resources model.

In this section, firstly it will be discussed the reason of the choice of this peculiar model respect to other widely spread tools. Successively, each component of the model is going to be deeply characterised. Eventually, a proposal of a model targeted for the CFO will be discussed and applied.

8.1 SELECTION OF THE MODEL

A deep analysis of the academic literature available revealed the creation burnout and motivation is studied through the use of three different models: (1) Job Demands-Control model; (2) Effort-Reward Imbalance model; and (3) Job Demands-Resources model. Here, these three models will be briefly presented and described in order to select the most appropriate one.

8.1.1 Job Demands-Control model

Job Demand-Control model (Karasek, 1979) is a model that dominated the issue of strain and health in working environment during the last 20 years of the twentieth century. According to this model, strain is caused by the imbalance of high job demands and low job control. In this model the creation of stress is a direct consequence of the individual's control over his working tasks. Albeit the literature provides several examples of the validity of this model in predicting the psychological strain related to the high job demands, the buffer effect of job control in reducing the strain moderating the high job demand is less consistent. The reason of that is that job control might represent a buffer on the impact of job demands although it may not be the only one or even the main one (Bakker & Demerouti, 2007).

Because of the limitation of the model in identifying the buffering factors on development of strain and the overlook of cause-effect relationship which brings to the creation of motivation and engagement over the employees and managers, it was thought this model is not suitable for this research's aim.

8.1.2 Effort-Reward Imbalance model

The **Effort-Reward Imbalance** (ERI) model (Siegrist, 1996) is based on the same logic of the Job Demands-Control model, thus, it sustains that an imbalance of job characteristics brings to the development of strain. In this case, the job demands have been substituted by the effort as factor influenced by the extrinsic job demands and

intrinsic motivation to meet these demands. The control aspect, which should buffer the effect of the effort, has been substituted by the reward, defined as salary, esteem, status and promotions. Once again, when the effort related to the job task is not counterbalanced by the reward in doing that task, according to ERI, the individual will experience stress (Bakker & Demerouti, 2007).

This model might be interesting considering the aspects of reward which can be proper of the expectation of a C-level manager and the consideration of attitudes, behaviours and emotion (e.g. esteem) of the individual.

However, this model has been discarded because the relationships among the use of new technology and the modification in CFO's reward is not clear. Moreover, the model strongly relies on personal and subjective aspects as commitment which arguably might vary, even considerably, from individual to individual making difficult to analyse the professional role.

In conclusion, as stated by Bakker and Demerouti (2007) both previously explained models, JD-C and ERI, present simplicity as a main weakness in addressing the high complexity of working conditions which might lead to strain and burnout. Indeed, the list of Job Demands and resources characterising a job is far more significant in volume and heterogeneous respect of the one predicted by these models. For instance, emotional demands, cognitive demands, social support and supervisor's feedback strongly influence the individual mental state. Moreover, in these models, workload and work pressure are always identified as a source of stress, while several researches (Crawford & Rich, 2010) connect them to the development of motivation through a mechanism of self-improvement.

8.1.3 Job Demands-Resources model

The Job Demands-Resources model (JD-R) differentiates respect to JD-C and ERI because of the fundamental assumption that every job has its own stressors and resources which can be classified in Job Demands and Job Resources (Bakker & Demerouti 2007).

As affirmed by Schaufeli & Taris (2014) the broader view on job characteristics gives to the model a much broader scope and higher flexibility of application, making it the most appealing for both practitioners and researchers.

Moreover, there is actually no single JD-R model. In fact, the model, instead of relating well-defined and rigid sets of concepts to each other (as the ERI and JD-C models), has a heuristic nature and represents a way of thinking about how job (and recently also personal) characteristics may influence employee health, well-being and motivation (Schaufeli & Taris, 2014).

The author Schaufeli (2017) underlined the completeness of the model. In fact, it integrates a positive focus on work engagement (motivational process) with a negative focus on burnout (energetic process) into a balanced and comprehensive approach. In contrast, previous models focused almost exclusively on negative aspects of the working activity.

The model predicts that job demands are not necessarily detrimental for workers psychophysical state as far as the individuals are provided with the necessary resources to bring forward the task. Moreover, oppositely to JD-C and ERI, JD-R gives the right importance to job resources even on their own, thus beyond the simple buffering effect on job demands impact. In other words, the development of job resources is not important just to mitigate high job demands but also when the job demands are not so relevant. Indeed, the presence of job resource might increase the level of motivation of the employee. Doing so, several studies (Bakker & Demerouti, 2007; Demerouti et al., 2001; Schaufeli & Bakker, 2004b) observed an increasing in operational performances of the employee.

Considering all these aspects, as far as the authors are concerning, JD-R model represents the most appropriate model when trying to assess the balance of strain and engagement in CFO professional role. More in depth, this research study will try to measure CFOs' burnout and linking it to its determinants.

Moreover, because the continuous transformation of the role and the availability of new tools might challenge CFOs, a lever of motivation might be seen. Thus, the same process used for burnout will be applied to understand the motivation created by the role transformation and the introduction of digital technologies.

In the end, the organizational commitment (Turnover intention) will be measured to understand if the impact of burnout overtakes the motivation creating an unstable professional figure which lack of those characteristics which make it sustainable over the long term.

8.1.3.1 Job Demands and Job Resources constructs

The Job Demand-Resource model (JD-R) is a key tool to understand employees' wellbeing in working environment. Indeed, many studies (Schaufeli & Bakker, 2004a) proved that job characteristics might have strong impact on employee's psychophysical equilibrium (Bakker & Demerouti, 2007; Xanthopoulou, Bakker, Demerouti & Schaufeli, 2007). The core principle on which the JD-R is build consists of understanding that the creation of strain or motivation related to the working task is due to the balance between the demands the job requires and the resources available to the employee; when this equilibrium is broken the employee might experience burnout or engagement (Bakker & Demerouti, 2007; Demerouti *et al.,* 2001; Schaufeli & Bakker, 2004a).

In order to better understand the model, the basic principles and definitions are going to be provided.

Stress is defined as the misalignment in cognitive-emotional-environmental system equilibrium led by external factors. These external factors are called stressors when they are related to an increasing of stress level of an individual (Demerouti *et al.,* 2001).

Job demands are defined by Demerouti *et al.*, 2001 (p. 501) as:

> Those physical, social or organisational aspects of the job that require sustained physical or mental effort and are therefore associated with certain physiological and psychological costs.

Thus, job demands represent the "things that have to be done" (Schaufeli & Bakker, 2004a, p.296).

Job demands lead to stress and they are due to factors (stressors) such as workload, time pressure and cognitive demand. The greater is the level of job demands,

the grater is the psychological cost of an individual. The psychological cost might bring to degradation of task's performance through narrowed attention, risky decisions and subjective evaluations. In the long term, breakdown or exhaustion are the main concretization of the presence of high stress level (Crawford, LePine & Rich, 2010; Demerouti *et al*., 2001).

As regard the job demands, two types of job demands can be identified: **hindrances** and **challenges**. The former is represented by those demands which act only in negative way on the psychophysical status of the individual creating stress and exhaustion (e.g. Emotional demand). Indeed, these factors cannot be tackled in a positive way by the employee which is forced at bearing the pressure. The latter represent those demands which challenge the individual. Thus, even if they consist in a request of the job position, the employee feels them like a way to emerge and prove himself developing motivation (Crawford & Rich, 2010).

In order to face difficult and challenging jobs, protecting factors, called job resources, are introduced to mitigate the effects of Job demands.

Job resources are defined by Demerouti *et al.,* 2001 (p. 501) as:

> "Those physical, social or organisational aspects that may do any of the following: (a) functional in achieving work goals; (b) reduce job demands at the associated physiological and psychological costs; (c) stimulate personal growth and development".

Thus, job resources refer to the resources necessary to face job demand and "get things done" (Schaufeli & Bakker, 2004a, p.296) and are mainly characteristics of the environment.

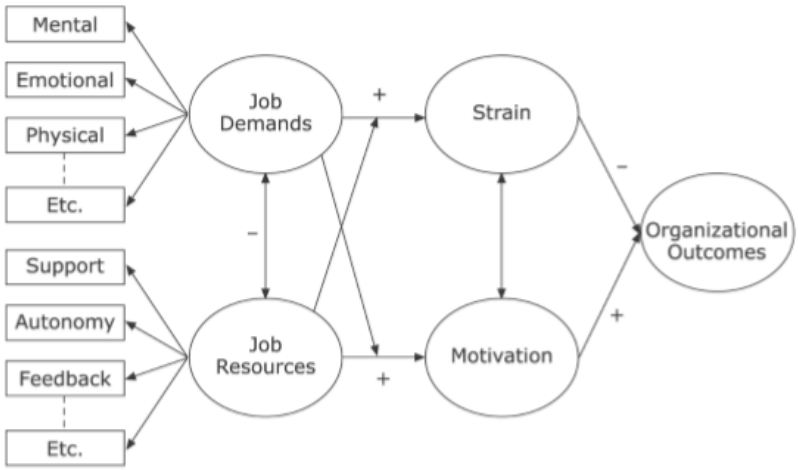
It is possible to distinguish also **personal resources.** They are defined by Xanthopoulou, Bakker, Demerouti, Schaufeli (2007) as aspects of the self that are generally linked to resiliency and refer to individuals' sense of their ability to control and impact upon their environment successfully. In their study, they include three typical personal resources, namely: self-efficacy, organizational-based self-esteem, and optimism. Schaufeli and Taris (2014) referred to personal resources as the psychological characteristics or aspects of the self that are generally associated with resiliency and

that refer to the ability to control and impact one's environment successfully. Similar to job resources, personal resources are functional in accomplishing work goals, and they stimulate personal growth and development. In some studies, personal resources are considered as supporters of job resources in order to buffer the impact of job resources on burnout (Bakker, Demerouti, Euwema, 2005).

Job resources are positively related with engagement and negatively related with burnout (Crawford, LePine & Rich, 2010).

8.1.3.2 The logic behind Job Demands-Resources model

Picture 8-1 shows the JD-R model structure. As it is possible to see, starting from the factors consisting in Job Demands and Job Resources, the model predicts the related organizational outcome. This is possible running correlation analysis (PLS-SEM analysis) among the factors and the development of strain and/or motivation. Depending on the balance of these last two, the individual might experience positive or negative organizational outcomes.



Picture 8-1: JD-R Model (Demerouti et al., 2001)

It might be thought as trivial that the right selection of the job demands-resources factors as well the strain, motivation and organizational outcomes is paramount for the right use of the model and the assessing of the employee's

psychophysical wellbeing. Thus, the model's variable should be based on resilient and reliable assumptions over the job activity relevant aspects, which may vary across different job and industries. This might be, but are not limited to, as far as Job Demands are concerned high workload, emotional demand, cognitive demand, role ambiguity lack in supervising and ineffective feedback; regarding Job Resources it is possible to identify autonomy, professional development, job variety, social support and financial rewards.

The **energetic process** model built by Hockey (1997) makes possible to better understand the link among job demands and mental efforts. In this model is linked the level of job demand with individual's health and working outcomes. Indeed, dealing with job demands requires effort which normally stays stable across the working activity if the job demands lay on an acceptable level. When the job demands reach an unbearable level, the effort required to sustain the job activity raise and individuals can cope this effort in two ways: raising their maximum effort limit or lowering the outcome's performances. The former obviously comes with extra physical and psychological costs, which gradually exhausts the employee physically and/or mentally causing burnout, on the other hand, lowering the target bar might mean to not reach acceptable performance.

Another model, called **motivational process** (Schaufeli & Bakker, 2004a) makes possible to link job resources with organizational outcomes (e.g. turnover intention) passing through engagement. The process is triggered by abundant job resources fostering internal motivation (because of learning and personal growth) and external motivation (through the achievement of goals). Motivation sparks employee's energy and make them feel engaged, which, in turn leads to better outcomes and lower intentions to leave their job position.

In addition to these two core processes, the JD-R model also predicts two **moderating effects**, namely that: (1) job resources buffer the potentially negative effects of excessive job demands on employee health and wellbeing, while (2) highly demanding work situations in combination with high levels of job resources result in higher levels of work engagement (Hu, Schaufeli & Taris, 2010). Note that both high job demands and poor job resources contribute to burnout, while only abundant job resources (and not low job demands) contribute to work engagement. Hence, by

increasing resources, burnout is prevented and engagement is fostered. In contrast, reducing demands would only affect burnout but not work engagement. The reason is that in addition to being potentially stressful, job demands may also be challenging to some point so that lowering job demands would result in less challenging jobs and hence lower levels of work engagement (Schaufeli, 2017).

In conclusion, the development of a model is able to manage the interactions between job resources and job demands is needed to understand the equilibrium leading to burnout in the job position. Several studies were conducted on the logic and validity of Job Demands Job Resources. Demerouti *et al.* (2001) in his study demonstrated that high levels of job demands are connected to development of feeling of exhaustion, while low level of job resources might bring to disengagement. If both are presented the two symptoms show up simultaneously. Moreover, the study showed that disengagement is not an outcome of exhaustion, but it is connected just to shortage of job resources.

In the next chapter each element of the model will be deeply characterised in order to have a clear picture of how the model works and the elements interact with each other.

8.1.3.3 Burnout

Maslach (1982) gave one of the most renowned definitions of Burnout, defining it as a *syndrome of emotional exhaustion, depersonalization and reduced personal accomplishment.* In his definition, Maslach (1982) referred to **emotional exhaustion** as the feeling of exhaustion related to emotional demands encountered in the work environment and thus it measures fatigue (Llorens, Bakker, Schaufeli & Salanova, 2006; Schaufeli & Bakker, 2004a). **Depersonalization** is an emotional status characterised by cynicism and detachment which highlights indifference and distance toward the job (Schaufeli & Bakker, 2004a). Eventually, the **reduced personal accomplishment** refers to the low capability in fulfilling the work's task.

Emotional exhaustion is connected to high emotional demands which are related to stressors such as workload and might cause turnover intentions. Depersonalisation

might happen at both blue- and white- collar level when expectations are not met, and rewards not achieved. As regard the reduced personal accomplishment it is thought as separate respect to the previous dimensions and it is considered, oppositely to the first two, as a non-core aspect of burnout (Demerouti et al., 2001). Indeed, the reduced personal accomplishment might be thought as a symptom of the first two dimensions of burnout. For this reason, in this study and in the related questionnaire, the burnout will be assessed considering just two core dimensions, the core ones: Exhaustion and Disengagement.

It is important to remark the Maslach (1982) definition is strongly connected to the human and social services industries, which has been found as limitative in descripting the more generic nature of burnout (Demerouti et al., 2001).

As argued by Demerouti *et al.* (2001) burnout is not something experienced just by human-services working activities but it is proper of every job. It is possible to find the reason why burnout is usually associated to human-services working activities in the strong attentions that academics have given to these ones during the last two decades of the twentieth century. However, it is paramount to highlight that the **burnout issue is proper of every work** and it is caused by the working conditions of every job, which are led by specific stressors.

More in depth, burnout is uncovered where jobs require high demands and low resources, thus eroding employees' energy and motivation. Indeed, stressors proper of human-service professions such as job-related depression, anxiety, psychosomatic complains may exist in any type of working activity. Demerouti *et al.* (2001) proved this assumption analysing the results of OLBI questionnaire across several different sectors and job activities observing the consistency of the factorial structure of the questionnaire throughout the several industries.

As proved by some researches, CFOs usually experience burnout because of the high responsibility and exhausting workloads which they have to bear (Barksy *et al.*, 2013; Ehrenhalt & Ryan, 2016). This causes a low tenure and high turnover of the job position. Albeit several studies (Barksy et al., 2013; Ehrenhalt & Ryan, 2016) proved that CFOs already experience burnout due to the difficult and challenging working conditions, none has yet studied the root causes of this problem.

Furthermore, as affirmed by the Eng. Solbiati, "Digital technologies allow on the one hand to manage data more easily, but on the other they require answering a higher and more difficult number of questions. Therefore, it is correct to associate burnout syndrome to professional role of CFO. However, burnout is subjective. For example, it can depend by the specific role of the CFO within the company, by the size of the company, by the industry…".

The measurement of burnout is done through the use of highly recognised self-assessment test. In this sense, two are the main tools used in the academic literature: the **Maslach Burnout Inventory General survey** (MBI-GS), which is the adapted version of original Maslach Burnout Inventory developed to be used outside the human services industry, and the **Oldenburg Burnout Inventory** (OLBI).

It is important to remark that **Burnout is a concrete characteristic of the job** which can be observed, measured and managed with actual interventions and modification of the working environment and not just trying to change people mind and perception (Demerouti *et al.*, 2001).

8.1.3.4 Job Engagement

When talking about engagement, it is referred to the "positive, fulfilling, work-related state of mind that is characterized by vigour, dedication, and absorption" (Schaufeli & Bakker, 2004a, p.295). **Vigour** is the high level of energy and resilience which lead to persevere is a working task for long period of time even if some difficulties arise. **Dedication** is a feeling of significance, enthusiasm, inspiration, pride, and challenge. Eventually, **absorption** is characterised by a full immersion in the working task and a resilience against disturbances (Llorens *et al.*, 2006). The latter has been proved to be highly correlated to vigour and dedication, thus switching into a direct consequence of these two. In conclusion, vigour and dedication represent the core characteristics of job engagement (Schaufeli & Bakker, 2004a). For this reason, in this study, just vigour and dedication are used to characterise the engagement of the sample.

Job engagement historically is defined as the positive antipode of burnout. Engagement is characterised by energy, involvement and efficacy which can be thought as the opposite of burnout factors (exhaustion, disengagement and professional inefficacy). Indeed, the relationship between burnout and engagement is represented as the two extremes of the same line. In this line burnout is the erosion of engagement. Individuals might find themselves in every point of the line more or less distant form each extreme point (Maslach and Leiter, 1997). Because of this concept, the assessment of burnout and engagement used to be done using the same scales and assuming that one excluded the other.

Work engagement is characterised by high level of energy and identification with the working activity; oppositely to that, burnout presents low level of energy and poor identification with one's work.

However, some researches (Schaufeli & Bakker, 2004a; Schaufeli & Bakker, 2004b) demonstrated that engagement and burnout are independent mental stated which are not necessary mutually exclusive but instead they can coexist and are negatively correlated. For this reason, it is suggested to assess burnout and engagement through two different and independent scales in order to isolate and identify each state (Schaufeli & Bakker, 2004a).

Schaufeli & Bakker (2004b) and Crawford, LePine and Rich (2010) report the development of employees' engagement might bring benefit to their performance. Indeed, high work engagement is related to job satisfaction, organisational commitment, lower turnover intention, highly proactive persons and strong extra-role behaviour.

Engagement assessed through the use of **Utrecht Work Engagement Scale** (UWES) which will be better characterised in the upcoming chapters.

8.1.3.5 Organizational commitment

Once assessed the amount of strain and engagement proper of a job position, it is important to assess, in addition to the individual well-being also the implication over the organization.

The early JD-R model was extended to include performance measures, which were conceived as positive or negative outcomes of the two psychological states. Bakker, Demerouti, de Boer, Schaufelia (2001) showed that job demands and job resources were respectively positive and negative indirect predictors of low tenure at work. Bakker, Demerouti, Schaufeli (2003) found that high job demands lead to health problems and, consequently, to longer periods of absence; while employees who can draw upon job resources such as social support from colleagues and performance feedback feel more dedicated to their work and more committed to their organization, and, consequently, are less inclined to leave the organization (i.e., turnover intention).

One of the most important organization outcomes is the organizational commitment. Organizational commitment has been defined as "a strong belief in and acceptance of the organization's goals and values, a willingness to exert considerable effort on behalf of the organization, and a definite desire to maintain organizational membership" (Porter, Steers, Mowday, & Boulian, 1974, p. 604)

The effect of burnout and engagement are synthetized into Organizational Commitment. Studies suggest that organizational commitment might be negatively related with burnout and positively related to engagement (Llorens, Bakker, Schaufeli & Salanova, 2006).

8.2 EVALUATION: SELF-ASSESSMENT AND OBSERVER RATINGS

The evaluation of job demands, job resources, burnout and motivation is made through self-evaluations. As argued by Demerouti *et al.* (2001), an opposite/complementary way to measure is through the observed ratings. In their study, Demerouti *et al.* (2001) proved that the concurrent use of self-reports and observer ratings might bring to different results. This is given by the gap between actual

working conditions and employee's perception. In this study, just a self-evaluation is run to assess the working condition.

This decision has been driven by two facts: the first is because of the impossibility of assessing the objective characteristics of each workplace due the lack in resources; secondly, the presence of burnout, even if proved to be an objective characteristic might not reflect the actual mind of the C-level individuals whose perception might considerably differ respect to the actual job conditions (Spector & Jex, 1998). Eventually the perception mainly drives the presence of motivation and burnout, indeed this one is highly individual and personal.

In order to be as much scientific and repeatable as possible, some of the most recognized psychological standard questionnaire are going to be used (COPSOQ, QWI, UWES and OLBI). Being tested and approved many times in the last thirty years, they allow comparability of results among different recipients and reliable connections among questions and variables.

In this study a revised version of the standards questionnaires is adopted, selecting just three questions relative to the scales identified as representative as driver for the CFO's mental health. These questions have been rewritten in order to isolate the effect of the introduction of digital technology in the working activity. The revisiting was carefully evaluated in order to obtain a different shape without distorting the questions' nature.

Moreover, as suggested by Schaufeli & Bakker (2004b), to avoid bias in self-evaluation, the respondents will not know which kind of variable is measured through a specific set of questions.

8.2.1 Copenhagen Psychosocial Questionnaire (COPSOQ)

The Copenhagen Psychosocial Questionnaire (COPSOQ) is a self-report assessment to measure the psychosocial work environment (Kristensen *et al.*, 2005). The questionnaire has been developed in three formats: the long (30 scales and 141 questions), the medium (26 scales and 95 questions) and the short (8 scales and 44

questions) one. COPSOQ presents many variable spanning from different levels of analysis (organisation, department, job, person work interface and individual) and covers several job stressors (e.g. workload, emotional demand, cognitive demand, …) and job resources (e.g. support, feedback, commitment, …). It has been developed to be as much generic as possible in order to allow its application in many industries and professions.

One of the main bias affecting COPSOQ is the lack in scales such as monetary rewards, values at work, justice trust and discrimination. However, in the authors' opinion, these might not be the main determinants in creating unfavourable condition when treating the introduction of digital technologies, the questionnaire is thought as suitable for this research.

8.2.2 Quantitative Workload Inventory (QWI)

The Quantitative Workload Inventory (QWI) is a self-report questionnaire aimed in assessing the amount of work volume and the work pace in a specific working task (Spector & Jex, 1998). The relevance QWI is to effectively measure the CFO's workload, one of the key factors leading to strain and burnout. Indeed, even if workload might be considered as challenging and motivating from some individuals, it cannot be denied that excessive workload might be connected to anxiety, frustration and eventually burnout.

OWI has just five items which are connected to the quantitative workload. The respondents indicate how often they experience what described in the sentence using a score range from one to five (Spector & Jex, 1998).

In the study conducted by Spector and Jex (1998), QWI resulted the best questionnaire to addresses the major determinants of burnout and engagement (the other two questionnaires were the Organizational Constraints Scale and Interpersonal Conflict at Work Scale).

In the research questionnaire, just three items have been selected and the score scale was adjusted from one to five to 1 to 7 in order to make it consistent with the scales extracted from the other questionnaires used.

8.2.3 Utrecht Work Engagement Scale (UWES)

The Utrecht Work Engagement Scale (UWES) is a questionnaire developed in 1999 to measure the three main aspects of work engagement: Vigour, Dedication and Absorption. It is a self-report questionnaire originally including 24 items (9 relative to vigour, 8 and 7 respectively for dedication and absorption), successively reduced to 17 (UEWES-17) to avoid unsoundness (6 vigour, 5 dedication and 6 absorption) (Schaufeli & Bakker, 2004b).

Some studies revealed the measurement of work engagement and burnout through UWES return a lower negative correlation between work engagement and burnout respect to the expectations. Moreover, it is possible to differentiate the presence of work engagement and workaholism. The former is characterised by engagement and good mental health of employees. The latter erode mental health and social attitudes because of the impossibility of detaching from one's working activity (Schaufeli & Bakker, 2004b).

8.2.4 Oldenburg Burnout Inventory questionnaire (OLBI)

It is possible to assess burnout through two different questionnaires: MBI-GS and OLBI. The Maslach Burnout Inventory (**MBI**) is almost universally used as instrument to assess burnout. Recently, Schaufeli, Leiter, Maslach and Jackson (1996) developed the Maslach Burnout Inventory – General Survey (MBI-GS) which includes three generic burnout dimensions labeled exhaustion, cynicism and professional efficacy.

The Oldenburg Burnout Inventory (OLBI) questionnaire is a self-report which assesses the level of burnout of the individuals according to two dimensions: exhaustion and disengagement.

OLBI questionnaire presents some advantages respect to the MBI-GS. Indeed, it presents positively and negatively worded statements in order to provide a higher stability and reliability of the answers. Oppositely, MBI-GS is characterised by items in each subscale which are all phrased in the same direction: that is, all exhaustion and cynicism item are phrased negatively, whereas all professional-efficacy items are phrased positively (Demerouti *et al.*, 2001).

Moreover, OLBI has been developed through a study in different occupational fields and it has been designed to be focused on the relationship between individual and his/her job and not among the employees and his/her social relationships. On the other hand, MBI-GS has been developed to assess just human-services related works and only after readapted to be used in other contexts. Furthermore, MBI-GS focus still lays on the social aspects of job activities (Demerouti *et al.,* 2001).

According to the aim of this study of measuring the psychophysical well-being of CFOs, which might not be related just on social interactions, OLBI questionnaire seems to be the most suitable choice.

For these reasons, in this study, OLBI has been preferred on MBI to assess the burnout level of CFOs and a revised version of its question are going to be administered to the sample.

8.3 PRACTICAL IMPLICATIONS OF THE MODEL

The JD-R model presents remarkable practical implications. Indeed, it might identify or predict the presence of unfavourable working conditions which might lead to strain, burnout and eventually in turnover intention. This threat should not be overlooked because they might bring toward psychophysical disturbs and low performances on the job (Schaufeli & Bakker, 2004a)

Though, the model should be used as a preventive tool to better tackle job demands and target job resources to improve the working environment. The best solution from a preventive viewpoint, according to Schaufeli & Bakker (2004a), is decreasing job demand and, in case it is not sufficient to obtain the personal wellbeing,

job resources should be improved. Doing so it is possible to have the best impact on burnout, engagement and turnover intention.

8.3.1 Examples of application of the model

JD-R model has been widely applied across many industries and working activities and adapted in many different shapes to effectively assess the peculiarities of each reality. Indeed, the nature of the model shall remain unchanged however the final output might change.

For instance, Jakanen, Schaufeli and Ahola (2008), Hu, Schaufeli and Taris (2011) and Schaufeli (2017) exploited the model to assess positive and negative outcomes of the uneven balance of job demands and job resources. Other researchers, such as Van den Broeck, Baillien, Elst and Sercu (2017), Bakker, Demerouti and Euwema (2005), Demerouti *et al.* (2001) and Crawford and Rich (2010) limited their studies in assessing the level of burnout and engagement, or just one of the two, proper of the job position under exam. Eventually, some authors focused on the effect of job demands and job resources in defining the in-role and extra role performances (Bakker, Demerouti & Verbeke, 2004).

The literature about JD-R is plenty of its applications in many sectors where the presence of unfavourable working condition which might lead to the development of burnout is well-known. For instance, teachers (Collie, Granziera & Martin), healthcare sectors (Viotti & Converso, 2016), cabin crew (Chen & Chen, 2014) and call-centre operators (Bakker, Demerouti & Schaufeli, 2003).

According to the analysis of the literature, a gap might exist in analysing the psychophysical well-being of mangers and in particular of the C-level. This might represent a problem since the optimal mental state of decision maker is paramount to bring forward a good decision-making process and eventually an objective, rationale and optimal decision. Indeed, at the highest level of the company, there might not be the luxury of making mistakes.

Due to these facts, in this study the JD-R model is going to be used to assess the mental state of CFOs related to the introduction of digital technology. The reason of that is to find if, starting from an unknow level of strain and motivation, it is possible to predict the effect of the actual digital disruption of the role assessing its sustainability by a psychological viewpoint.

To do so, the JD-R model used connect factors, job demands, job resources, burnout, motivation and eventually organisational outcomes.

9 BEHAVIOURAL DETERMINANTS

The digital changing occurring to CFO has been defined previously as pervasive and ground-breaking to the professional role, even if it is arguable that the individual will be actually involved within this changing and will proactively foster his/her own digitalization, Finance Function's digitalization and firm's digitalization. Therefore, it is fundamental to understand which are the practical influences and forces which pull CFOs toward the adoption and spread of digitalization.

In order to understand how the CFO's will behave, a theoretical model has been borrowed from marketing and psychological field. This theoretical model will help in understanding and defining the key determinants in CFO's attitude toward digitalization. The model selected is **Ability-Motivation-Opportunity** (AMO) framework.

9.1 ABILITY-MOTIVATION-OPPORTUNITY MODEL

The Ability-Motivation-Opportunity (AMO) framework was originally established within the context of information processing. Particularly, the framework focused to explain how consumers process information in advertisements. The model was developed at the beginning MacInnis and Jaworski (1989). Today, the AMO framework is well established as a theoretical basis for the explanation of work performance of the employees, which then determine performance of the firm. It has been successfully employed to explain a wide range of behaviours such as consumer choice, firm-level decision making and social capital activation (Ou-Yang, Ariphongphokin & Trung, 2014).

Therefore, the AMO model constitutes an attempt in building a holistic model to understand and explain the determinants of consumers' actions and behaviours. The AMO framework is based on basic concepts of psychology: Ability – skills and capabilities requisite to the performance of a behaviour; Motivation – the impetus toward a behaviour; and Opportunity – contextual and situational constraints relevant to the performance of the Behaviour (Hughes, 2007; Egmond & Bruel, 2007).

Some more thorough definitions might be useful to the reader, thus, well-recognised definitions of each brick of the model will be reported.

Ability is defined as the group of habits, knowledge and experiences possessed by the individual (Egmond & Bruel 2007; Jepson, Clarke & Ragsdell, 2013). Habits might be seen as an independent determinant of behaviour mitigating the effects of intention. Knowledge is concerning the capabilities, skills and theoretical concepts held by the individual.

Motivation is a simplification of the Theory of Planned behaviour (Egmond & Bruel 2007) and has be defined as the main driving force of a person's behaviour (Bettman, 1979). It is possible to distinguish extrinsic and intrinsic aspects of motivation (Trošt, Škerlavaj & Anzengruber, 2016; Binney, Hall & Oppenheim, 2007). On the one side, extrinsic motivation can be defined as the type of motivation controlled by externalities, which are not part of the activity or behaviour they are influencing (Wayne Binney, John Hall, Peter Oppenheim, 2007). On the other, intrinsic motivation is defined as enacting behaviour for its inherent satisfactions rather than for some separable external consequence (Wayne Binney, John Hall, Peter Oppenheim, 2007).

Opportunity is the connection between the individual and the external environment and might be seen as the objective precondition for behaviour (Ölander & Thøgersen, 1995). It represents a situational or operational constrains under which individuals act (Siemsen, Roth & Balasubramanian, 2008). It can be influenced by factors as communication, involvement initiatives, team working and autonomy (Trošt, Škerlavaj, Anzengruber, 2016).

The model highlights the importance of these three determinants in explaining behavioural outcomes and decision of individuals (Siemsen, Roth & Balasubramanian, 2008). Therefore, AMO suggests that the more capabilities, external opportunities and motivation are enhanced, the more the desired attitude is triggered. Thus, at the base of the model, each of the factors is theorized to have a positive relationship with the outcome of a specific behaviour.

However, Ability, Motivation, Opportunity are not seen only as complementary elements which works together influencing behaviour. In fact, these three do not share just a common relationship with the eventual behaviour, but recent literature has tried

to investigate if and how these determinants are correlated each other. The authors Siemsen *et al*. (2008) conceptualized Ability, Motivation, Opportunity as correlated but distinct constructs, even though existing empirical evidence from work-performance theories suggests that little explanatory power is gained by adding interaction terms. The researcher Hughes (2007) described Motivation having a direct influence on Behaviour, while Ability and Opportunity as moderator variables of motivation's impact on Behaviour. Therefore, a gap in the literature related to clear evidence about the relationships between these determinants exits and provides opportunities for further research.

Moreover, among the three key determinants, previous literature has highlighted Motivation as main driver of behaviour (Siemsen, Roth & Balasubramanian, 2008).

9.2 SELECTION OF THE MODEL

Overall, AMO can be defined as a meta-theory, a high-level generalization framework about the origins and the understanding of human behaviour. Specific types of motivations, abilities and opportunity factors are designed within the model depending to the specific research question (Hughes, 2007).

Another indicator of its high generality is represented by the wide breadth of focus. In fact, AMO is a formal theory designed for studies of behaviour involving abilities and opportunities, and thus it could be adopted to develop a series of mid-range theories, which have more limited scope and generate testable hypotheses. This AMO-based mid-range theory would produce a probabilistic causal analysis, which develop causal relationships between the independent variables (here Ability, Motivation and Opportunity) and the dependent variable (here, a specified Behavior). Therefore, AMO framework is operationalized in mid-range theories which attempt to provide both explanation and prediction with testable hypotheses (Hughes, 2007).

Furthermore, the AMO-derived mid-range theories rely upon empirical data, collected in experimental arrangements or field studies, employee surveys or direct

observations and measurements. Use statistical analytic methods are applied to verify the testable hypotheses designed (Hughes, 2007).

Therefore, the AMO framework is open-ended, since the Motivation, Opportunity, Ability components can be any factors considered relevant to a particular research question. This heuristic nature of the framework confirmed its wide scope and applicability (Hughes, 2007).

To summarize, the AMO framework provides a formal theory for developing mid-range theories in research studies which

- investigate individuals' behaviour;
- collect empirical data;
- employ statistical analyses;
- test hypotheses;
- aspire to explain and predict (Hughes, 2007).

Particularly, the application of AMO model is suited for research questions concerning:

- E-commerce
- IT ethics and security
- IT and culture
- Digital Divide
- Consumer user behaviour generally (Hughes, 2007).

Due to the wide range of possible applications and the complexity of the human behaviour's determinants, when operationalizing AMO as a particular mid-range theory of behaviour, one challenge is to sort out the most important factors of the constructs , in order to produce a parsimonious but relevant model (Hughes, 2007).

Finally, the same structure of AMO model may represent a limitation of the framework. In fact, it is aimed at explaining a particular behaviour from only three kind of determinants. However, other researchers have employed many other determinant factors as well, among which: gender, age, experience, voluntariness, intellectual

capability, cultural background, technology purpose and complexity, task/profession, ego strength, locus of control, organizational ethical climate (Hughes, 2007).

The wide scope and the focus on the explanation of the determinants of a particular human behaviour have been the main drivers that led to the choice of AMO model.

Moreover, recent applications of AMO framework in understanding innovation attitude and focusing on managerial perspective offer great support for this research study.

9.3 EXAMPLES OF APPLICATION OF THE MODEL

The model has been implemented by researchers in understanding the individuals' behaviours in different research studies. Depending on the research field, the determinants of the behavioural output have been chosen accordingly by the authors. Some examples of AMO application are briefly reported.

Researchers Jepson, Clarke and Ragsdell (2013) exploited the model to define community interactions. Siemsen, Roth and Balasubramanian (2008) applied the model to understand willingness in knowledge sharing.

Other authors applied the framework in order to understand innovation attitude. For example, Trošt, Škerlavaj, Anzengruber (2016) adopted the model to analyse the willingness of a team toward innovation, while Radaelli, Lettieri, Mura, Spiller (2014) focused on how employees' knowledge sharing affects their own innovative work behaviours. Moreover, the author Hughes (2007) developed a review of the model in the context of Information Systems application.

Moreover, some authors applied the model at managerial level. Tay, Tan and Yahya (2017) used AMO focusing to study management practices. Clark, Abela, Ambler (2005) applied the framework as a theoretical approach to link managerial attitudes and behaviors with the processing of marketing performance information. Particularly, Clark et al. (2005) authors developed a survey which involved senior managers at 66 large corporations to test their research model.

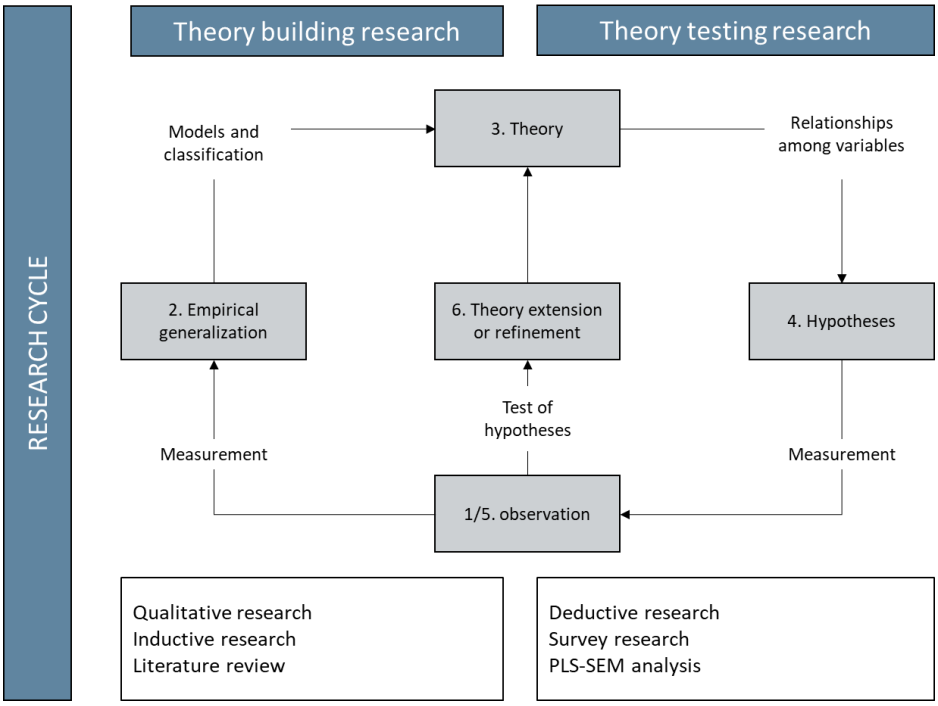
10 RESEARCH QUESTIONS AND CONCEPTUAL FRAMEWORK

In this chapter, the methodology, frameworks, objectives, models and tools used to bring forward the empirical research are going to be described and discussed.

The chapter will follow the traditional scientific research framework: initially the objective and research model will be deployed; after that, it will be explained how the survey has be designed and managed; and eventually, the data retrieved are going to be analysed and critically discussed.

In Picture 10-1, it is possible to understand the steps involved within this study. The span of the research embraces both theory building phase, consisting of literature review and model definition. Successively, the theory developed is going to be tested in order to assess the validity of the hypotheses formulated.

In each phase, peculiar tools are going to be used, from inductive and empirical research in theory building phase, to survey and quantitate and deductive research in theory testing phase. All these elements are going to be deeply characterised in the following sections.



Picture 10-1: Research cycle

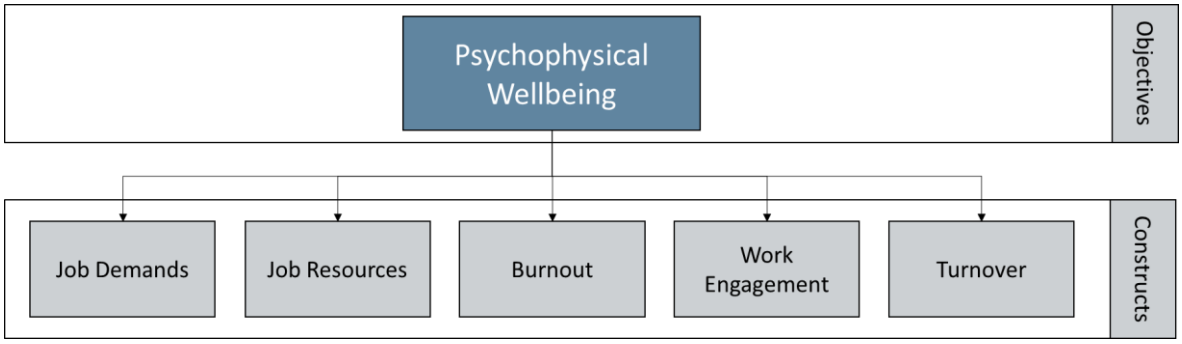
10.1 RESEARCH QUESTIONS

In order to fill the research gaps identified earlier, this study has two research questions. The first one wants to determine if the level of strain and motivation, caused by the introduction of digital technologies, lead to a **reduced psychological well-being** of the individual. The second one is concerning the **definition of Digital CFO's behavioural determinants**, thus, understanding under which conditions and forces a "traditional" CFO is pushed toward a digital revolution.

To achieve both objectives, two different and separated models have been introduced and to touch the research objectives, the main constructs of each were defined. These constructs act as connection between the research goal and the measurable variables.

The former is based upon Job Demands-Resources model (Demerouti *et al.*, 2001) and it is targeted toward the measurement of psychological well-being of the CFO.

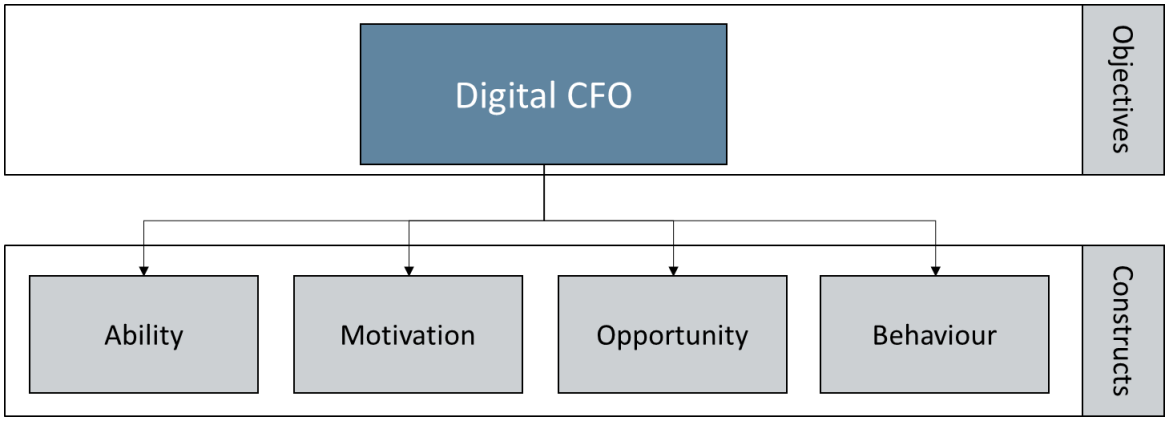
As far as the psychophysical well-being is concerning, five constructs have been identified and they consist in the core constructs of the Job Demands-Resource model: Job Demands; Job Resources; Burnout; Work Engagement; Turnover (Picture 10-2).



Picture 10-2: Psychological wellbeing constructs

The latter assesses the CFO's digitalization and it is based on a model borrowed from marketing. This model addressed as Ability-Motivation-Opportunity (AMO) wants to predict individual's behaviour starting from internal and external conditions.

As shown in Picture 10-3 Digital CFO behaviour is defined according the inner motivation, the opportunity the environment is presenting to him/her and the abilities held which can be used to exploit the opportunities.



Picture 10-3: Digital CFO's determinants constructs

The measurable variables, which will be used to test the model, are selected accordingly to the goal and key constructs here defined. This will be better explained in the upcoming chapters: "Conceptual framework – Psychological wellbeing" and "Conceptual framework – Digitalization of the CFO".

Eventually, before starting discussing the models, it is required to identify the unit of analysis. Because this study focused on the Chief Financial Officer, it has been thought as consistent if acting directly toward this one, thus having the perspective of someone living that role. Indeed, the unit of analysis selected is the Chief Financial Officer as professional.

10.2 Conceptual framework – Psychological wellbeing

Once defined the right model to analyse the psychological state of CFOs, thus JD-R model (Demerouti et al., 2001), it is necessary to exploit the flexibility allowed by the model in order to target it toward the focus of this analysis. More in depth, the peculiarities of CFO's professional role and the impact of introducing digital technologies

will be addressed through a thought selection of the right variables, connections and outputs.

Before starting analysing the JD-R model of the CFO, some considerations need to be done. It is fundamental to immediately clarify the logic and aim of this analysis. Indeed, to the best of available knowledge, there is a **lack in the literature** about the psychophysical well-being of C-level managers and more specifically of CFOs, which created some difficulties in assessing the psychological impact of introducing new business model and tools because of the acquired availability of digital tools.

In fact, these would have meant to bring forward two different analysis on psychological state of CFOs. In the first place, it would be required to assess the strain, engagement and turnover intention in "traditional" CFOs. After that, it was necessary to repeat the analysis targeting those CFOs which were considered as digitalised or surrounded by a digitalised environment.

This was not possible for many reasons among which the impossibility of defining in the first place the "traditional" since almost every working activity presents a certain degree of digitalization. Moreover, due to the lack of resources and limited availability in number of CFOs on which rely, it was not possible to bring forward two statistically valid analysis.

10.2.1 Designing the model

The detailed analysis of the CFO's history, roles, responsibilities and tools revealed as paramount to effectively define the right model parameters. The main concept extracted from the analysis of the CFO literature highlighted some specific issues.

Firstly, many studies (Accenture, 2018; Buchard, 2016) suggested that the evolution of CFO brought along an expansion of the role responsibilities and activities. This means that since the born of the role, the number of activities that CFOs have to run grew. This growth is far than superficial and brought a "simple" accountant to be a true value owner and the second role by relevance in a company. According to this its

workload increased and it is arguably growing in the next years. Workload simply represents the sheer volume of work required of an employee (Spector and Jex, 1998). Digital technologies might impact on CFO's workload in two ways. On one hand, it might reduce the workload thanks to automation and computer-aided activities. On the other, the new responsibilities and roles coming from the introduction and use of digital technologies, such as supervising ICT investments and supporting other departments operations, might strongly increase the CFO's workload.

A second relevant stressor might be represented by the **cognitive demand** CFOs should bear. Indeed, learning new skills and capabilities more than changings themselves requires mental efforts. Cognitive demand refers to the overall amount of mental effort used during the working activity. It is arguable that in order to manage all the activities in which CFOs are involved, the cognitive demand might be relevant. Albeit cognitive load, as well as workload, might represent a challenging and motivating characteristic of a job, indeed they give the chance to managers to prove themselves and gaining respect within the organization, they might also represent a strong driver of strain when they are seen as an insurmountable barrier. The introduction of digital technologies will arguably impact on cognitive workload, in particular it can relieve some of the cognitive workload through the application of Artificial Intelligence, which might take care of the quantitative aspects of the working activities extracting and communicating just the relevant insights from a huge number of datasets. Something similar might happen thanks to the use of Robotics Process Automation which may release the back-office repetitive work in Finance Department. However, once again, the expansion of the role and the new responsibilities coming from the introduction of these new technologies might increase the cognitive load of CFOs. Because of the effect of the variable and the unclear effect of digital disruption on it, it is thought that cognitive demand might be a representative variable in developing turnover intention.

H1. The use of Digital Technologies in CFO's role increases Job Demands

H2. CFO's burnout is positively related to Job demands as workload and cognitive demand

As regard the job resources, two main factors have been identified: Autonomy and Professional development.

Autonomy is defined as a high degree of control over the execution of the task (Bakker, Demerouti, & Verbeke, 2004). Autonomy represents one of the most effective elements to cope with job demands because it allows freedom and independence when working. Autonomy has been selected because it might be strongly affected by the introduction of digital technologies. In fact, it is expected an increasing of autonomy due to an enlargement of the CFO's area of influence (Sharma & Jones, 2010; Sweeney, 2013) especially toward ICT department and strategic decision-making field. Indeed, even if without the impact of digital technology, the natural expansion of CFO's influence has been huge during the almost hundred years of its existence, digital technologies should boost this expansion process. The higher autonomy might help the professional role in better organizing the work and better face the demands of its role.

Professional development is defined as opportunity to learn new things and possibility to develop himself/herself at work (Bakker, Demerouti, & Verbeke, 2004). Maybe professional development might represent the strongest resource CFOs can count on. Indeed, it allows to provide a meaning and a personal attachment to the job, thanks to the growth achievable by the individual. It is generally accepted that every time changings happens, personal development occurs. This is particularly true today for CFOs, who are going to face probably the most groundbreaking disruption in the entire history of the professional role. New challenges, new learning opportunities, new competences, new actors, new tools may profoundly shake the "bean counter" job making it always more satisfying and appealing for the new finance directors' generations, enabling the development of a more skilled and traversal professional role able to interact and manage always more different aspect of the firm.

H3. The use of Digital Technologies in CFO's role increases Job Resources

H4. CFO's engagement is positively related to job resources as autonomy and personal development

The Job Demands-Resources model applied to CFO wants to measure if the introduction of digital technologies is going to increase or reduce the turnover intention

of CFO's. According to the role's issue identified in the literature, the turnover intention seems to be a specific and unsolved problem of CFOs' role (Ehrenhalt & Ryan, 2007).

The model built is made up by the traditional five main blocks of JD-R: Job Demands, Job Resources, Burnout, Engagement, and turnover intention plus the construct measuring the relevance of digital technology to CFO identified as the use each of the four digital technologies considered in this study (Cloud Computing, Big Data and Analytics, Artificial Intelligence, Robotics Process Automation) in day-to-day activities. Constructs are connected by eight main hypotheses which mirrors the Demerouti *et al*. (2001) model and reflects the focus of this study.

More than the four hypotheses previously established, here are summarized the other four which are justified by the Demerouti *et al*. (2001) theoretical model:

H5. Job resources is negatively related to burnout

H6. Job demands is negatively related to work engagement

H7. Burnout is positively related to CFO's turnover intention

H8. Work Engagement is negatively related to CFO's turnover intention

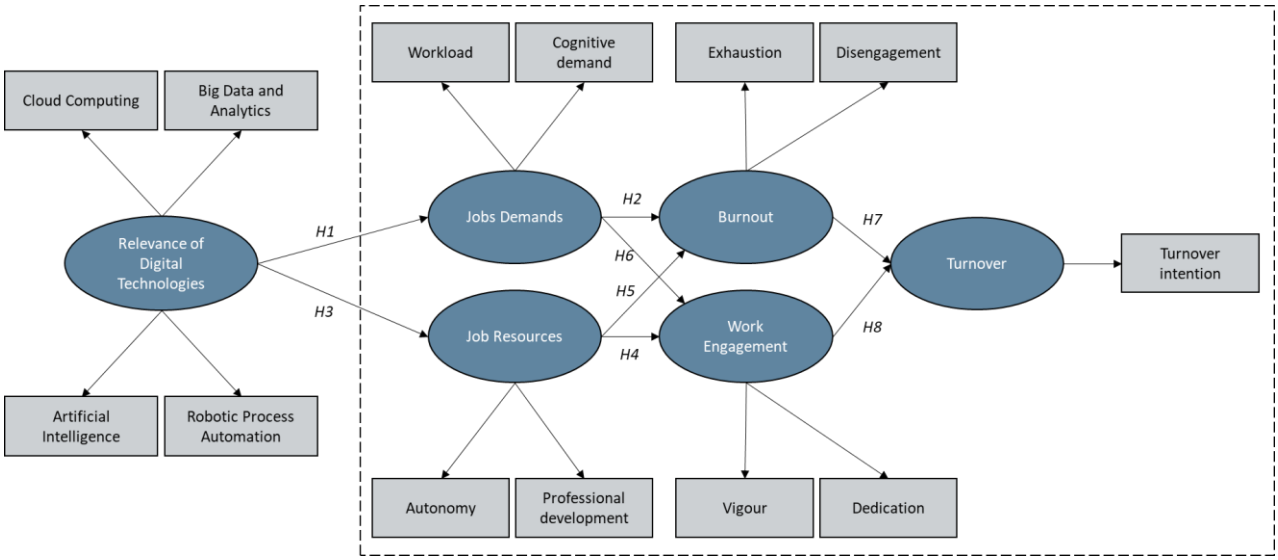
Picture 10-4 shows the JD-R model adapted to study the psychological state of CFOs. As it is possible to see, Workload and Cognitive load have been selected as main characteristics of CFO's job demand. As far as job resources are concerned, Autonomy and Professional development have been identified.

Burnout is studied through it two core determinants: Exhaustion and Disengagement (Demerouti *et al.*, 2001). Similarly, Engagement is characterised by the two core determinants defined by Demerouti *et al*. (2001): Vigour and Dedication. Eventually, Turnover is measured through the turnover intention similarly to Bakker, Demerouti and Schaufeli (2003) study. It is expected a negative relationship of Turnover with Engagement and a positive relationship with Burnout.

The selection of just two core determinants of burnout and engagement is led by the optimal solution found in solving the length/completeness trade-off proper of every questionnaire. Because every additional variable would require at least three

more items in the questionnaire, it has been necessary to focus just on the core ones in order to assure an acceptable response rate.

The model pass through two streams, one defines the level of burnout that CFO have to cope with, the other defines the engagement which motivates CFOs. The two flows eventually met each other in the final stage, defining though the organizational commitment of the professional role.



Picture 10-4: JD-R model applied to CFO's digitalization

The model is designed not only to monitor the psychophysical wellbeing of the manager which can be used to target preventive actions, but also to define the possible impact of the CFO mental state on the organization characterising the willingness of leaving the job position.

10.3 Conceptual framework – Digitalization of CFO

To analyse the attitudes and behaviours of an individual, and more specifically concerning the CFO, the Abilities-Motivation-Opportunity (AMO) model is used. The model defines individuals as rationale actors which behaviours are the results of internal (Motivation and Abilities) and external (Opportunity) factors (Siemsen, Roth &

Balasubramanian, 2008). Through the AMO model, it is possible to explore the key determinants fostering digitalization of the managerial function. In fact, as suggested by the author Hughes (2007), the model allows to investigate research questions related to digital divide and IT and culture aspects. Therefore, the behavioural outcome of the research model focuses on the perceived digitalization degree of the CFO.

10.3.1 Designing the model

The AMO research framework is built to investigate the results of the questionnaire which involved CFOs. In the literature review, the model was already adopted involving senior managers of large corporations (Clark, Abela & Ambler, 2005).

Obviously, considering the complexity affecting the human behaviour, the uncertainty led by decisions-making process, the non-rational mind of individuals and the simplistic nature of the model used (Hughes, 2007), the definition of an extensive list of relevant determinants which play a key role in fostering digitalization appears as a particularly challenging goal.

Moreover, due to the lack in systematically tackling the CFOs' digitalization issue within the literature, this study seems to represent the first time in which the question about which are the key determinants in nurturing digitalization is tried to be solved. This consideration brings along an important point of reflection, indeed, the model built is not supported by a strong literature analysis and the selection of key variables is driven by a background theory and an exploratory effort in analysing the CFO's behaviour.

The hypotheses to be tested within the research model mirrors the hypotheses of the original AMO model presented by MacInnis and Jaworski (1989).

As regard Abilities, they are measured through the diffusion of use of the four digital technologies considered within this study (Cloud Computing, Big Data and Analytics, Artificial Intelligence, Robotics Process Automation) across the Information Management Process (Ogiela, 2015). The Information Management Process here defined is made up by four stages (Ogiela, 2015):

1. **Data Collection**, consisting in gathering the raw data from the different sources (e.g.: centralised vs fragmented database);
2. **Data Analysis**, which consists in elaborating the raw data with the aim of extracting useful information (e.g.: elaboration of KPIs);
3. **Data usage**, this stage consists in using the information extracted to support business processes (e.g.: decision-making process);
4. **Data storage,** eventually the information and knowledge created should be communicated and stored (e.g.: budget, financial reports).

The abilities of CFO's in using the digital technologies to manage processes throughout the whole Information Management Process might be used as proxy of the CFO's capabilities in grasping the opportunities the environment is presenting to him/her and thus increasing the level of digitalization of the role.

H1. Strong digital capabilities increase the digital behaviour of a CFO.

Motivation is represented by **perceived relevance of digital technologies**, **predicted growth of digital technologies in the next few years in Finance Department** and **severity of the external forces pulling the use of digital technologies**. The first two factors are considered as intrinsic aspects of motivation of CFO. The latter is identified as extrinsic motivation, moved by external forces. The logic behind this choice is that CFO's might be motivated in undertaking a digital evolution if they hold the idea that digital technologies will become paramount tools in the future and they perceive tangible forces pulling the use of digital technologies.

H2. A high motivation in introducing digital technologies increases the digital behaviour of the CFO.

As far as the opportunity is concerned, it has been identified three environments from which opportunities might arise: the **firm**, the **Finance Function** and the **role** itself. The first is represented by the degree of communication among the departments of the firm allowed by digital technologies. It is supposed that a more

effective and digitalised knowledge sharing within the firm push CFO to digital technology adoption. Therefore, communication is supposed to be influenced by communication factor (Trošt, Škerlavaj & Anzengruber, 2016). The Finance Function is the function led by the CFO. Therefore, an environment digitalized push toward the implementation of innovative digital solutions. This first two sources of opportunity were about external direct push originated by the company's culture and way of working. Eventually, an indirect Opportunity might show up thanks to the expanding role of the CFO toward decision-making support, communication, operations and definition of the digital business strategy. The CFO's expanding role might trigger the digital changing process due to the necessity in optimising the different tasks and new tools to face the upcoming challenges.

H3. The more the environment will present opportunities, the more the CFO might become digitalised.

Moreover, this research model goes beyond the basic relationships between inputs and output characterizing the AMO model. In fact, the research framework wants to investigate also the potential correlation between the determinants. The analysis of determinants' relationships represents a research field without clear and empirical evidence, thus it leaves space for potential exploratory research (Siemsen, Roth & Balasubramanian, 2008, Hughes, 2007).

Therefore, two more hypotheses have been added to the model aimed at explaining if and how motivation is pushed by the other two determinants, opportunity and ability.

Personal digital capabilities are supposed to boost motivational process. In fact, the more the CFO is able to adopt and implement digital technologies, the more he/she is inclined to enhance and understand the potentials and the relevance of their application.

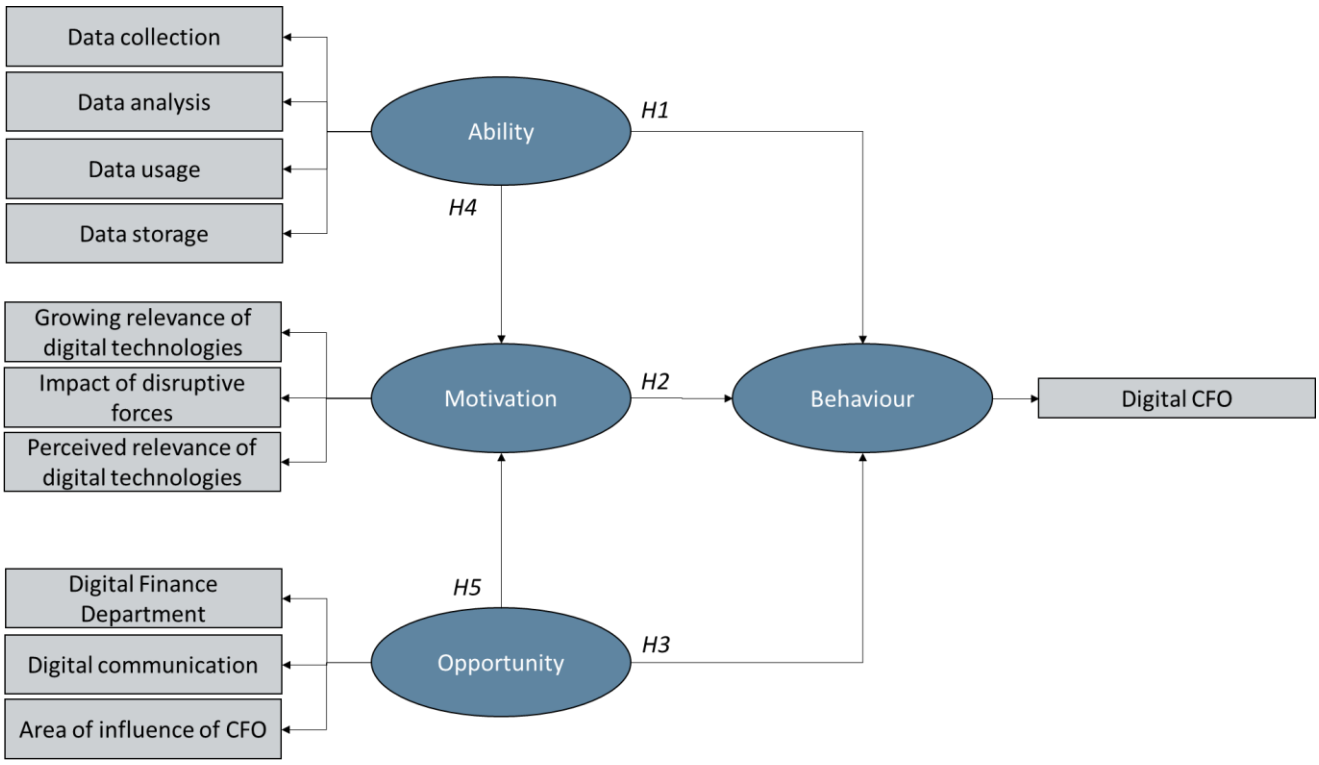
H4. Strong digital capabilities increase motivation in introducing digital technologies.

Finally, CFO's motivation is supposed to be pushed by opportunities from the environment. On the one hand, an organizational background, represented by firm and department, investing and fostering the digital technologies will increase awareness and motivation towards digitalization. On the other, CFO will be motivated and challenged by new responsibilities and by a wider area of influence allowed by digital adoption.

H5. The more the environment will present opportunities, the more the CFO might be motivated in introducing digital technologies.

Overall, the three determinants are supposed to have a positive impact and to foster the digital behaviour of the CFO. Moreover, motivation is assumed to be pushed by digital abilities and opportunities, trying to explore the literature review gap.

Picture 10-5 illustrates the AMO model.



Picture 10-5: AMO model for Digital CFO

11 MATERIALS AND METHODS

The main tool used in this research consists of a survey from which the hypotheses are tested. The questionnaire was divided into three main sections: (1) Control variables, (2) Digitalization of the CFO and (3) Psychological wellbeing.

In total the questionnaire was made up of 67 questions and required a standard mean time of 15 minutes to be fully completed (Annex 2).

11.1 QUESTIONNAIRE

11.1.1 Control variables

The control variables selected were aimed at identifying the individual in order to allow future classification and definition of relationships between the adoption of digital technologies and the characteristics of the individual.

Thus, the respondents were classified according to: (1) Age; (2) Gender; (3) Education level; (4) Academic field of belonging; (5) Tenure; (6) Firm's revenues; (7) Firm's internationalization; (8) Firm's industry; (9) Firm's involvement in Industry 4.0 projects; (10) Relationships between ICT Function and Finance Function.

These variables have been selected because thought as critical for the selection and implementation of advanced solution such as digital technologies.

Here the answers to the questions were closed-ended, i.e. nominal scales, and open-ended. In total, 12 questions made up this section (D1-D12).

11.1.2 Digitalization of the CFO

The second section, relative to the Digitalization of the CFO, has the aim of understanding the perception CFO's have on their level of digitalization and the actual use they would make of the digital technologies. Unfortunately, due to the fact that it was impossible for us to develop a customised questionnaire based on the level of

digitalization of each recipient, the questions proposed were mostly about the perceptions and perspectives CFOs have about the tools under discussions.

The Digitalization section counts 28 questions in total (D13-D40). Some relevant examples of the questions are: “How much this definition mirrors you? The DCFO is an innovative and technical-skilled professional figure able to understand, align, merge and optimize the traditional functions of Finance department (budgeting, risk analysis, reporting, cost analysis, …) through a harmonic and holistic exploitation of digital technologies such as Big Data, Cloud Computing, Artificial Intelligence and Robotics Process Automation. DCFO is proactively involved in company digital business strategy definition promoting firm’s digitalization.”.

With this type of questions, it has been assessed the perception CFOs have about their actual level of digitalization. In order to evaluate more objectively the real level of digitalization, some specific questions about the use of digital technology were proposed, such as: “Fulfil the following matrix, specify how much the following processes should be supported by Big Data: Auditing, Budgeting, Communication, Control, Cost analysis, Decision-making support, Forecasting, Risk analysis, Sensitivity analysis)”.

This type of question has been proposed for each of the four digital technologies under analysis and allowed to evaluate two aspects:

1. The real level of digitalization of the CFO, indeed, the non-use of the specific technology might be truly declared, showing lack in usage, or falsified, which can result in outliers.
2. The actual expectation or expected use that CFOs do of these technologies.

Here, it is possible to identify a clear bias given by the mash-up of expectations and actual use. Because of the constrain given by the inaccessibility of the physical workplace to run observations, this level of bias has to be accepted. Successively, all the bias, flaw and countermeasures will be described in detail.

The types of questions in this section was divided into three sub categories:

1. The first one was mainly devoted to the perception and relationship CFO has with the general idea of digitalization;
2. The second one was designed to be more specific, investigating the use of the four digital technologies considered in this study to the CFO's main activities;
3. The third one was related to the use of digital technologies within the information management process.

In this section, two types of answers were presented. For some questions, it was necessary to give a weight from 1 to 7 to the relevance of the item under examination. For others, the response range was yet from one to seven but displayed according to Likert scale, with these values: "Per nulla"; "Molto poco"; "Poco"; "In parte"; "Abbastanza"; "Molto"; "Completamente".

The differentiation was made according to the type of question. If a question was by its own, it has been preferred the Likert scale because it allows a lower level of subjectivity. Instead, if the question was structured as a list, it has been preferred the quantitative scale. Indeed, even if it reduced the accuracy, it was thought as easier to compile and thus increasing the response rate.

11.1.3 Psychological wellbeing

The section related to the hypotheses of Job Demand-Resource model consisted of 27 readapted standard questions (D41-D67).

More in depth, UWEQ is going to be used to test engagement; OLBI to assess burnout, QWI to evaluate workload; and eventually COPSOQ to measure Cognitive load, Autonomy and Professional development.

The questions used are just an extract of three items per questionnaire (nine for COPSOQ). These questions have been modified in order to clearly isolate the effect of digital technologies on the working activity and, due to the fact that each person might bring forward other activities more than CFO one, the working activity itself was

specified. All this process was done trying to not flaw the original nature of the question. Each question was proposed in Italian Language and transformed in an affirmative sentence.

The transformation from question to statement has been done to create consistency in the questionnaire, allowing the perfect integration of four different standard questionnaires. Moreover, the response range has been uniformed in a scale of agreeableness from one to seven.

An example of the work done might be seen in this transformation: the original question, extracted from QWI was: “How often does your job require you to work very hard?”. This question was reported in the questionnaire as “Da quando sono state introdotte le tecnologie digitali, il mio lavoro di Direttore Finanziario (CFO) è più pesante” (D41).

The response range was selected according to Likert scale and spans from one to seven, ditributed with the following options: “Sono in completo disaccordo”; “Sono disaccordo”; “Sono disaccordo in parte”; “Non sono né in accordo né in disaccordo”; “Sono d'accordo in parte”; “Sono d'accordo”; “Sono completamente d'accordo”.

11.1.4 Validation of the questionnaire

In conclusion, the questionnaire presented high relations to the models and the constructs. It presents mainly perceptive questions, even if, due to the high specificity of the questions, it might be considered as a suitable substitute for objective questions. Eventually, questions were designed to be neutral, **without preferring a digitalised answer** to a non-digitalised answer.

The scale used for the closed-ended questions was an **odd scale** with a range from **one to seven**. This allows to obtain a detailed level of digitalization without confusing the responded and give the possibility to answer neutrally to the question proposed. The scale used was designed to solve the **equidistance issues** in order to obtain comparable results to use in the statistical analysis. As said before, the scale has a neutral point which occupy the middle position (fourth) and three answers spreading

out from the neutral position toward the two extremes with the same equal shape of the statements.

Once completed, the questionnaire has been **vetted** by internal experts of Politecnico di Milano's Dipartimento di Ingengeria Gestionale and by external consultants. The latter consists of the authoritative opinion of Ing. Luigi Solbiati, Managing Director at Accenture, who, after some minor adjustments, approved the validity of the survey.

Furthermore, before the official launch of the survey, the questionnaire was **tested** by Ing. Francesca Torrente, Chief Financial Officer at Henry Schein. After that, the questionnaire was sent to the sample.

11.2 SAMPLE DESIGN

As previously stated, the Chief Financial Officer represents the unity of analysis, thus the target population.

The sample has been chosen according to few relevant criteria. Firstly, the organization might be Italian or not, internationalised or local but it should run their operations in Italy.

The size of the company is between medium and large; thus, the minimum volume of revenues is 50m€, and in any case, preferring companies with revenues over 500m€.

Furthermore, just manufacturing and service provider companies were considered. Public Administration (PA) and FINTEC organizations are excluded from this study.

The reason of this parameters is clear and straight forward. The Italian market was chosen because of its accessibility. The reason of the focus on medium-large companies is given by the necessity of having a minimum level of complexity which requires the adoption of digital technologies.

Eventually, PA and FINTEC organizations were excluded because operating differently in ways and aims respect to manufacturing and service firms, this difference might lead to a relevant gap in facing digitalization issue. The focus fell on manufacturing and service organization due to a wider population which might increase the number of respondents.

There are no other strong constrains to the selection of the sample. Indeed, age of the CFO, level of education, and industry of the company are thought as relevant control variables to better understand the criteria for adoption of digital technologies, thus, no selection will be done according to them.

11.3 SAMPLE EXTRACTION

Once defined the population boundaries, it is necessary to extract the sample to which deliver the questionnaire. One main issue in this step is given by the total number of the population. Indeed, in Italy, there are 1048 groups and 2496 companies with revenues higher than 50 million of euros[1] in 2016. Thus, the population is too large to be wholly considered and sampling is needed.

The sample counted 235 CFOs directly reached though their e-mail addresses and 101 CFOs reached through the institutional e-mail address of the company. In total 336 companies were included in this study.

The sample was defined considering to the resources available, the optimal level of response and the response rate expected. More in depth:

1. The resources available are limited in terms of CFO's contacts;

2. The optimal level of response (68 responses) has been defined according to the following equation:

[1] According to MedioBanca Ricerhce e Studi S.p.A. 2018. Retrieved from: http://www.mbres.it/it/publications/leading-italian-companies

$$n = \frac{t^2 * p * (1 - p)}{m^2}$$

- n= Optimal number of responses;
- t= Confidence level (90%; z=1.65);
- p= Estimated prevalence of the variable under investigation (0.50-0.50);
- m= Confidence Interval (10%).

3. Expected response rate of 20%.

According to an expected response of 20% and an optimal sample size of 68, 340 was defined as the optimal number of questionnaires to send.

The survey delivered was just self-administered and fulfillable through the on-line platform *Survey Monkey*.

The delivering of the questionnaire started from 1st of October and lasted one month. Every week after the first one, a reminder was sent to the non-respondents. During the whole administration process, the number of respondents and the response rate was monitored to assure consistency with the previously defined goal.

After two weeks, the actual response rate did not meet the expectation, settling on a value of 16.9%. Moreover, due to the presence of unfinished questionnaires, the "useful" response rate assessed on the value of 10.7% with a total of 36 useful questionnaires, thus, the number of responses did not touch the optimal value.

The low response rate might be explained by many elements: (1) Firm's policy in not participating to survey research; (2) Busy respondents who do not have the time to participate to the survey; (3) non-interested recipients; (4) Overlooked communication.

Because the emails were not enough to reach the previously defined optimal level of responses some follow-up action were implemented.

Firstly, two associations of CFOs were contacted, CDAF (Club Dirigenti Amministrativi e Finanziari) and ANDAF (Associazione Nazionale Direttori Amministrativi

e Finanziari). Just CDAF took part in this study and thanks to its involvement the level of survey completed grew up to 49.

Even if an improvement was achieved, the optimal level was still far from being reached. In order to try to meet the original goal 68, eighty of the most strategic companies which did not participate until then to the survey were directly contacted by phone call to improve the response rate. However, just two of these one eventually completed the questionnaire.

In conclusion, 76 questionnaires were received among which just 51 fully completed.

Having 51 exploitable questionnaires and fixing the level of Expected Prevalence (0.5) and Confidence level (0.9), the Confidence Interval is guaranteed at 11.5%.

However, an anticipation of a successive chapter is required. Because of the involvement of CDAF, the control of the recipients fell apart and data filtering was necessary to assure representativeness of the population. For this reason, 10 out of 51 responses were considered as not suitable for this study and removed from the database. The selection process will be explained in detail in the following chapter "Data Analysis".

Eventually, considering the final database containing 41 useful answers, the guaranteed Confidence Interval settled on a value of 12.88% (Table 11-1).

Table 11-1: Optimal and actual number of respondents

	Optimal	**Actual**
Confidence Interval	*0.1*	*0.129*
Confidence level	0.9	0.9
Expected prevalence	0.5	0.5
Sample size	*68*	*41*
Response rate	*20%*	*~10%*
Number of questionnaires to send	340	336

In conclusion, the predefined optimal sample size has not been met, however the Confidence Interval obtained at the end of the survey might be considered as within the acceptability range.

All the data retrieved were treated according to UE legislation in use and treatment of personal data General Data Protection Regulation (UE 2016/679).

11.4 BIAS AFFECTING THE METHODS

Considering the possible presence of bias affecting every empirical research, it is important to highlight and discuss the main ones in order to assure the reliability of this study.

In the following sections, the four main bias are going to be defined and discussed. These are: non-response bias, social desirability bias, common method bias and reliability of the measurement tool.

11.4.1 Non-response bias

Non-response bias is defined by Berg (2005, p.3) as:

> "the mistake one expects to make in estimating a population characteristic based on a sample of survey data in which, due to non-response, certain types of survey respondents are under-represented."

From this definition, it is possible to highlight a relevant problem of questionnaire based on voluntary participation. Indeed, it might happen that recipients, who feel like they do not fit the questionnaire aim, tend to not participate to the study. Doing so, part of the population will not be represented by the result of the survey mismatching the real characteristics of the population.

In conclusion, when the non-response bias is present, it is not possible to generalise the result obtained from the survey to the whole population.

In this study, the non-response bias might not be caused by sampling errors. Being the census made by MBRES and the selection of the population is made by selecting the most relevant players, nor it can be caused by non-representative samples, being the sample selected not according to a random principle but following a representativeness principle.

The main cause leading toward a non-response bias might be the behaviour of the respondents themselves. In fact, a non-interested respondent might ignore the survey and covering the relevance and severity of non-digitalised companies and CFOs.

As stated by Berg (2005) the non-response bias given by the non-interest of respondents, i.e. “selection bias” is a key issue if the questionnaire is based, as in this study, upon a variable of interest, i.e. use of digital technologies.

According to Berg (2005), it is possible to manage the non-response bias at both data gathering and data analysis stage.

In this study, during the design of the questionnaire, it has been tried to avoid the non-response bias through the use of questions based on perception and not on actual use of digital tools. This solution might pull the participation of everyone interested in the topic, despite the level of digitalization. However, a non-interested recipient might still not answer, hiding the presence of a lower level of digitalization.

While it is impossible to estimate the bias given by non-respondents, somethings can be extrapolated by respondents who partially completed the questionnaire and eventually abandoned it. Indeed, some insights may be extrapolated by uncomplete data through estimations techniques and weighted answers. However, the authors thought that the use of these techniques will lead to results as reliable as the effects of taking no action upon the non-response bias.

Because of the absence of any parameter about the population regarding digitalization and the lack in a second sample from which measuring the presence of the bias, here it is just possible to acknowledge the reader of this possible bias and provide a sample to the literature which can be used for future survey researches.

11.4.2 Social desirability bias

The Social desirability bias is a phenomenon afflicting potentially every self-report measure concerning social science (Fisher, 1993; King and Bruner, 2000). It consists in the tendency of reacting to question in a way to put the individual in the best possible light toward the society. A social desirability bias happens when the respondents mis-report their answer (Berg, 2005). It is wrong to associate this issue just to the individual behaviour, simplifying its nature which is mostly related to the "tendency of the test items to elicit particular responses" (King and Bruner, 2000, p. 81).

In case of presence of social desirability bias, the survey results are systematically flawed toward the society perception of correct answers, thus, covering the real situation (Fisher, 1993). Because of that, this bias might mislead the researcher bringing toward conclusions far from the reality.

According to Fischer (1993), the social desirability bias might lead to several issues such as: (1) unreliable relationships among variables; (2) increased measurement error; (3) deviation in variables' mean.

In the authors' mind, the social desirability bias does not represent a relevant bias within this study. Indeed, social desirability mainly appears when the questionnaire presents "good" and "bad" answers. Moreover, the questions might be related to self-reports of abilities, personalities, sexual behaviour, drug abuse and more in general to the main society taboos (Fisher, 1993).

Due to the characteristics of this study, the social desirability bias might be present in a limited and non-relevant bias. Indeed, elements such as: (1) Neutrality of the questions, (2) Anonymity and confidentiality, (3) Questions related to personal perception, and (4) Focus upon the professional role and not the individual, assures the detachment from the questionnaire fostering sincere answers.

Unfortunately, due to the limited resources available in terms of sample answers, it was not possible to run quantitative tests about the presence or not of social desirability bias, e.g. MCSDS (Marlowe-Crowne Social Desirability Scale).

In conclusion, it is impossible to assure the absence of social desirability bias because it was not possible to quantitative test the responses, however, many countermeasures were used within the questionnaire trying to reduce the magnitude of the issue to an acceptable level.

11.4.3 Common method bias

With the term common method variance or common method bias is intended the attribute of the measurement system causing measurement errors in behavioural research. Measurement error might represent a problem when threatens the validity of relationships among measures (Kock, 2015; Podsakoff, 2003).

According to Cote and Buckley (1987), the common method variance is affecting approximately 26.3% of the variance observed in relationships in behavioural research field.

Common method bias refers to the systematic measurement errors proper of a measurement system, leading toward misleading conclusions. Indeed, when common method bias is present, it is possible to observe a higher correlation between variables, however this correlation is not caused by the actual relationship but by a bias of the measurement system, i.e. the questionnaire, which is characterised by a systematic error in assessing the variables' values.

As proved by Podsakoff (2003), this kind of bias might be caused by many different sources, here just the most relevant about this study are going to be described and discussed.

One of the main sources is identified in the common source and rater from which predictor and criterion variables are measured. This can be explained by the rational reasoning of the respondent which tries to answer consistently to questions sharing causal-effect relationships or which assess the same construct. Doing so, relationships, which might not exist in the reality are erroneously observed (Podsakoff, 2003).

Another key element causing the common method variance issue is given by the implicit theory the respondent holds in his/her mind which influence the sticking to the reality of the answers in favour of the theory (Podsakoff, 2003).

Eventually, the common scale formats, defined as "the covariation produced by the use of the same scale format on a questionnaire" (Podsakoff, 2003, p. 882), might increase the variability related to common method.

More than these, many other biases might contribute to the severity of the common method variance such as: Leniency bias, Item characteristics effects and Social desirability (Podsakoff, 2003).

This analysis highlights the severity given by this issue and the many sources of errors which have to be considered. In order to avoid unacceptable levels of common method variance several measures were applied at both ex-ante and ex-post level.

As regard the former, in the questionnaire there is no a direct connection between questions and the actual construct they want to measure, doing so, it appears difficult to the respondents to find an actual link among the different questions. Moreover, the questions selected consist of an adaptation of standard questionnaire which are validated and approved against this kind of bias.

Despite this, some characteristics of the questionnaire might foster the impact of common method variance. For instance, every respondent took care of both predictors and criterion variables' assessment, and the scale used to answer, i.e. Likert scale, is shared in many questions of Digital CFO's section and by every question in psychological wellbeing section.

Although many countermeasures were taken during the survey design phase, it has been not possible to definitely exclude the presence of common method bias without an ex-post analysis. Thus, once collected the answers, the presence of common method bias has been tested to ultimately exclude an unacceptable level of its impact into the relationships emerged.

In order to statistically test the presence or not of the common method bias, three of the most well-known tests have been considered; Harman's single factor test; Confirmatory Factor Analysis (CFA); and Variance Inflation Factors (VIF).

Harman's single factor test is one of the most widely tools used to test the presence of common method variance. It is based on the concept that if the issue affects the measurement system, the majority of variance in the variables can be explained by a single factor (Podsakoff, 2003).

Confirmatory factor analysis is a more sophisticated test based on the same logic of Harman's single factor test (Podsakoff, 2003).

As regard the Variance Inflation Factors, it is an automatic procedure run by the software *smartPLS 3* which allows the full collinearity test for all the latent variables in the model. A VIF higher than 3.3 indicates the presence of a not acceptable level of the common method bias. As demonstrated by Kock (2015), VIF test is reliable in successfully identifying the presence of common method bias. A practical example of use of VIF is provided by Tay, Tan & Yahya (2017) who used VIF in testing common method bias in PLS-SEM modelling.

In conclusion, the common method bias has been evaluated through the use of the **VIF test**. Indeed, this one is the most reliable test among the three and allows to spot the presence of this bias in situation when single factor analysis fails (Kock, 2015).

11.4.4 Reliability of the measurement tool

Cronbach's alpha is an estimator of the reliability of a psychometric test. It measures the correlation of two items regarding the same construct. According to this tool, a psychometric test is reliable when the average correlation of the items measuring a certain construct is high. Indeed, the questions effectively measure the construct due to the fact that they share similar behaviours (Gliem & Gliem, 2003).

Cronbach's alpha will be used in two moments within this study. Firstly, it will be used to assess the reliability of the items of each measure of the model. After that, it is going to be used to assess the reliability of the measures in defining the latent construct beneath.

Cronbach's alpha threshold for an acceptable test is over 0.7, while values over 0.8 characterize good reliability of a model.

Due to the assumption, proper of Cronbach's alpha, of equal reliability of indicators, the sensitivity to the number of items in the scale and the tendency of underestimate the internal consistency reliability (Hair, Hult, Ringle & Sarstedt, 2016), another measure will be integrated to the Cronbach's alpha in assessing the internal reliability of the measures: the Composite Reliability.

The composite reliability index varies between 0 and 1. Values close to 1 indicate a high reliability and threshold of 0.7 for an acceptable level of reliability.

On the contrary of Cronbach's alpha, the Composite reliability use to overestimate reliability. Thus, in this study, the reliability will be assumed as a value tilting between the Cronbach's alpha (lower bound) and Composite reliability (upper bound). The interval of value will be used just for the assessment of constructs' reliability. The validity of the questionnaire will be computed using only Cronbach's alpha.

Very high values of Cronbach's alpha and Composite reliability (over 0.95) might represent an issue because demonstrate a convergence that it is likely to be explained by semantic redundancy of the items (Hair, Hult, Ringle & Sarstedt, 2016).

11.5 DATA PREPARATION

Once collected the answers from the survey several checks and adjustment were made in order to structure the data and making them usable for the statistical analysis.

Before starting analysing the answers, a preliminary check was required in order to assure the minimum number of answers to enable statistical validity. In the moment of closing the survey, 76 answers were received among which 51 completed. According to PLS regression's parameters, the number was sufficient to run the model. Further information about this aspect will be provided in the following chapters.

The achievement of an acceptable level of answers allowed the preliminary analysis on the responses.

The first problem to solve consisted in understanding how many of the answers collected could be used for the anlysis. Indeed almost 30% of the respondents did not complete the survey, abandoning the questionnaire. According to this, it has been possible to classify the answers into two categories:

1. S1: Questionnaires correctly completed in all its section. To this category belongs all the answers usable for both Digital CFO model and JD-R model. In total 51 responses (67.1%) join this group.
2. S2: Questionnaires not fully completed where just control variables and the first section of Digitalization of CFO were completed, the psychophysical well-being section is wholly blank. In total 25 responses (32.9%) join this group.

Because of the high correlation among the different sections of the questionnaire in order to run the statistical analysis, just S1 will be considered in this study. The 25 respondents of S2 group will be delated from the database.

After that, due to the involvement of CDAF in survey diffusion, some of the questionnaires collected did not match anymore the target population defined in the first place. Indeed, nine respondents were working for a company with less than 50 m€ of revenues and one respondent came from FINTEC industry. To stay consistent with the objective of this study, these 10 answers will be deleted from the database.

Now, the ultimate database is ready but, before running the statistical analysis another step it is required: the data structuring. Indeed, many answers are unstructured (e.g. text string) and other are inconsistent with the rest of the questionnaire (e.g. negative and positive worded questions in Job Demands-Resources section).

To solve this issue, the open-ended answer has been turned into structured answers, for instance, the company's industry question was gathered into seven main classes of answers:

- **Manufacturing**: it comprehends all the industries devoted to production processes and transformation of input into output (e.g.: automotive; buildings; chemical; clothing; electronics; mechanics; paper; pharmaceutical);

- **Services**: It embraces all the industries which provides intangibles services to the customer with a high level of back-office (e.g.: Hotel & Restaurant; ICT; Travel);
- **Logistics**: this category comprehends all the firms which are focused in moving, stocking and manage material flows (e.g.: Distribution; Transportation);
- **Utilities**: it embraces the firms which provides energy, water and gas to the users.
- **FMCG** (Fast Mover Consumer Goods): this category gathers those firms devoted in managing production and distribution of highly perishable produces (e.g.: Food and Beverage);
- **Healthcare**: it comprehends those organizations devoted to health and wellness of individuals (e.g.: hospitals);
- **Entertainment**: this category gathers the firms devoted in producing intellectual properties and intangibles for entertainment purpose (e.g.: Producers; Publisher).

Other open-ended answers were made consistent among them in terms of magnitude, such as: "Average revenues" and "Percentage of investment in digital technologies".

Moreover, the answers provided according to the Likert rating were turned into quantitative values according to the equivalences showed in Table 11-2:

Table 11-2: Likert scale conversions

Likert - Digital CFO section	Likert - Psychophysical section	Quantitative values
"Per nulla"	"Sono in completo disaccordo"	1
"Molto poco"	"Sono disaccordo"	2
"Poco"	"Sono disaccordo in parte"	3
"In parte"	"Non sono né in accordo né in disaccordo"	4
"Abbastanza"	"Sono d'accordo in parte"	5
"Molto"	"Sono d'accordo"	6
"Completamente"	"Sono completamente d'accordo"	7

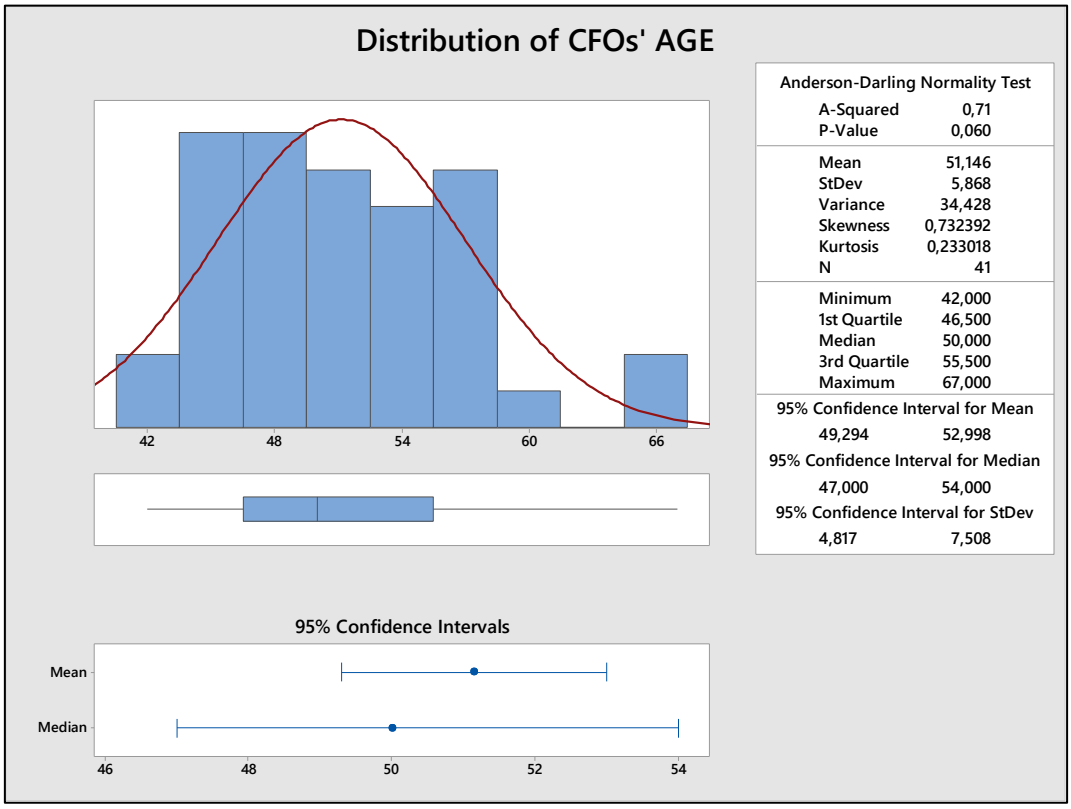
Eventually, the questions concerning the Job Demands-Resources model were adjusted to stay consistent among them and to correctly measure the actual level of their construct. More in depth, questions: D54; D55; D56; D58; D66; D67 were adjusted in complement to 7. Thus, if the answer was 1 it was turned into a 7, if the answer was 2 it was turned into a 6, and so on. Just the answers with value of 4 (central value) remained unchanged.

11.6 Data Analysis

In this section, the reliability and representativeness of the data collected will be assessed. To do so, the correspondences between target population and survey's result will be analysed from two perspectives: size and industry.

Moreover, to assure reliability of the data, outliers regarding CFOs' age will be analysed in order to eliminate those data which are external to the population distribution.

11.6.1 CFOs' Age

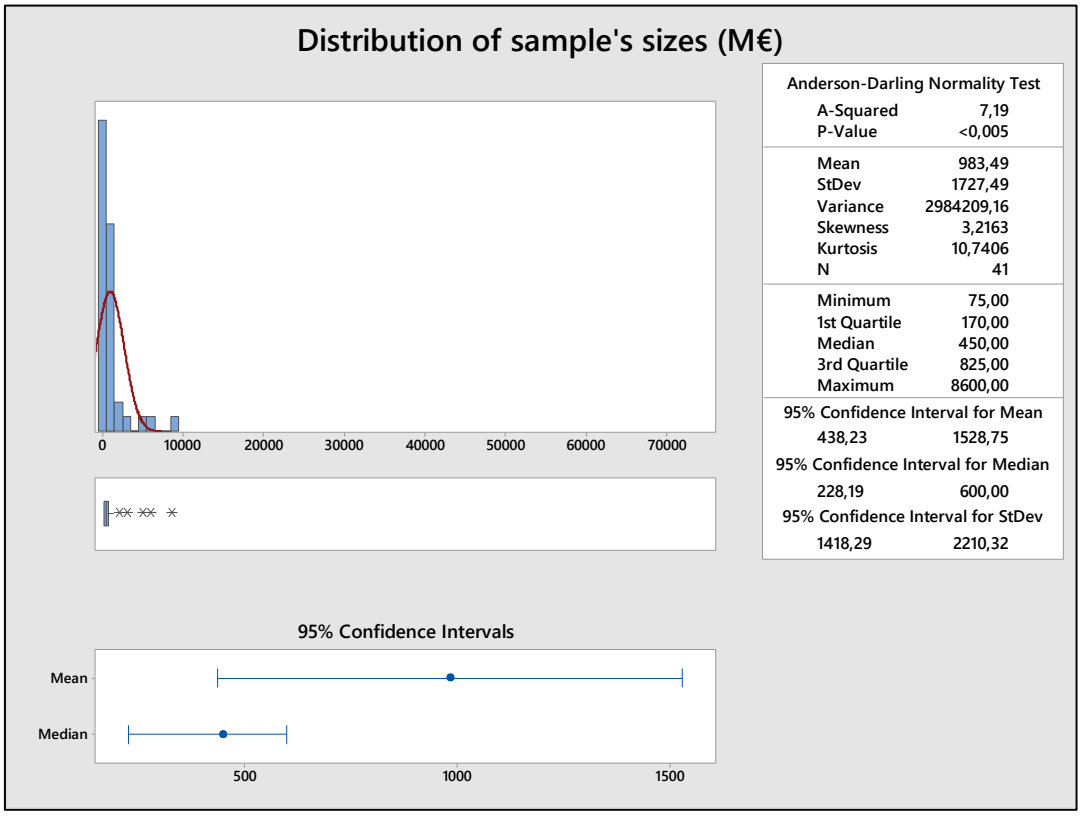


Picture 11-1: Distribution of CFOs' age

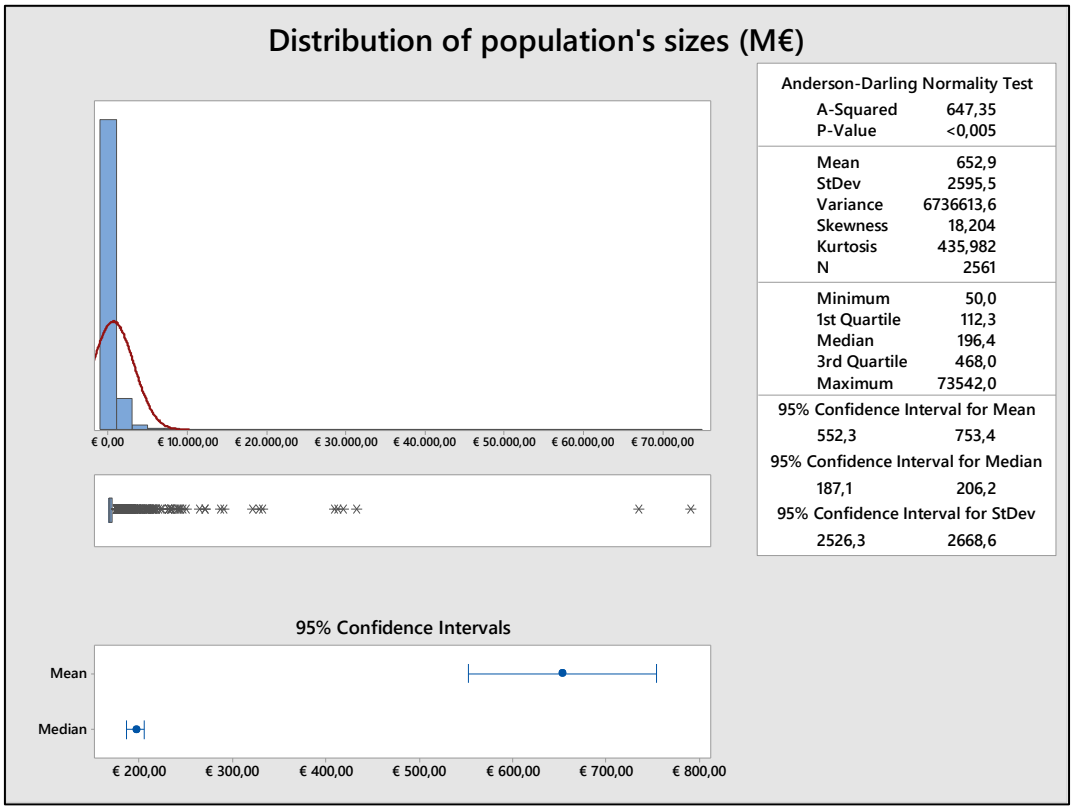
The age of respondents is distributed as a gaussian distribution (Anderson-Darling Normality Tests P-value= 0.060) with mean value of 51 and standard deviation of 5.8 defining a Confidence Interval for mean between 49 and 53 years old. The distribution presents a faint skewness and no outliers (Picture 11-1).

The analysis defines a highly consistent distribution and no actions have been taken according to CFOs' age criteria.

11.6.2 Representativeness of the firms' sizes



Picture 11-2: Distribution of sample's sizes



Picture 11-3: Distribution of population's sizes

The analysis of the sample's size is done together with the comparison with the population characteristics in order to assess the representativeness of the data obtained through the survey.

Population (Picture 11-3) and the sample (Picture 11-2) present similar characteristics: both are not distributed according to a bell-shaped distribution and present strong skewedness (3.2 for the sample and 18.2 for the population) toward the left side of the distribution. The reason of that is given by the peculiar features of the Italian production system, which presents a highly fragmented fixture. Indeed, the majority of manufacturers and service providers have a small dimension with revenues below M€1 000. However, many companies overcome that bar with some companies covering positions over M€10 000 and the extreme point is found at M€73 000 reached by ENEL, the main Italian energy provider. It is possible to appreciate similar trends into the sample extracted. Indeed, the majority of companies find themselves within the M€1 000 bound with some extremes reaching almost M€9 000.

The average revenues extracted from the sample is higher of almost 50% respect to the population size (Sample mean= M€983; Population mean= M€652), this is aligned with the aim of this study of analysing digitalization's impact in leading organizations.

It is possible to appreciate similar standard deviation, with values of M€1 727 and M€2 596 respectively for sample and population sizes. It is interesting to notice that in both cases the average size is lower than the standard deviation of the distribution, showing a high dispersion of the population (σ/μ (sample)= 1.757; σ/μ (population)= 3.981)

However, despite the differences in average size and dispersion of the distribution, the sample confidence interval for mean is embracing the whole confidence interval for mean of the population, highlighting representativeness of the sample.

Table 11-3 summarises the main metrics of the two distributions.

Table 11-3: Comparison of companies' size distribution between population and sample

	Population	Sample
Mean μ (M€)	652.9	983.49
Standard deviation σ (M€)	2595.5	1727.49
Skewedness	18.204	3.2163
Number of firms	2561	41
Minimum (M€)	50	75
Maximum (M€)	73542	8600
Confidence Interval for mean (M€)	[552.3; 753.4]	[438.23; 1528.75]

11.6.3 Representativeness of the firms' industries

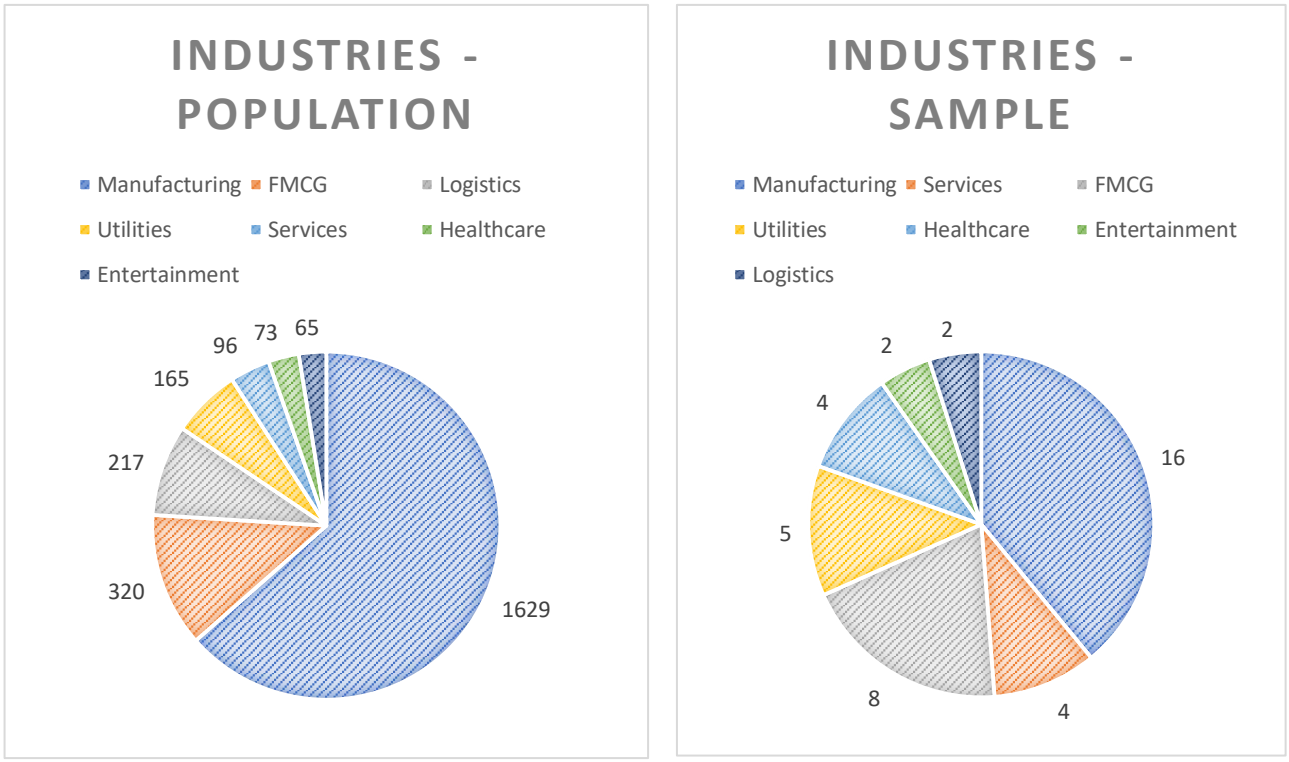
As regard as the industry of manufacturer and service provider, the representativeness is done according the aggregation into the seven macro-areas previously defined (Manufacturing; Services; Logistics; Utilities; FMCG; Healthcare; Entertainment).

The population and the sample show some common points regarding the distribution of industries. More in depth, the trend of the two seems to be consistent maintaining the same order and magnitude.

However, some differences should be considered. Firstly, the manufacturing industry is less represented, due to the sample undersize of 38.5% respect to the population.

The logistic industry suffers the same issue of the manufacturing one with a sample undersized of 42% respect to the population.

Graphs in Picture 11-4 show the comparison between the distributions of the sample's and population's industries.



Picture 11-4: Comparison of firms' industries between population and sample

Despite these two differences, the authors assume a fair representativeness of the sample according to the distribution among the different industries.

11.7 PLS-SEM REGRESSION

The results of the survey are going to be analysed through Partial Least Squares Structure Equation Modelling (or Partial Least Squares path modelling) technique. Particularly, the application of Partial Least Squares Structure Equation Modelling (PLS-SEM) is aimed to test and verify the hypothesises behind the defined model of Job demand – resource in order to find out significant relationships between the constructs.

First, the theory related to PLS-SEM methodology is going to briefly present in order to provide an overall picture about the framework and the reasons for the adoption of this technique.

After that, PLS-SEM technique is going to be applied to JD-R and AMO model. The different variables, constructs and relationships and measures required are going to be described and the results are analysed and presented.

11.7.1 PLS-SEM methodology

The algorithm at the bottom of PLS-SEM was originally developed by Wold (1975, 1982) and later it was extended by other authors, as Lohmöller (1989), Bentler and Huang (2014), Dijkstra (2014), Dijkstra and Henseler (2015a), and Dijkstra and Henseler (2015b).

PLS-SEM is a method for **structure equation modelling** (SEM). There are two types of SEM: Covariance-Based SEM (CB-SEM) and Partial Least Squares SEM (PLS-SEM). Generally, CB-SEM is adopted in order to confirm (or reject) established theories, while PLS-SEM is primarily used to develop theories in **exploratory research**, when searching for patterns in the data in case there is no or only little prior knowledge on how the variables are related. Therefore, in this study the aim is to analyse which independent variables are better predictors of the dependent variable. Moreover, there are other advantages that led to the choice of the application of PLS-SEM analysis for this research. In fact, PLS-SEM works efficiently with **small sample sizes**, **complex models** (many constructs and many indicators) and makes practically **no assumptions**

about distribution of data set (non-parametric analysis). On the contrary, CB-SEM analysis requires normally distributed data and its structural models require circular relationships (Garson, 2016; Hair, Hult, Ringle & Sarstedt, 2016).

11.7.1.1 Minimum sample size

As regards small sample size for PLS-SEM, some researchers have investigated and developed theories and rules of thumb regarding the **minimum sample size requirements** for the application of PLS-SEM. Particularly, two different methods have been developed. Barclay et al. (1995) have defined a rule of thumb known as **10 times rule** which states that the minimum sample size should be 10 times the maximum number of arrowheads pointing at a latent variable anywhere in the PLS path model. Cohen (1992) defined the minim number sample size depending on the minimum R^2 values detected (considering values of 0.1, 0.25, 0.5, 0.75) in any of the endogenous constructs in the structural level for significance level of 1%, 5% and 10%, assuming the level of statistical power of 80% and a specific level of complexity of the PLS path model (i.e., the maximum number of arrowheads pointing at a construct in the PLS path model).

11.7.1.2 Modelling technique

Going more in depth, PLS-SEM is an Ordinary Least Squares regression-based estimation technique that determines its statistical properties. This method focuses on the prediction of a specific set of hypothesized relationships that maximizes the explained variance in the dependent variables, minimizing on the contrary the unexplained variance. Therefore, PLS-SEM relies on variances instead of covariances of dependent variables to determine the optimum solution. As a result, the focus of PLS-SEM is more on prediction rather than on explanation, which makes PLS-SEM particularly useful for studies on the sources of competitive advantage and success driver studies (Hair, Hult, Ringle & Sarstedt, 2016; Garson, 2016).

PLS-SEM is represented as a **path model**. Path models are diagrams used to visually display the hypotheses and variable relationships within the model that are examined when SEM is applied (Hair, Hult, Ringle & Sarstedt, 2016; Garson, 2016).

In PLS-SEM model, **variables** can be defined as constructs or indicators. **Constructs** (**or latent variables**) are abstract, complex concepts and cannot be directly measured; they are graphically represented as circles or ovals. Moreover, latent variables can be exogenous, when they explain other constructs in the model, or endogenous, when they are being explained in the model. **Indicators** (**or items or manifest variables**) are the directly measured proxy variables that contain the raw data; they are represented in path models with rectangles. The indicators can be formative or reflective depending on the model, as it is going to be explained the next lines. **Relationships** between constructs as well as between constructs and their assigned indicators are shown as arrows. In PLS-SEM, the arrows are always single-headed, thus representing directional relationships (Hair, Hult, Ringle & Sarstedt, 2016; Garson, 2016).

Furthermore, a PLS path model is made up by two different elements. First, there is a **structural model** (also called the inner model) that represents the constructs (circles or ovals). The structural model also displays the relationships between the constructs. Second, there are the **measurement models** (also referred to as the outer models) of the constructs that display the relationships between the constructs and their indicator variables (rectangles) (Hair, Hult, Ringle & Sarstedt, 2016; Garson, 2016).

Each path model is explained and developed based on theory. Therefore, there are measurement theory and structural theory. **Measurement theory** specifies how the latent variables (constructs) are measured. Therefore, it explains the relationships between the latent variables and its indicators. In general, there are two different approaches to measure unobservable variables, depending on the type of relationship. The two approaches are the formative measurement model and the reflective measurement model (Hair, Hult, Ringle & Sarstedt, 2016; Garson, 2016).

In the **reflective measurement model**, measures account for the effects (or manifestations) of an underlying construct. The reflective indicators are viewed as a representative sample of all the possible and available items within the conceptual

domain of the construct. Therefore, since a reflective measure implies that all indicator items are caused by the same domain of the construct, indicators associated with that particular construct should be highly correlated with each other. Moreover, indicators should be interchangeable, and any single one can generally be left out without changing the meaning of the construct. The relationship between the indicators and the latent variable in a reflective measurement model is called outer loadings (Hair, Hult, Ringle & Sarstedt, 2016; Garson, 2016).

The **formative measurement models** rely on the assumption that causal indicators form the construct by means of linear combinations. Each indicator for a formative construct explains a specific aspect of the construct's domain. Taken together, the indicators constitute the meaning of the construct, which implies that omitting an indicator potentially modifies the nature of the construct. As a consequence, formative indicators are not interchangeable in contrast with reflective indicators. The relationship between the indicators and the latent variable in a reflective measurement model is called outer weight (Hair, Hult, Ringle & Sarstedt, 2016; Garson, 2016).

The specification of the content of the construct depends on the construct conceptualization and the objective of the study. Furthermore, the specification primarily guides and impacts on the measurement perspective (Hair, Hult, Ringle & Sarstedt, 2016; Garson, 2016).

Structural theory explains how the latent variables are related to each other. Therefore, it focuses on the path relationships between the constructs in the structural model. There are different types of relationships. The relationships linking two constructs with a single arrow are defined as direct effects or path coefficients. The relationships that involve a sequence of relationships with at least one intervening construct involved are defined as indirect effects. The indirect effects involve the presence of a moderator variable between the two constructs. The sum of direct and indirect effects is defined as the total effect between two constructs. The structural model **path coefficients** represent the hypothesized relationships among the constructs, thus they indicate the extent to which the exogenous construct is associated with the endogenous construct. (Hair, Hult, Ringle & Sarstedt, 2016; Garson, 2016).

After this brief explanation, it is possible to conclude that PLS-SEM estimates coefficients of relationships (structural model path coefficients) that maximize the R^2 values (amount of explained variance) of the (target) endogenous constructs.

The analysis of the path modeling implies both the evaluation of the measurement model and of the structural model. As regard the measures of the measurement model, they depend on the type of the model adopted, if formative or reflective one. Particularly, in this chapter the evaluation of the reflective measurement model is going to be studied since, it will be adopted for JD-R and AMO research model.

11.7.1.3 Evaluation criteria of the measurement model

Assessment of **reflective measurement model** includes the evaluation of **internal consistency reliability**, **convergent validity** and **discriminant validity** (Hair, Hult, Ringle & Sarstedt, 2016).

The main criterion for evaluating **internal consistency reliability** is composite reliability. **Composite reliability** takes into account the different outer loadings of each indicator variable. This measure varies between 0 and 1 values, with higher values indicating higher levels of reliability. Generally, composite reliability values can be evaluated considering the following ranges (Hair, Hult, Ringle & Sarstedt, 2016):

- below 0.6: lack of internal consistency reliability;
- between 0.61 and 0.70: acceptable in exploratory research;
- between 0.71 and 0.90: acceptable in more advanced stages of research;
- above 0.91 (and definitely above 0.95): not desirable, because they outline that all the indicator variables are measuring the same phenomenon and are therefore not likely to be a valid measure of the construct.

The **convergent validity** represents the extent to which a measure correlates positively with the alternative measures of the same construct. To evaluate convergent

validity of reflective constructs, individual indicator reliability and average variance extracted (AVE) are calculated (Hair, Hult, Ringle & Sarstedt, 2016).

Individual indicator reliability expresses the size of the outer loadings of the indicators. A common rule of thumb adopted by researchers is that the standardized outer loadings should be 0.708 or higher in order to be significant (Hair, Hult, Ringle & Sarstedt, 2016).

Average variance extracted (AVE) represents the grand mean value of the squared loadings of the indicators associated with the construct, thus the sum of the squared loadings divided by the number of indicators. An AVE value of 0.50 or higher suggests that, on average, the construct explains more than half of the variance of its indicators. On the contrary, an AVE of less than 0.50 indicates that, on average, more variance remains in the error of the items than in the variance explained by the construct (Hair, Hult, Ringle & Sarstedt, 2016).

The **discriminant validity** expresses the extent to which a construct is truly distinct from other constructs by empirical standards. Therefore, confirming discriminant validity means that a construct is unique and captures phenomena that are not represented by other constructs in the model. The discriminant validity is evaluated considering cross-loadings, the Fornell-Larcker criterion and the heterotrait-monotrait ratio (HTMT) of correlations (Hair, Hult, Ringle & Sarstedt, 2016).

The **cross-loadings** accounts for the correlations between an indicator and another construct. Therefore, the outer loading of the indicator should be higher than any of its cross-loading on other constructs. In this way, it affirms that the correlation between the indicator and its construct is higher than the correlations between the indicator and the other constructs in the model (Hair, Hult, Ringle & Sarstedt, 2016).

The **Fornell-Larcker criterion** compares the square root of the AVE values with the latent variable correlations. Thus, the square root of each construct's AVE should be higher than its highest correlation with any other construct. An alternative approach to evaluate the results of the Fornell-Larcker criterion is to calculate whether the AVE is larger than the squared correlation with any other construct. The logic behind the Fornell- Larcker criterion is based on the idea that a construct shares more variance with

its associated indicators than with any other construct (Hair, Hult, Ringle & Sarstedt, 2016).

However, recent research has found that neither cross-loadings or Fornell-Larcker criterion is able to detect discriminant validity issues. As regards cross-loadings, it fails to indicate a lack of discriminant validity when two constructs are perfectly correlated. As far as the Fornell-Larcker criterion, it performs very poorly when indicator loadings of the constructs under consideration differ only slightly (Hair, Hult, Ringle & Sarstedt, 2016).

Therefore, in order to have a reliable measure of discriminant validity, the **heterotrait-monotrait ratio (HTMT) of the correlations** is taken into account. HTMT represents the mean of all correlations of indicators across constructs measuring different constructs relative to the geometric mean of the average correlations of indicators measuring the same construct. In a few words, HTMT is the ratio of the between-trait correlations to the within-trait correlations. The HTMT approach provides an estimation of what the true correlation between two constructs would be, if they were perfectly reliable. A true correlation between two constructs close to 1 indicates a lack of discriminant validity. Researchers consider that a HTMT value *above 0.90* suggesting a lack of discriminant validity. Particularly, when the constructs in the path model are conceptually more distant, a lower and thus more conservative threshold value of 0.85 seems acceptable (Hair, Hult, Ringle & Sarstedt, 2016).

Moreover, the HTMT can be adopted as the basis of a **statistical discriminant validity test**. However, since PLS-SEM does not require distributional assumptions, standard parametric significance tests cannot be applied to test whether the HTMT statistic is significantly different from 1. Therefore, researchers have developed a procedure called **bootstrapping** to derive a distribution of the HTMT statistic. The bootstrapping allows to draw randomly subsamples with replacement technique from the original set of data. Replacement technique means that each time an observation is drawn at random from the sampling population, it is returned to the sampling population before the next observation is drawn. Each bootstrap sample has the same number of observations as the original sample of data set. Bootstrapping process is repeated until a large number of random subsamples have been created, usually about

5 000 subsamples. The bootstrap distribution is an approximation of the sampling distribution. From the bootstrap distribution, it is possible to estimate statistic parameters. The HTMT statistic is one of the parameters that can be gained with this technique. In this way, it is possible to derive a bootstrap confidence interval. The confidence interval represents the range within the true HTMT population value will fall, assuming a certain level of confidence (e.g., 95%). A confidence interval containing the value 1 indicates a lack of discriminant validity. On the contrary, if the value 1 falls outside the interval's range, this suggests that the two constructs are empirically distinct (Hair, Hult, Ringle & Sarstedt, 2016).

When discriminant validity is not met, there are two different approaches that can be adopted. In order to decrease the average heteromethod-heterotrait correlations, it is possible to eliminate items that are strongly correlated with items in the opposing construct, or reassign these indicators to the other construct, if theoretically plausible. Otherwise, another approach to treating discriminant validity problems involves merging the constructs that cause the problems into a more general and broader construct. In both cases, it should be checked that measurement's content validity is not decreased (Hair, Hult, Ringle & Sarstedt, 2016).

11.7.1.4 Evaluation criteria of the structural model

Once the measures for reflective measurement model have been checked, the next step addresses the assessment of the **structural model** results. This means examining the model's predictive capabilities and the relationships between the constructs. The assessment of structural model results adopts a systematic approach, divided in six different steps (Hair, Hult, Ringle & Sarstedt, 2016).

The **first step** requires the assessment of **collinearity**. To assess the level of collinearity, researchers compute the Tolerance or the Variance Inflation Factor (VIF). The **Tolerance** expresses the amount of variance of one indicator not explained by the other indicators in the same block. The **variance inflation factor (VIF)** is just the reciprocal of the tolerance. Tolerance values below *0.20* (and VIF value above *5*) in the predictor constructs are considered critical levels of collinearity. If a critical level of

collinearity is indicated by the Tolerance or VIF guidelines, it should be considered eliminating constructs, merging predictors into a single construct, or creating higher-order constructs to treat collinearity problems (Hair, Hult, Ringle & Sarstedt, 2016).

The **second step** focus on the evaluation of **structural model path coefficients**. The path coefficients calculated as standardized values approximately between –1 and +1 (values can be smaller or larger but usually fall in between these thresholds). The closer the estimated coefficients are to +1 or to -1, the stronger are the relationships (positive or negative respectively). On the contrary, the closer the estimated coefficients are to 0, the weaker are the relationships (Hair, Hult, Ringle & Sarstedt, 2016).

Specifically, if a coefficient is significant ultimately depends on its standard error that is obtained by means of **bootstrapping** process. The bootstrap standard error allows to compute the empirical t-values and p-values for all structural path coefficients (Hair, Hult, Ringle & Sarstedt, 2016).

As regards the empirical **t-value**, the path coefficient is statistically significant at a certain error probability (i.e., significance level) if the t-value is larger than the critical value. Generally, critical values for one- tailed tests are 1.28 (significance level = 10%), 1.65 (significance level = 5%), and 2.33 (significance level = 1%); critical values for two-tailed tests are 1.65 (significance level = 10%), 1.96 (significance level = 5%), and 2.57 (significance level = 1%). The choice of the significance level and type of test (one or two-tailed) to adopt depends on the field and on the objective of the study. Usually, when a study is exploratory in nature, researchers often consider a significance level of 10% (Hair, Hult, Ringle & Sarstedt, 2016).

As regards **p-value**, it expresses the probability of erroneously rejecting a true null hypothesis, thus assuming a significant path coefficient when it is not significant. Specifically, when assuming a significance level of 10%, the p-value should be smaller than 0.1 to assess that the path coefficient considered is significant at a 10% level (Hair, Hult, Ringle & Sarstedt, 2016).

Finally, bootstrapping process allows to evaluate **confidence intervals** of path coefficients. Therefore, if a confidence interval for an estimated path coefficient does not include 0, the null hypothesis that the path equals zero is rejected, and it is possible to assume a significant effect of the path coefficient (Hair, Hult, Ringle & Sarstedt, 2016).

After having examined the significance of relationships, it is important to assess the relevance of significant relationships. In fact, it is possible that path coefficients in the structural model may be significant, but their size may be very small. For example, the structural model path coefficients can be analyzed also as relative to one another. Therefore, if one path coefficient is higher than another, its effect on the endogenous latent variable is bigger (Hair, Hult, Ringle & Sarstedt, 2016).

Moreover, instead of path coefficients, the total effect between two constructs can be evaluated. It is particularly useful when there are mediating variables (Hair, Hult, Ringle & Sarstedt, 2016).

In the **third step,** the **coefficient of determination (R^2 value)** is calculated. The R^2 value is the squared correlation of actual and predicted values, thus represents a measure of in-sample predictive power. It varies between 0 and 1, with higher levels indicating higher levels of predictive accuracy. In success driver studies, researchers consider 0.75 as threshold. In scholarly research focusing usually on marketing issues, R^2 values of 0.75, 0.50, or 0.25 for endogenous latent variables may, as a rule of thumb, be respectively described as substantial, moderate, or weak (Hair, Hult, Ringle & Sarstedt, 2016).

The **fourth step** focuses on the change in the R^2 value when a specified exogenous construct is omitted from the model. In this way, it evaluated if the omitted construct has a substantive impact on the endogenous constructs or not. This measure is known as the **f^2 effect size**. Values of 0.02, 0.15, and 0.35, respectively, represent small, medium, and large effects of the exogenous latent variable. Effect size values lower than 0.02 indicate that there is no effect (Hair, Hult, Ringle & Sarstedt, 2016).

In the **fifth step**, Q^2 value is calculated. Q^2 value is an indicator of the model's out-of-sample predictive power or predictive relevance. When a PLS path model shows predictive relevance, it is able to accurately predict data not used in the model estimation. Specifically, Q^2 values higher than 0 indicate that the model has predictive relevance for a certain endogenous construct. On the contrary, values of 0 and below indicate a lack of predictive relevance (Hair, Hult, Ringle & Sarstedt, 2016).

The Q^2 value is calculated by applying the **blindfolding** procedure for a specified omission data point. Blindfolding is a sample reuse and iterative technique that omits

every data point in the endogenous construct's indicators and estimates the parameters with the remaining data points.

The **sixth step** evaluates the **effect size q^2**. It measures the relative impact of predictive relevance. Effect size q^2 values of 0.02, 0.15, and 0.35, respectively, indicate that an exogenous construct has a small, medium, or large predictive relevance for a certain endogenous construct (Hair, Hult, Ringle & Sarstedt, 2016).

11.7.1.5 Analysis tool for Partial Least Squares

After the evaluation of the structural model, the assessment of the PLS-SEM path model is concluded. In order to apply the PLS-SEM algorithm, ***SmartPLS 3*** software has been chosen. It is considered as the most popular software for the implementation and execution of PLS-SEM of analysis (Garson, 2016). In fact, respect to other programs with user-friendly graphical interfaces such as XLSTAT's PLSPM package, Adanco, PLS-GUI, WarpPLS. SmartPLS is the most comprehensive and advanced program in this field (Hair, Hult, Ringle & Sarstedt, 2016). Therefore, in the next chapters PLS-SEM analysis will be applied to JD-R and AMO model with the graphical interface of SmartPLS.

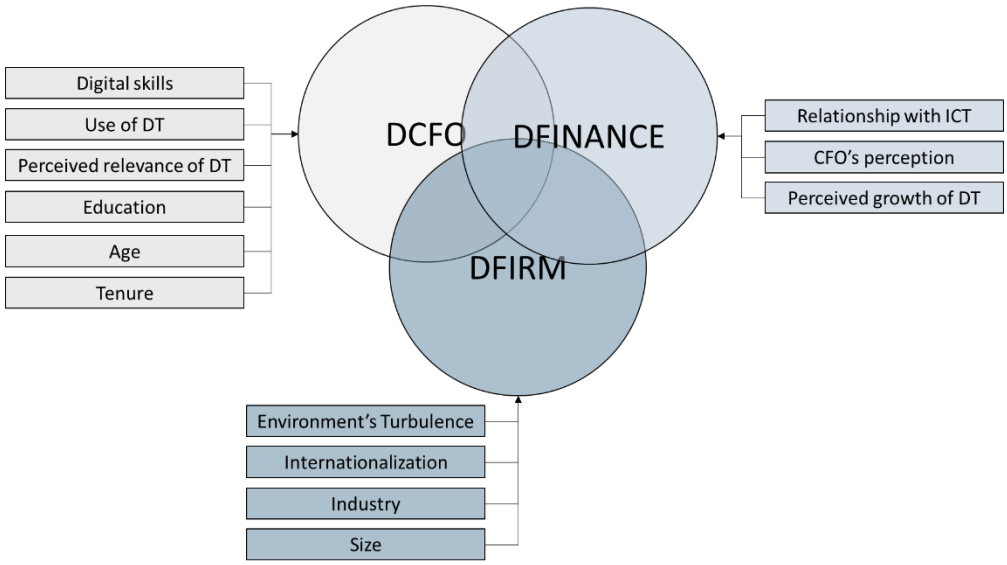
12 DESCRIPTIVE ANALYSIS

This descriptive analysis is aimed at providing a snapshot of the actual digitalization of CFOs in manufacturing and service providers organizations.

The analysis wants to assess the level of digitalization of the CFO, here defined as Digital CFO (DCFO), and the environment which surrounds him/her. The environment is composed of two elements:

- The **micro-environment** consisting of the Finance Function, the company's function lead by the CFO;
- The **macro-environment** consisting of the Firm's organization and its industry.

Picture 12-1 visualizes how the analysis has been brought forward in order to achieve a broad and holistic perspective. Thus, each of the three components will be studied by its own and in relation with the other two.



Picture 12-1: Framework of descriptive analysis

For each item few key measures have been considered. Regarding the **CFO,** a relationship between the level of education and the personal background with the level of digitalization is sought. Thus, the characteristics used are: (1) Digital skills; (2) Use of

digital technologies; (3) Perceived relevance of digital technologies; (4) Education; (5) Age; (6) Tenure.

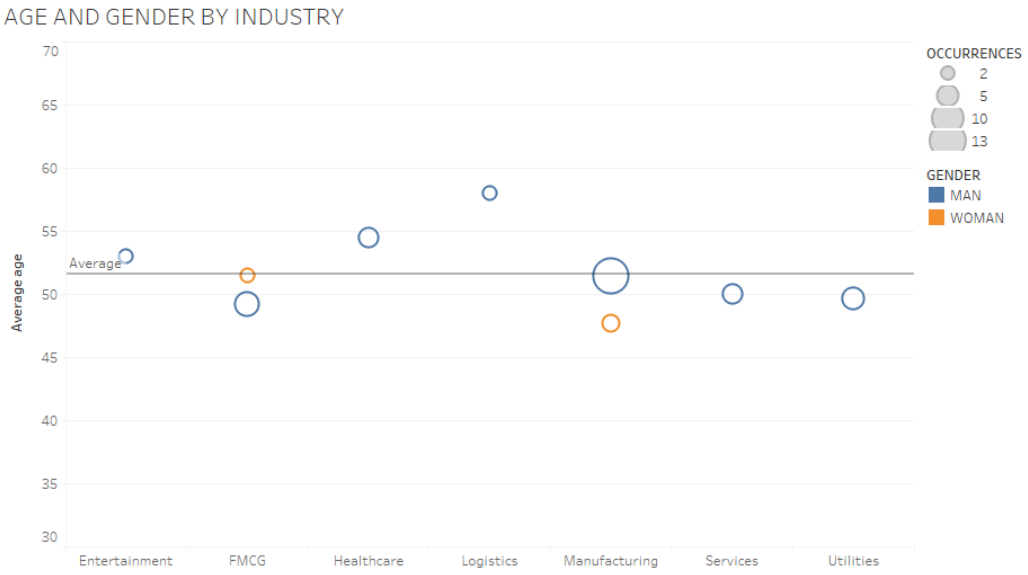
As far as the **Firm** is concerned, it is characterised by: (1) Industry's turbulence; (2) Firm's internationalization; (3) Industry of belonging; (4) Company's size.

Eventually, the level of digitalization of the **Finance Function** with two proxies: (1) The relationship with the ICT Function; (2) CFO's perception of the level of digitalization in Finance Function; (3) Perceived growth of digital technologies within the function.

This chapter will follow the logic of this framework. Initially the single components are going to be assessed independently, after that, the different measures are going to be combined to uncover possible enablers regarding CFO's digitalization.

12.1 CFO CHARACTERIZATION

The CFOs' was initially characterised according to demographic characteristics: age, gender and education. Picture 12-2 shows the relationships between age and gender with the industry of belonging.



Picture 12-2: Age and Gender of CFOs by industry

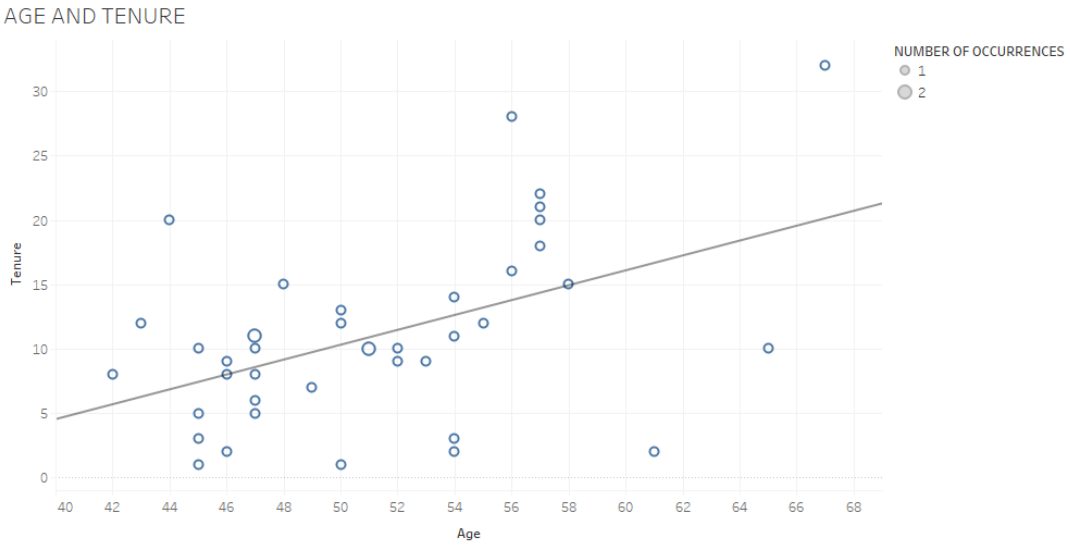
A it is possible to see, and already discussed in "Data Analysis" chapter, the average age is 51 years old and presents strong consistency among the different industries. Moreover, the graph highlights a skewed distribution of gender in CFO's professional role, just five out of forty-one participants were women.

Some relevant insight might be highlighted from the analysis of the relationship between CFO's age and tenure. **Tenure** has been defined as the number of years recipients declare to have covered CFO's roles during their professional life, despite the company where they were working in.

Indeed, oppositely to what sustained by Ehrenhalt & Ryan (2007), within the Italian industrial environment it seems that CFO tends to keep their role for long periods of time, thus, turnover might not be an impellent problem of firms operating within the industries analysed in this study.

Picture 12-3 displays this relationship through a single regression model using as causal variable CFO's tenure and as predictor CFO's age. The regression model proves a statistical relevance (p-value= 0.0019372) and a positive impact (β= 0.57792; R^2= 0,23136) of ageing in defining CFO's tenure (Table 12-1).

According to Ehrenhalt and Ryan (2007), it was fair to expect low values of tenure even in elder managers, however this is not happening, and it was identified a positive relationship between tenure and ageing and, in absolute figures, high levels of tenure of the participants (average tenure of 11 years and peaks over 25 years).



Picture 12-3: Relationship between age and tenure

Below the most relevant coefficients of the regression model are showed.

P-value:	0,0019372
R-Squared:	0,23136
Equation:	Tenure = 0,577992*Age + -18,6002

Table 12-1: Coefficients of age-tenure regression

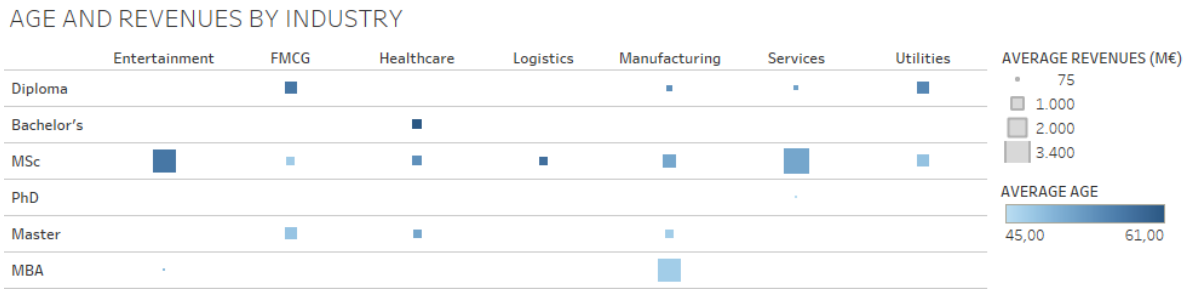
Coefficients

Term	Value	StdErr	t-value	p-value
Age	0,577992	0,173196	3,33721	0,0019372
intercept	-18,6002	8,93612	-2,08146	0,0443665

According to the current trend here uncovered and the foreseen improvement of psychophysical wellbeing due to role's digitalization demonstrated in this study, it might be expected a growing CFO's tenure in the following years.

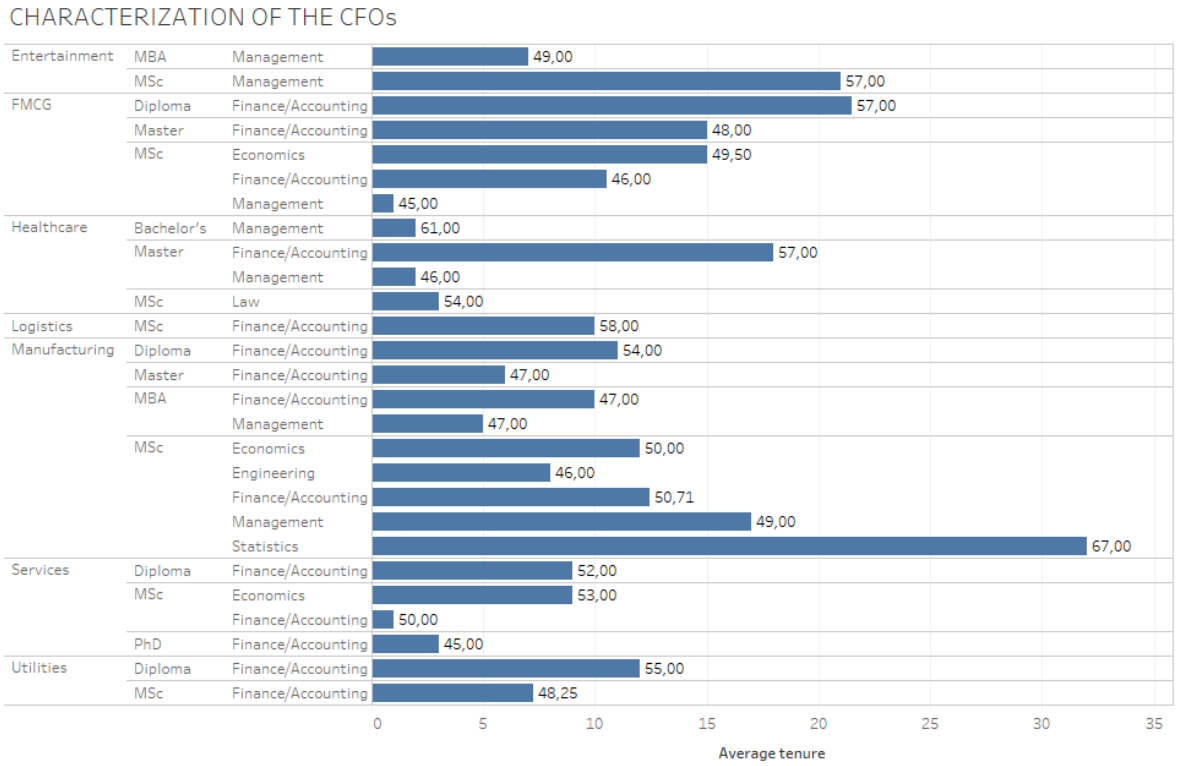
The CFOs' education has been analysed together with the company's industry and size, age and tenure. This analysis wants to seek particular trends and triggering effects of education.

Picture 12-4 compares CFOs' demographic characteristics with the firm's size and industry. From this analysis it was uncovered that large companies prefer high level education (Master of Science or MBA), while age seems not to be a relevant parameter in designating the CFO.



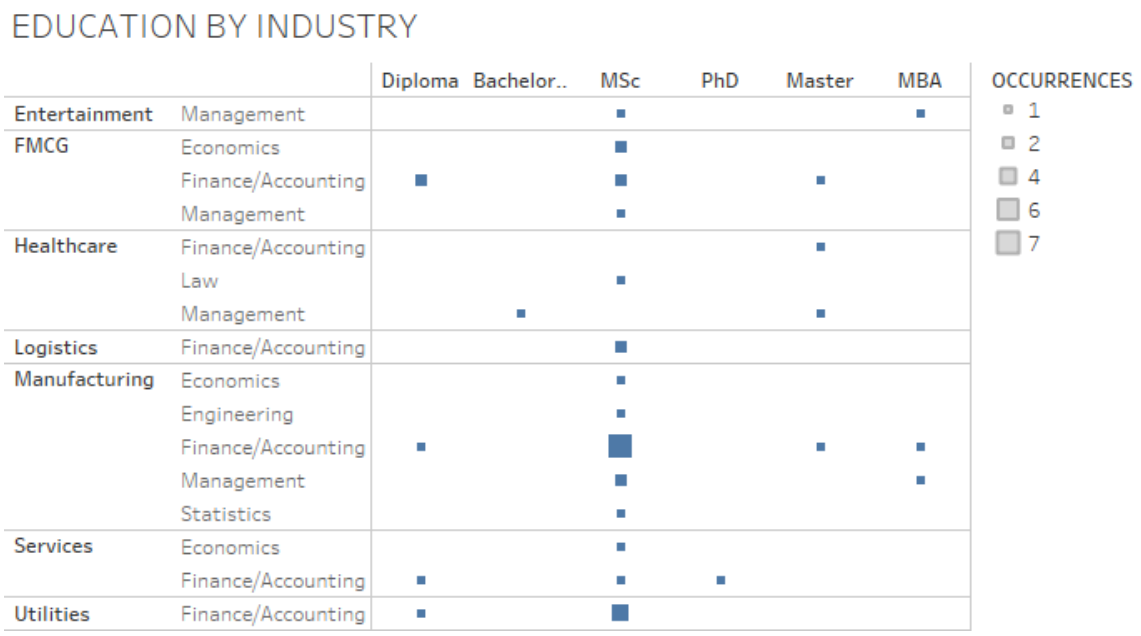
Picture 12-4: Age and revenues by industry

As shown by picture 12-5, no peculiar behaviours are identified between the level of education and the field of study with age (displayed at the end of each bar) and tenure. Hence, it indicates that there is not a specific study path leading toward successful careers in CFO's role. Indeed, CFO's performances might be the result of a highly complex system made up by inner passion and attitudes together with the environment characteristics, thus making education a non-relevant parameter in identifying successful CFO's. This clue is also sustained by Hoitash, Hoitash, and Kurt (2016).



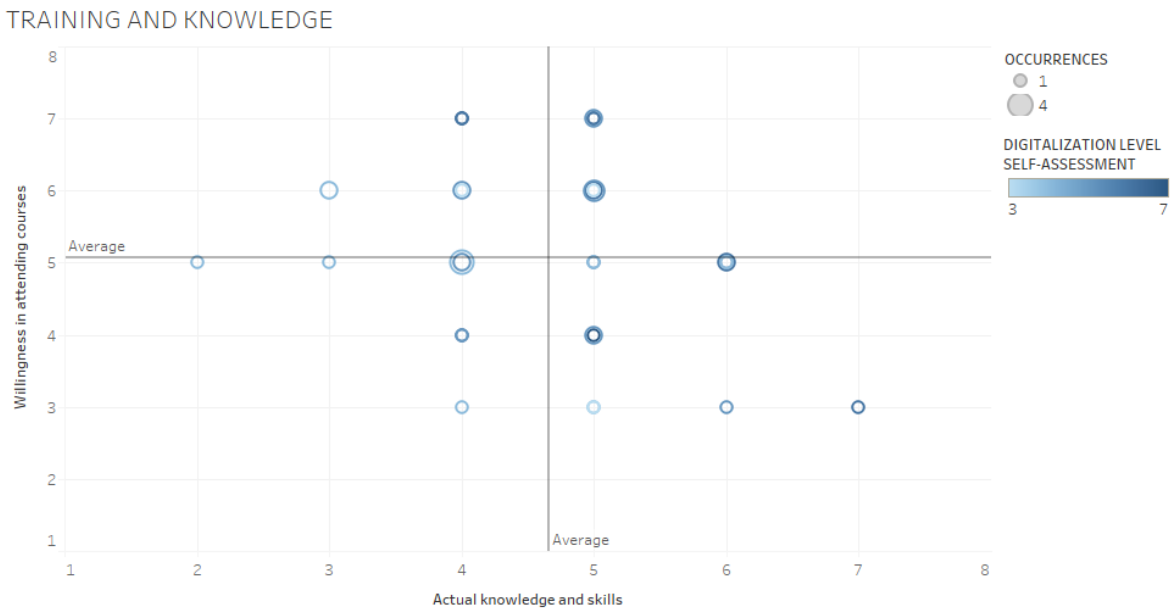
Picture 12-5: Characterization of CFOs

However, from Picture 12-5 and Picture 12-6, it is possible to highlight that Master of Science degree is the most frequent highest education level achieved by CFOs, indeed its presence can be observed almost in each industry considered in this study. Moreover, albeit no correlations are found in this study between academic path and successfulness of CFOs, Picture 12-6 undeniably highlights a strong presence of CFO's coming from Financial and Accounting background.



Picture 12-6: Education of CFOs by industry

Having discussed about CFOs' education, it is important to understand which kind of skills CFO's need to correctly couple with digitalization. Indeed, due to the changing environment and evolving technology, just the standard education path (Highschool and University) might not be sufficient to fully exploit the opportunities provided by digital technology. New skills and competences need to be developed to correctly tackle digitalization (Accenture, 2018). According to the evolution of tools and related skills, **life-long learning** is now more important than ever to stay up-to-date with the current and future digital advancements. The use of the right capabilities and tools in data processing might create more value than ever before, thus CFO's should not overlook targeted training and courses.



Picture 12-7: Training and knowledge

Picture 12-7 plots the perceived digital skills and knowledge CFOs perceive to possess in relation to the willingness in attending courses.

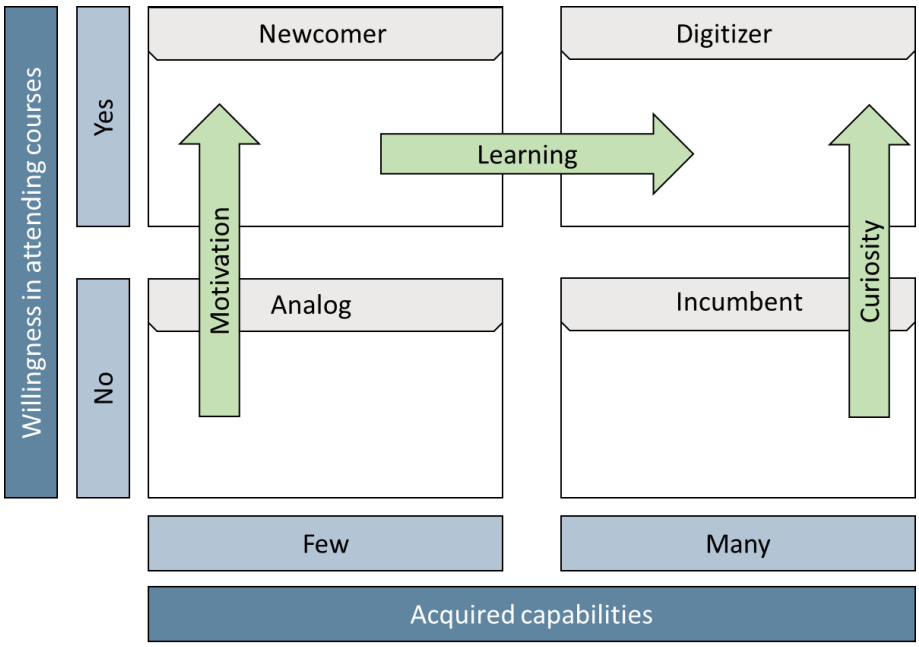
According with a successful medium-long term perspective, it is fair to assume that the best results in exploiting the new technologies will be achieved by CFO's which are at the same time not only knowledgeable but also hungry for new capabilities.

Thus, to better analyse the answers, Picture 12-8 displays a framework to correctly tackle learning of new knowledge and skills. The matrix is made up by two axes with two dimensions each: the horizontal axis represents the **acquired capabilities** CFO's possess, which can be summarised in few or many; on the other hand, the vertical axis represents the **willingness in attending courses**; the answers to this category might be gathered in a simple yes or no alternatives.

According to the axes, four classes are defined:

- **Analog**: to this class belong CFOs who do not possess advanced expertise in digital technologies and are not interest in improving their capabilities. According to this study, Analog CFO's belongs to industries and companies where digitalization is not yet perceived as a disruption.

- **Incumbent**: CFOs who do possess strong expertise in exploiting digital technologies but are not interested in acquired new capabilities to this class belong. CFOs who falls in this category might perform well in the short term but might risk becoming obsolete in the medium-long term due to the fast pace of changing.
- **Newcomer**: CFOs who do not already possess digital skills but are willed to attend courses to get up-to-date with the new technologies and trends to this class belong. This CFOs start from a position of reduced competitive advantage respect to their peers who possess more digital capabilities. According to this study, these CFOs recognize the severity of the on-going change and are motivated in not to be overcome by the events.
- **Digitizer**: CFOs who do possess capabilities and who are motivated in learning new skills to this class belong. Digitizer possess the right attitude to correctly tackle digital disruption in finance and according to the authors defines the pure essence of a *digital CFO.*



Picture 12-8: Training-Capabilities matrix

It is suggested to CFOs to not overlook not just the opportunities but also the threats coming from the digital disruption. Indeed, it is far from being just a seasonal trend but promises to change the way companies do business.

CFOs should understand which quadrant of the matrix they might cover in order to plan corrective actions. For instance, a CFO who found him/herself in *Analog* quadrant should understand why he/she is not willed to attend courses and if this attitude is the result of a careful evaluation of the actual and future role or if it is driven by inertia. Obviously, the latter require corrective actions and through a motivational process the CFO might move to *Newcomer's* group. As proved by AMO analysis (described in upcoming chapters) motivation might be triggered by a careful evaluation of the external environment or by opportunities provided by the organization. From here, through exploration activities (i.e. courses) and involvement of experts, it is possible to achieve the *Digitizer* class, where the value of data can be fully expressed.

On the other hand, *Incumbents* should not be satisfied in just exploiting the actual capabilities they possess. Indeed, new knowledge and tools are developed every day and the risk of becoming *Analog,* thus reducing the opportunity of creating value from the data, rises. An *Incumbent* CFO should always be permeated by curiosity in learning and get up-to-date with the digital technologies.

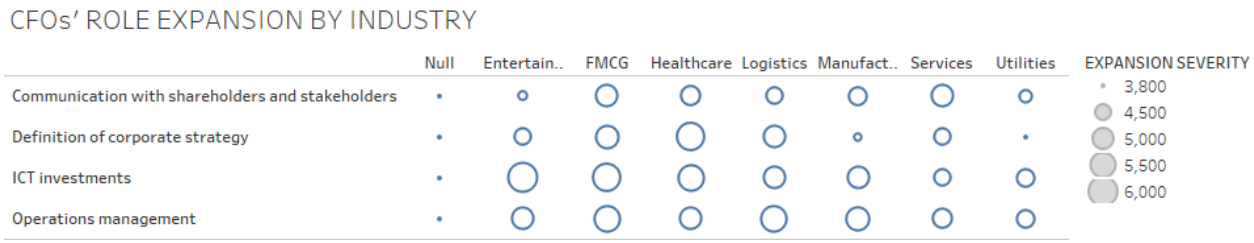
Now, it is possible to analyse Picture 12-7 more effectively. Drawing the average level of skills and willingness in attending courses, it is possible to visualize a first benchmark to categorize the respondents. According to Picture 12-7 just few respondents fall in *Analog* class. The majority of the sample is found in *Newcomer* class, they recognize the relevance connected to digital tools, but maybe because of the difficult application of some of them or the novelty (e.g. Artificial Intelligence), they do not feel comfortable in managing digital tools.

Eventually, almost 40% of the sample is identified as a *digitizer* with good perspective of growth thanks to the use of digital technologies.

Moreover, focusing on the self-perception of digitalization, CFOs tend to correctly understand their positioning within the matrix, clarifying that usually CFOs are aware about their digital state. This implies that the digitalization issue was not overlooked.

In order to remove subjectivity in evaluation, it was asked to CFOs a self-evaluation, in a range from one to seven (1 – Not at all; 7 – absolutely), how much the Digital CFO definition mirrors him/her. The key characteristics were identified in the use of digital technology in strategical and operative tasks run in the Function and the proactive role in digitalising the business.

It is interesting to notice that the respondents hold very high concerns regarding digital skills and training. Indeed, the evaluation scale is one to seven for both axes and no observation fall under a rate of 3 and 4 respectively for willingness in attending courses and actual knowledge and skills. This consideration unveils a population of CFOs that is already devoted to the use of digital technologies.



Picture 12-9: Expansion of CFO's role

CFO's role itself will not remain still to the disruption brought by digital technologies. Albeit CFO role has always been subjected to evolutions and expansions since it born at the beginning of the 20th century, the advent of digital technologies will deeply impact on this professional role.

This evolution has been repletely proven by several authors (Decker & Sinnett, 2013; Favaro, 2001; Howell, 2006) and this research confirms the literature results. Picture 12-9 shows how much CFO's role is expanding toward non-financial tasks differentiated by industries. The expansion has been measured in a range from one (negligible) to seven (substantial).

All the industries identified are experiencing an expansion of the role, which can be smooth, as the definition in corporate strategy in Utility industry, to substantial, as ICT investments in FMCG industry.

FMCG, Healthcare and Logistics seem to be the most hit industries and ICT investments and Operations Management are the most common areas of expansions.

The role expansion increases the severity of the ongoing changing, adding new tasks and responsibility to the use of new and complex tools. This might bring CFOs toward an unbearable condition characterised by high level of stress and low motivation which might make an implosion of the role itself. For these reasons, the next chapter will be focused in analysing if is this going to happen or not.

12.2 Finance Function characterization

The Finance Function is the firm's Function traditionally lead by CFO. Consistently with the worldwide and managerial digitalization trend, arguably this function will be subjected to a digital evolution (Accenture, 2018). In the actual context, Finance Function might play the promoter, the follower or the hindrance role in the on-going changing.

In this section, through the use of relevant proxies (relationships with ICT; judgement of CFO), it is sought the role played by the sample's Finance Function in CFO's digitalization.

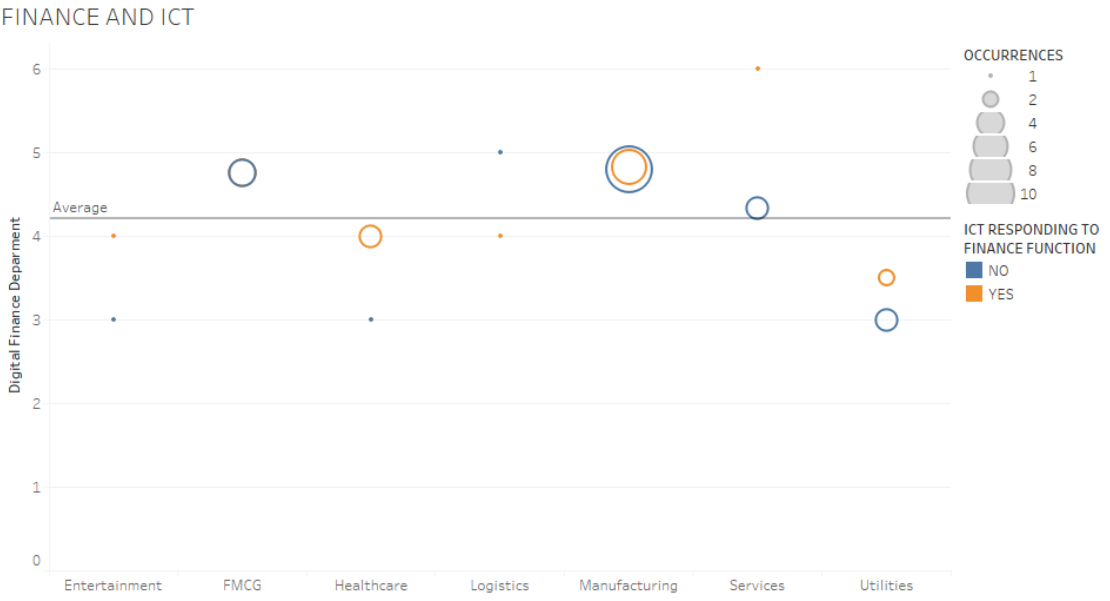
Before starting analysing the graphs, an explanation of the metrics used it is necessary to fully understand the data.

As regard the **relationship with ICT**, it is reported if the ICT Function directly responds to Finance Function. Being Finance the company's function that makes the most use of data and informative processes, it should play a forefront role in defining digital strategy and digital investments.

Another element to consider is the **perception CFOs** have about the level of digitalization of the function. According to the consistent results obtained from the analysis of CFOs' digitalization and their self-perception, it is possible to argue that the declared level of digitalization of the function might be close to the reality. Thus, this

metric will be considered as primary in classifying digital and non-digital Finance Functions.

In order to remove subjectivity in evaluation, it was asked to CFOs to evaluate, in a range from one to seven (1 – Not at all; 7 – absolutely), how much the Digital Finance Function definition mirrors his/her finance function. The key characteristics were identified in the use of digital technology in strategical and operative tasks run in the Function.

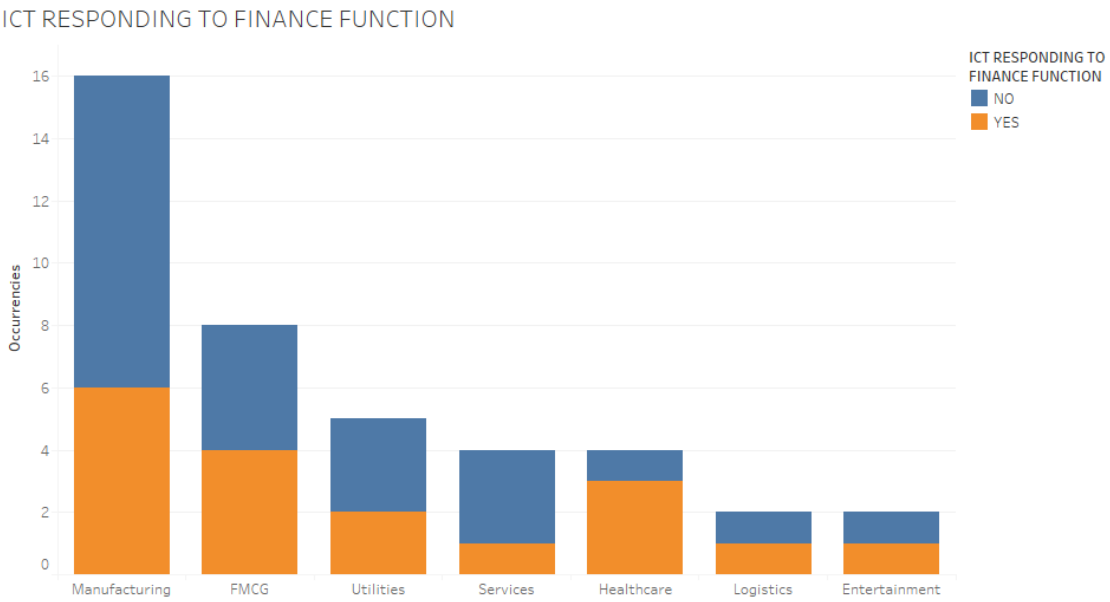


Picture 12-10: Characteristics of Digital Finance

Picture 12-10 shows the first two relevant characteristics of a Digital Finance Function: **relationship with ICT** and **CFO's perception**. According to the data 46% of the sample has a Finance department over the average level. Although the data are highly consistent across the industry (σ=1.248), enhancing a uniformity of the digital level of finance departments within Italian industrial fixture.

It is interesting to notice that there is almost a perfect balancing of ICT function responding to Finance beneath (6 observations) and over (7 observation) the average line. This leads the idea that in reality the direct control of Finance over ICT is not a driver for the function digitalization. Picture 12-11 displays the absolute level of ICT-Finance

relationships. It is worth observing that the distribution of the option is similar for every industry but healthcare where 75% of Finance functions are controlling ICT functions.



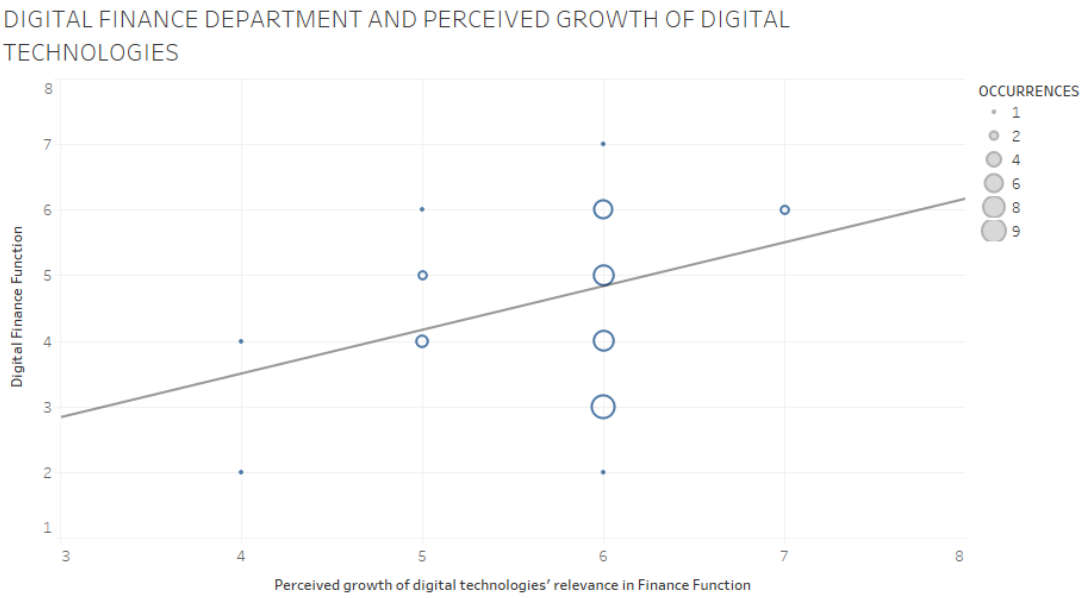
Picture 12-11: Relationship between Finance and ICT

Another key metric considered is the perceived growth of digital technologies within the function. The perceived growth was measured through a direct question and ranged in a scale from one to seven.

The results have been plotted in Picture 12-12 and analysed through a single regression model. According to the model no statistically valid relationship has been extracted between perception of digital function and perceived growth of digital technology (p-value= 0.2345) (Table 12-2).

The main analytical reason can be found in the low variability in perception of growth (σ=0.6) which does not meet the higher variation brought by the perception of digital function.

It is possible to argue that while there is a common agreement that digital technology will disrupt Finance Function, the function itself does not adapt yet to the imminent changing



Picture 12-12: Digital Finance and Growth of Digital Technologies

P-value:	0,234585
Equation:	Digital Finance Function= 0,666667* Perceived growth of digital technology in Finance Function + 0,833333
R-Squared:	0,137931

Table 12-2: Coefficients of Digital Finance and Growth of digital technologies regression

.

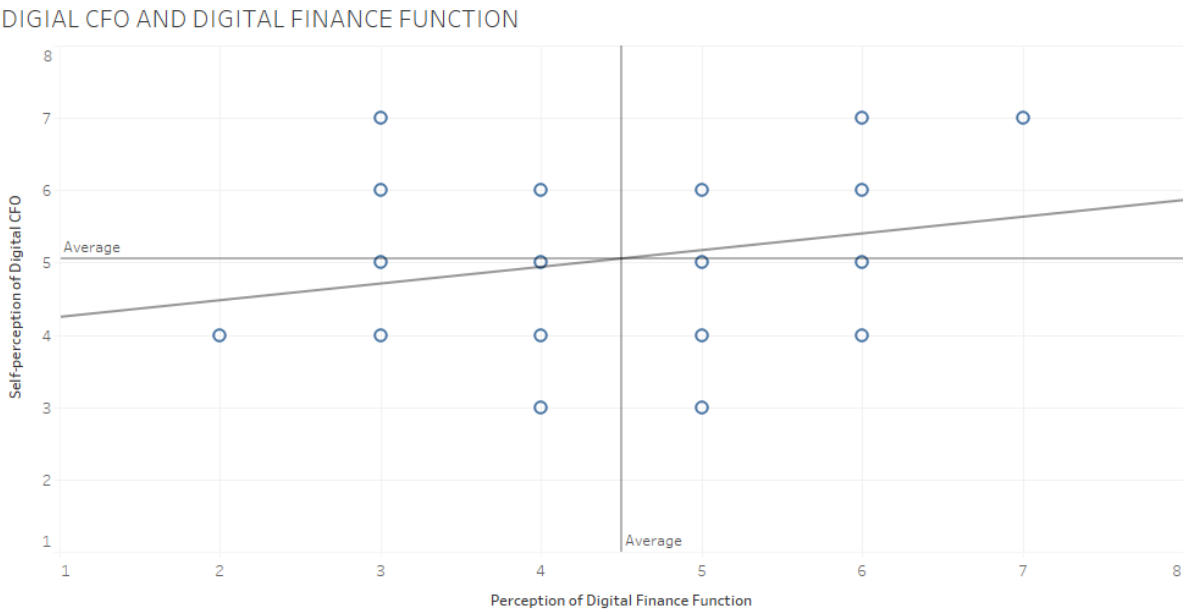
Coefficients

Term	Value	StdErr	t-value	p-value
Perceived growth of digital technology in Finance Function	0,666667	0,527046	1,26491	0,234585
intercept	0,833333	2,93447	0,283981	0,782218

To conclude the analysis, the relationship between self-assessment and perception of Digital Finance Function has been analysed (Picture 12-13). Firstly, on average the perception CFOs have on their situation is higher (+10%) respect to their judgement on the finance function.

Moreover, according to the results obtained from the single regression model, there is no significant relationships between the perception of Digital CFO and Digital Finance Function (p-value=0.3281) (Table 12-3).

It is possible to conclude that the two entities might be considered as independent and a Digital CFO might coexist where digital technologies are not fully exploited. This result confirms what discovered through AMO model, thus the major determinants in CFO's digitalization is not the opportunity provided by the environment but the inner motivation pulling for a change.



Picture 12-13: Digital CFO and Digital Finance Function

P-value:	0,328105
Equation:	Self-perception of Digital CFO = 0,230769* Perception of Digital Finance Function + 4,01709
R-Squared:	0,0597962

Table 12-3: Coefficients of Digital CFO and Digital Finance Function regression

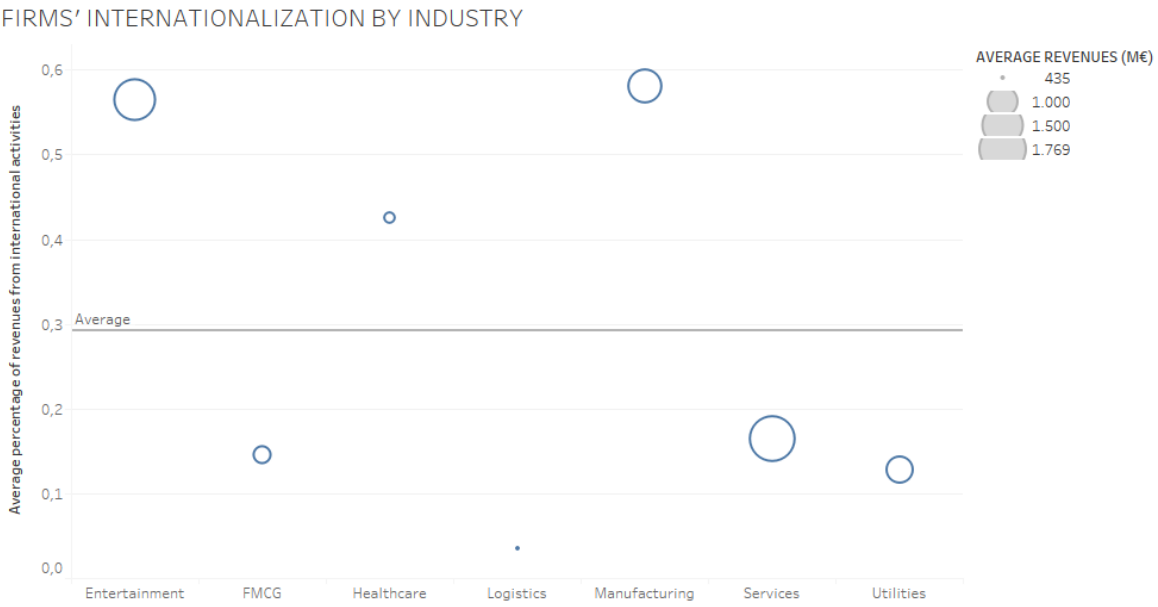
Coefficients

Term	Value	StdErr	t-value	p-value
Perception of Digital Finance Function	0,230769	0,228766	1,00876	0,328105
intercept	4,01709	1,07436	3,73905	0,0017886

12.3 FIRM CHARACTERIZATION

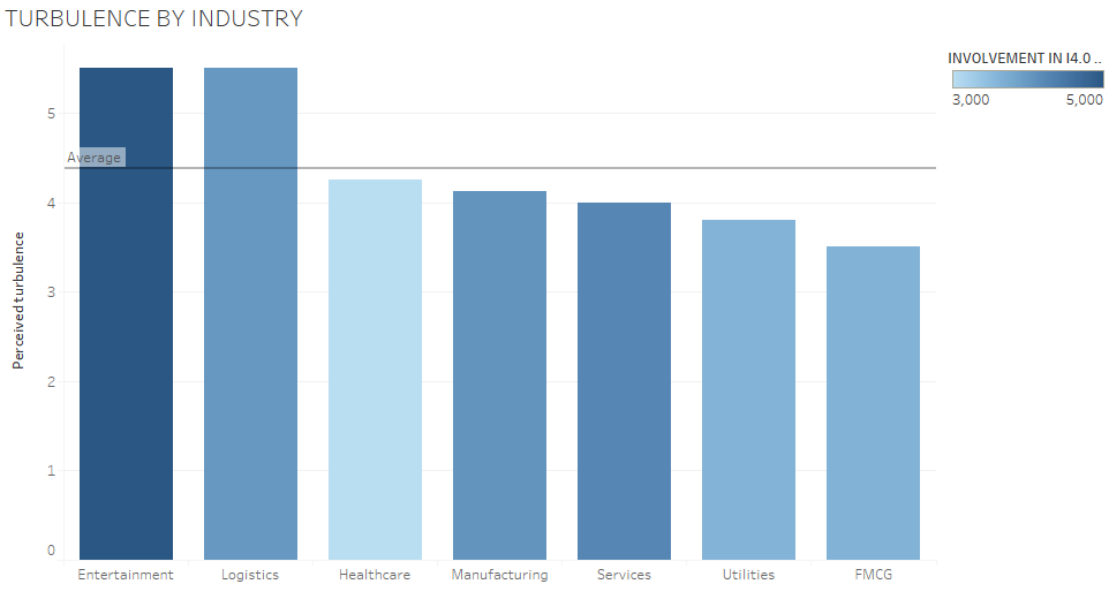
Similarly to CFOs characterization, also the firms are going to be analysed according to the key demographic variables: (1) Size; (2) Internationalization; (3) Turbulence of the industry; (4) Digitalization of the firm.

According to Picture 12-14, the sample presents strong dispersion among industries from both sizes and internationalization, with ranges respectively from 435M€ to 1769M€ and from 11% to almost 60% of the revenues coming from international activities. The picture seems to be representative of the highly heterogeneous Italian industrial environment.



Picture 12-14: Firm's internationalization by industry

It is interesting to analyse the level of industry's turbulence perceived by CFOs. Picture 12-15 shows the level of perceived turbulence by industry in a scale from one to seven. It is possible to notice that Entertainment and Logistic industries cover the first two position of perceived turbulence and they are the only two industries overcoming the average level, which is assessed on a level of 4.4. It is interesting to notice that some industries, such as Fast Mover Consumer Goods and Utilities are not felt as turbulent respect to the digital environment.

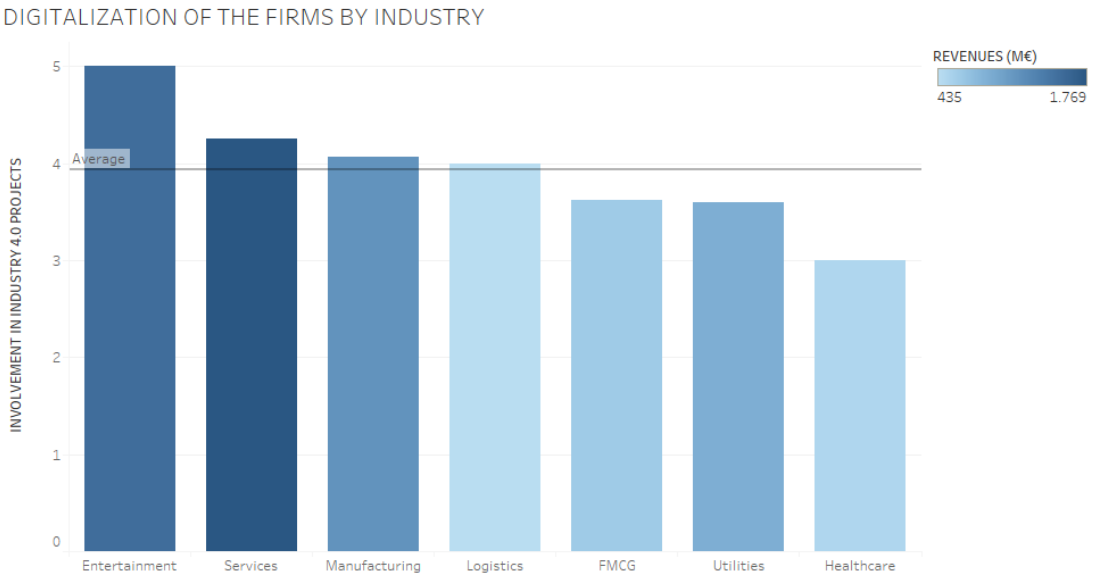


Picture 12-15: Level of perceived turbulence by industry

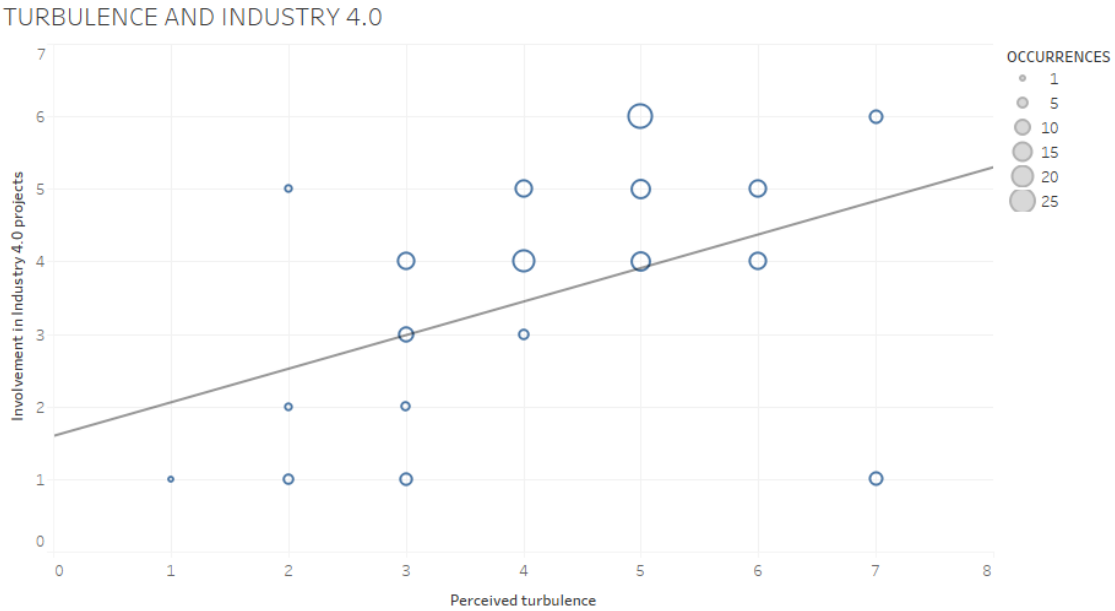
This consideration might surprise the reader as it surprised the authors. Indeed, Utilities and FMCG represent sectors where tools, as Artificial Intelligence, may create strong value, predicting failures and variation in customers' demand. One reason which might lead toward this result can be the anticipated, and already absorbed, shock brought by the introduction of digital technologies. Indeed, they might have already applied and get use to digital technologies, lowering the perspective of turbulence. However, the study of the reasons of industries' evolution due to digital technology is wide and complex, thus it is not deepened anymore in this study and it is left to other researches the thorough analysis of this topic.

It is interesting to notice the relationship between the perceived turbulence of the industry with the involvement of the company in Industry 4.0 projects. Picture 12-17 highlights a statistically significant relationship between the perceived turbulence and the involvement in Industry 4.0 projects ($p= 0.0491712$; $\beta=0.462963$; $R^2= 0,220692$) (table 12-4). Moreover, from Picture 12-16 it is possible to notice that usually very large companies are mostly concerned about the environment and the adoption of the latest technology and business paradigms.

From the shade of colour of bar chart in Picture 12-16, the companies within the three out of four industries more involved in Industry 4.0 projects are on average larger than the ones which are not implementing Industry 4.0 paradigm.



Picture 12-16: Digitalization of the firms



Picture 12-17: Industry 4.0 and turbulence perceived

P-value:	0,0491712
Equation:	Involvement in Industry 4.0 projects = 0,462963*Perceived Turbulence + 1,59259
R-Squared:	0,220692

Table 12-4: Coefficients of Industry 4.0 and turbulence perceived regression

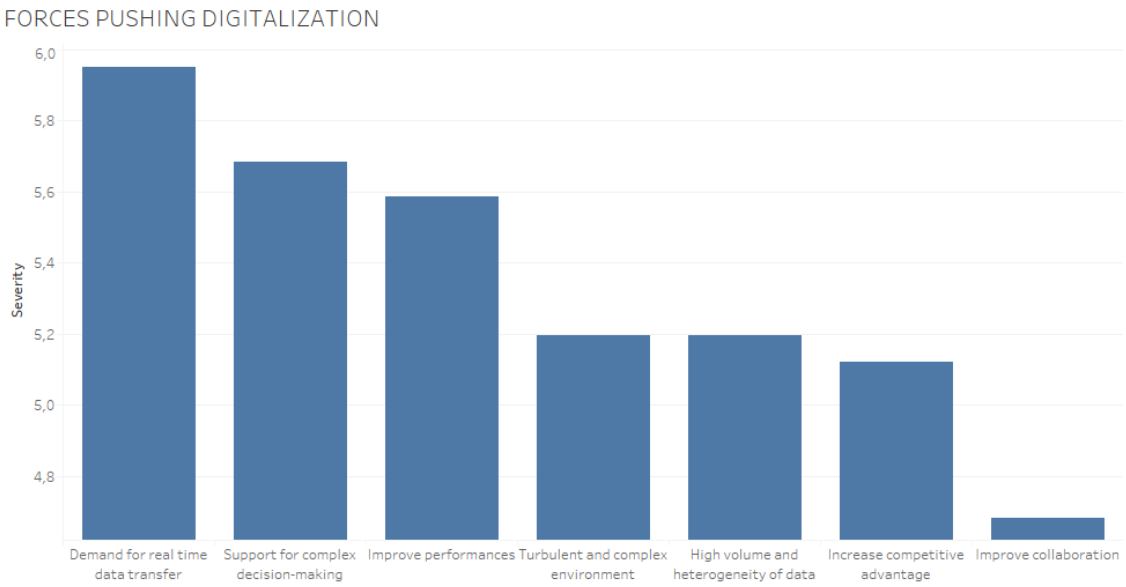
Coefficients

Term	Value	StdErr	t-value	p-value
Perceived turbulence	0,462963	0,217494	2,12862	0,0491712
intercept	1,59259	0,948035	1,67989	0,112396

As regard the relationship between involvement in industry 4.0 projects and the perceived turbulence, a single regression model has been built to test the hypothesis of statistical positive relevance which is eventually accepted. According to the result of the regression, perceiving turbulence of the environment pull toward the involvement in Industry 4.0 project. Industry 4.0. creates an environment made by virtual and real context through the use of digitalization which helps in managing complex and turbulent environments (Xu, Xu & Li, 2018).

This regression brings along an important insight. The external environment is one of the key elements (β=0.4629) determining the implementation of Industry 4.0 paradigm. A C-level executive too focused on internal processes might underestimate the real need for new technology, creating a risk of lost in competitive advantage of the firm.

Thus, a question spontaneously arises: “which are the key external forces pushing digitalization?”. According to the sample used in this study, the main force is given by the demand for real time feedback and data transfer. Following, it is possible to find, in decreasing order of relevance: request for a more effective support for decision-making process; the request for performance improvement; coupling with a complex environment; improvement of competitive advantage; and improving collaboration and partnerships (Picture 12-18).



Picture 12-18: Forces pushing digitalization

12.4 DIGITAL TECHNOLOGIES

Once assessed the different entities involved in the digitalization process, it is possible to analyse the use of digital technology. To do so, different perspectives are going to be used. Firstly, the diffusion and intensity of use of the digital technologies in the different industries is going to be analysed; after that, the exploitation of digital technologies throughout the Information Management Process will be described; eventually some data regarding the impact of digital technologies on CFO is going to be provided.

Once again, before starting analysing the graph, the explanation of the metrics and concepts used is required.

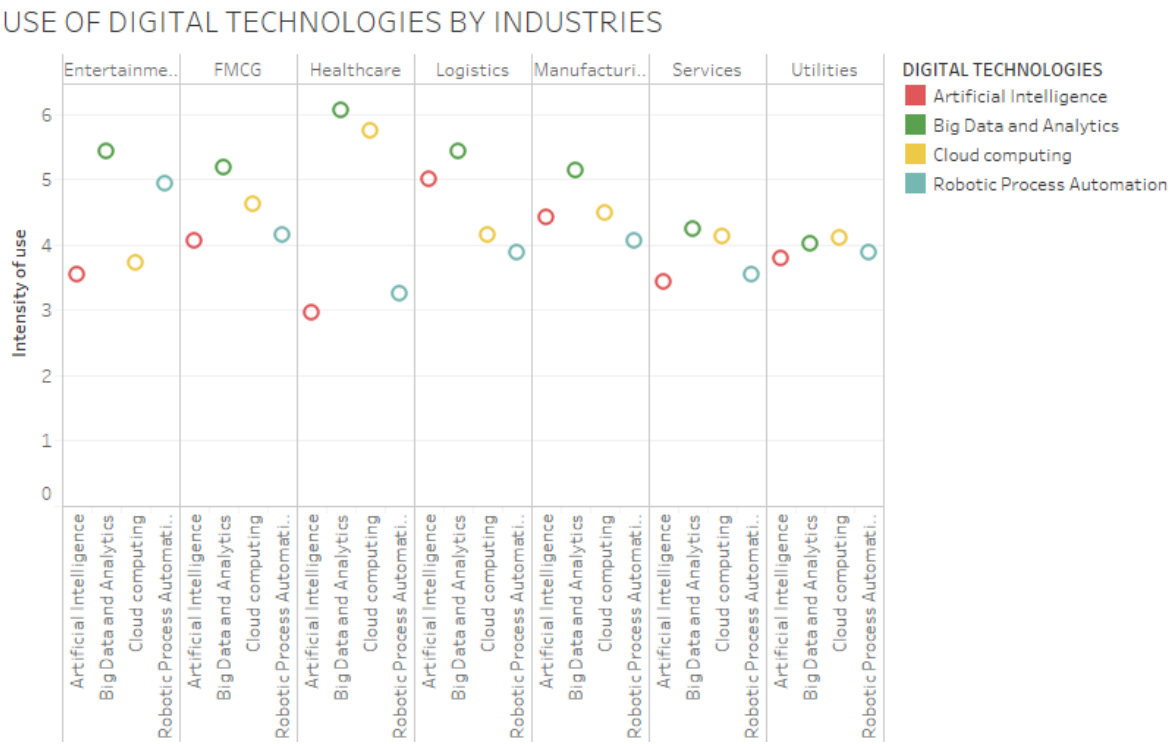
The **intensity of use of the digital technology** is a compound indicator measured in a scale from one (no use) to seven (essential). The indicator is computed as the simple average of the use of the specific technology (i.e. Cloud Computing; Big Data and Analytics; Artificial Intelligence; Robotics Process Automation) in CFO's everyday tasks (Auditing; Budgeting; Communication; Control; Cost Analysis; Decision-making support; Forecasting; Risk Analysis; Sensitivity Analysis). This value is considered as fairly representative of the relevance of digital technologies to CFO.

Together with digital technology also **data sources** (Customers; Competitors; Mass Media; Operations; Partners; Social Media; Stock Market) will be exploited enhancing the use of social media.

The **Information Management Process** is a framework used to understand and optimise the information flows from the data sources to the creation of knowledge (Ogiela, 2015). Following this approach proposed by Ogiela (2015), is useful to adopt a holistic perspective in studying the application of digital technologies. The information management process has been described in the developing the AMO model. Here, the same concept is going to be applied (Data collection; Data analysis; Data usage; Data storage).

In order to achieve the digitalization of the role, it is paramount to master the use of digital tool throughout the whole Information Management Process.

Once defined the key concept used to develop the analysis, it is possible to go through the study.



Picture 12-19: Use of digital technologies by industry

Picture 12-19 shows the intensity of use of digital technologies among the different industries. It is possible to notice that the use of digital technologies is not homogeneous across industries and within the same industry the level of use of each technology is not always consistent.

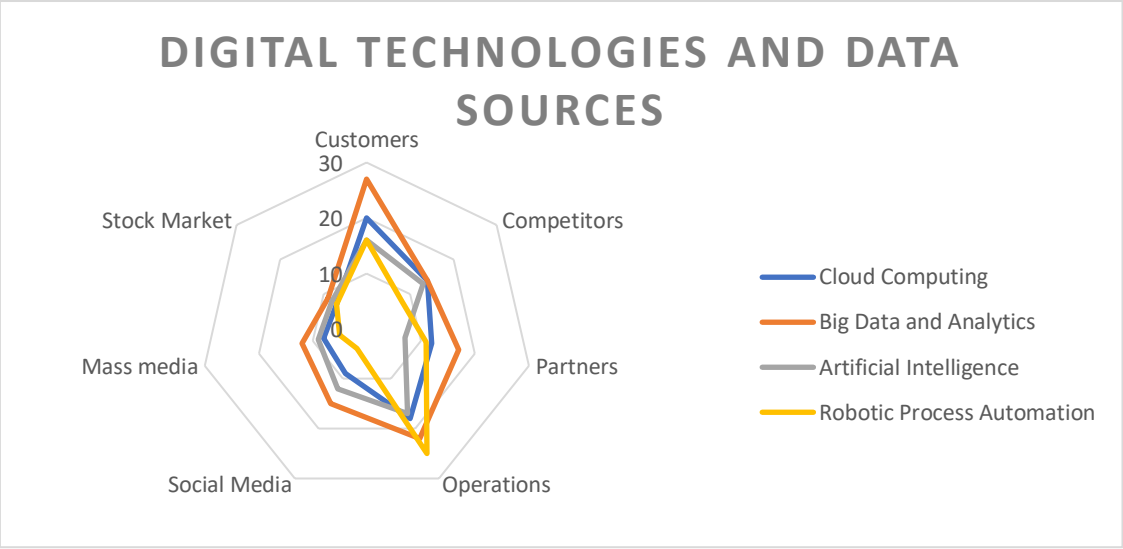
Generally, **Big Data and Analytics** seems to rule the digital technologies and it is classified as the most used technology in six out of seven industries considered. Immediately after Big Data and Analytics, it is found **Cloud Computing** which is considered as the second tool by intensity of use in FMCG, Healthcare and manufacturing. As regard **Artificial Intelligence**, it appears to not be a highly used technology and in four industries it covers the lowest position according to intensity of use criteria. **Robotics Process Automation** is found between the third and fourth position.

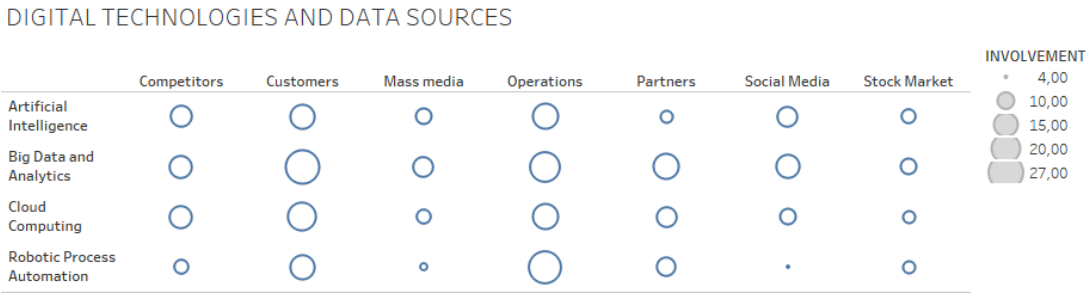
Utilities seems to be the industry where digital technologies are used most consistently among each other and lays on values around four. On the other hand, Healthcare presents a highly heterogenous use characterised by a strong exploitation of Big Data and Analytics; while Artificial Intelligence seems almost unexploited.

This variety in use and in diffusion among industries highlights a lack in standard approach in using digital technologies in managing Financial activities.

Moreover, having a non-uniform use of digital technologies does not allow the full exploitation of the advantage brought by digital technologies. Indeed, Big Data and Analytics helps in managing huge volumes of data from storing to processing and requires the Cloud Computing infrastructure to achieve full accessibility to data and enhanced computational power. Moreover, the use of Artificial Intelligence makes sense of the information available thanks to Big Data and helps in elaborating enlightening insights from the datasets. Furthermore, the use of Robotics process automation makes efficient the elaboration of routinized data (Chang & Wills, 2016; Jarrahi, 2018; O'Keeffe, 2017).

Just through a holistic, consistent and harmonic use of this tools it is possible to achieve strong value creation from information management.





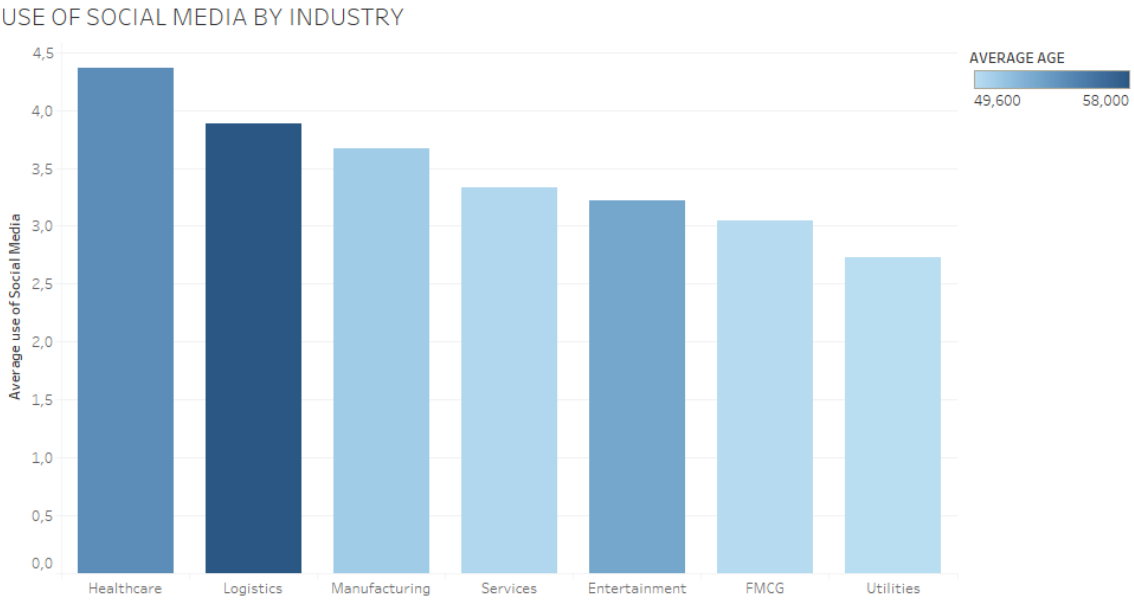
Picture 12-20: Digital technologies and data sources

Picture 12-20 shows the relationship between technology used and data sources. Data from **customers** and internal **operations** are the most exploited through digital technologies. It is interesting to notice that usually these data are the most voluminous. Indeed, Industry 4.0 creates data in the order of exabyte while the data transmitted by customers usually are around terabyte.

Data from **competitors** and **partners** occur immediately after and present some differences. Data from competitors usually are less exploited by Robotics Process Automation, probably due to their non-standardised nature. On the other hand, data from partners are not well exploited by Artificial Intelligence. This might be due to the types of data managed which are mainly standardised and structured, thus not requiring the complexity introduced by Artificial Intelligence.

Eventually, data from **mass media**, **social media** and **stock market** are the less used. They present similar patterns and their use is mainly linked to technologies able

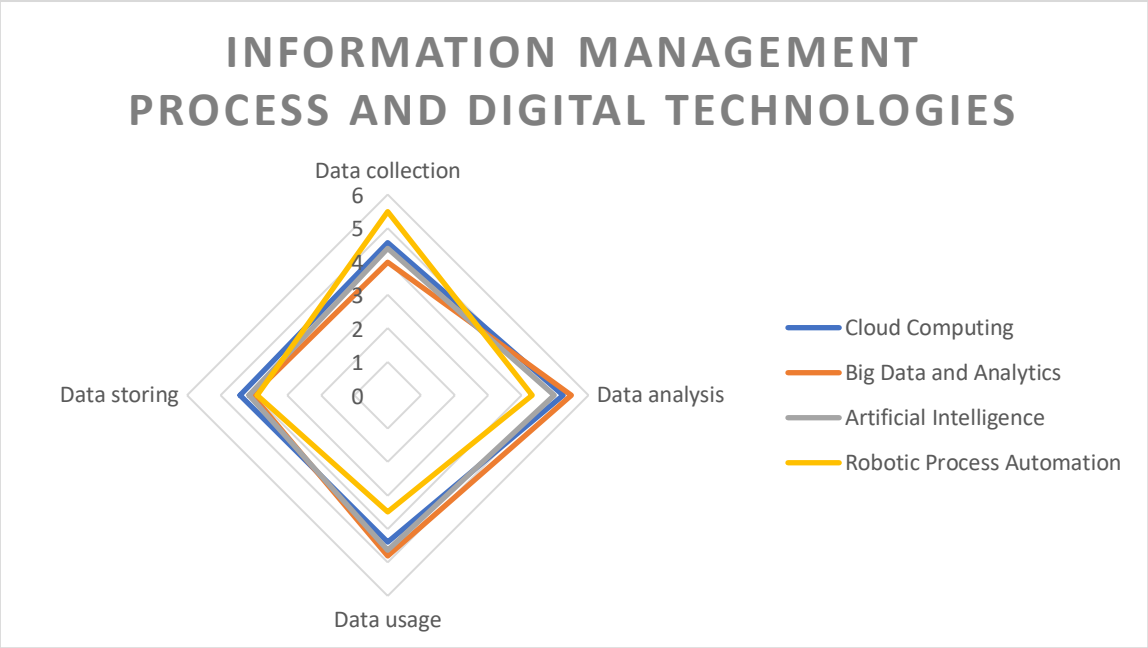
to process unstructured and complex information: Artificial Intelligence and Big Data and Analytics.

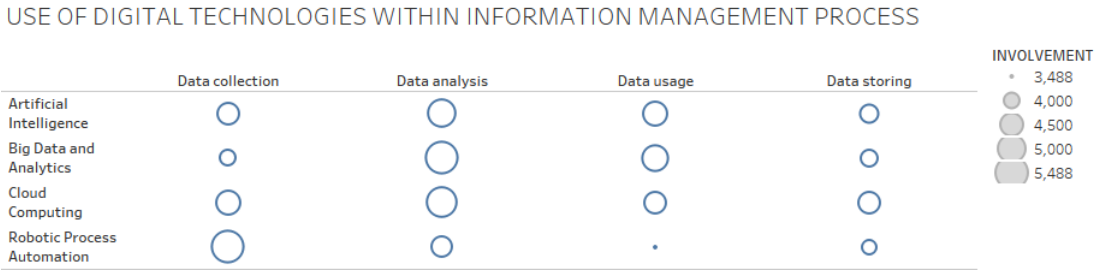


Picture 12-21: Use of social media by industry

Some more comments might be done regarding the use of the latest data sources: Social Media. Social Media are an amazing source of data for businesses. However, to the best of our knowledge, the use of these data within the Finance Function seem to be not clear and it is limited to sensitivity analysis and forecasting. However, their use might be underestimated, and a relevant growth might occur when digital technologies and new methodology eventually will be established.

In Picture 12-21, the connection between the perceived relevance of data from Social Media in relation to the age of CFO is shown. Surprisingly, elderly CFO seems to perceive higher values from these data respect to the younger ones. However, this conclusion is not strong enough due to the small sample used in this study, thus the relationship might be random, and the actual reason of perceived relevance of Social Media might be actually driven by other elements not considered in this study.





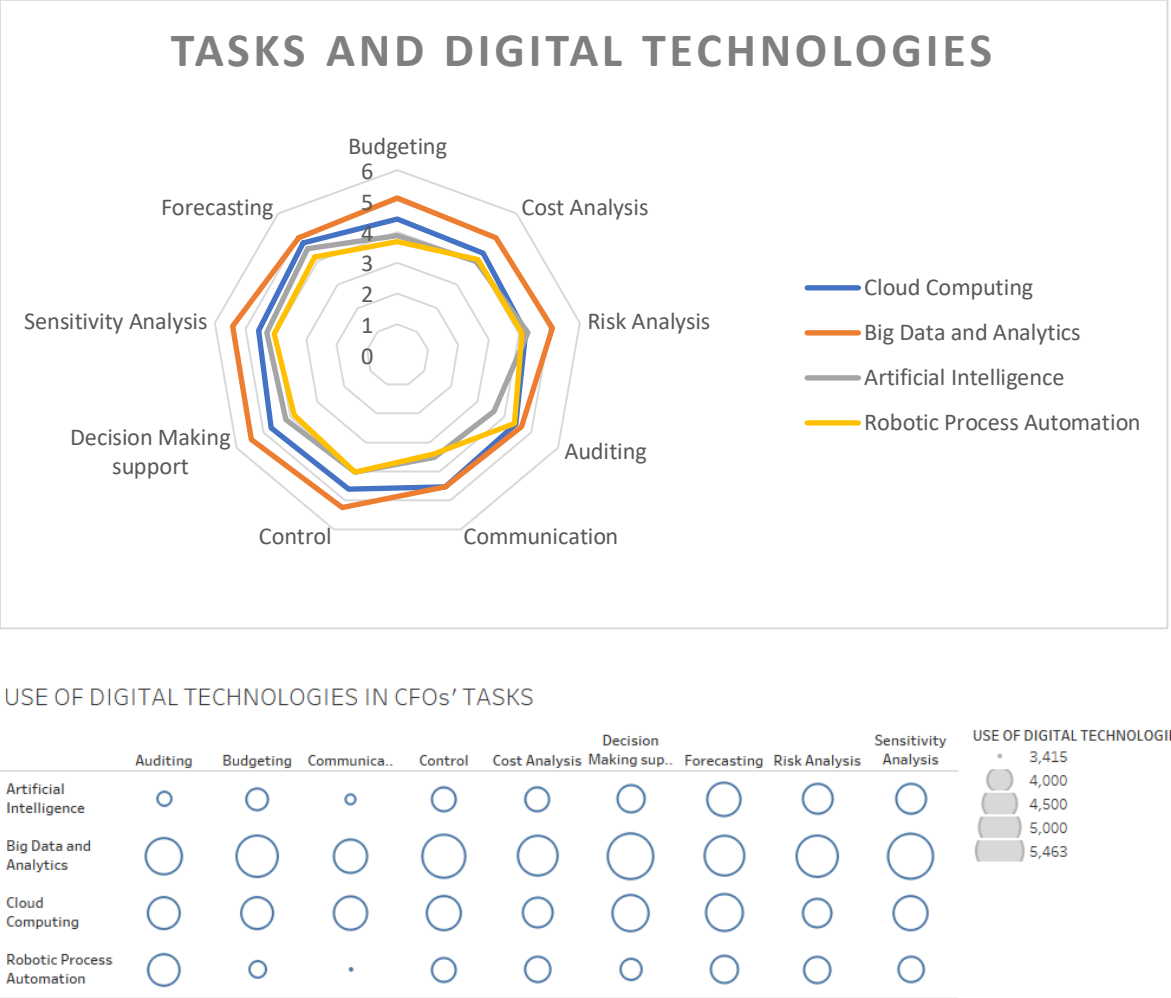
Picture 12-22: Use of digital technologies within the Information Management Process

The analysis of technology used coupled with the Information Management Process reveals some relevant insights (Picture 12-22). As expected, **Data Analysis** is the stage where technologies are used the most. **Data Storing** presents the lowest use of digital tool and, as foreseeable, Cloud Computing is the most relevance technology at this stage.

Data usage presents some consistent trends, indeed technologies aimed at analysing and extracting insights from data and Cloud Computing to share and discuss results are the most used technologies. In Data Usage, there is a limited usage of Robotics Process automation, which instead has key roles in **Data Collection** and Data Analysis.

The forefront role played by RPA in Data Collection and Data Analysis is justified by the seek for efficiency in highly standardised and structured processes which might be these two stages.

Interestingly enough, an unexpected result came out from Artificial Intelligence use in Data Collection. Indeed, the authors did not foresee a relevant use of this technology within this stage. The use might be led by necessity of collecting information from unstructured data coming from a multitude of sources (e.g. social media and mass media). It is suggested to bring forward further studies to better understand the involvement of technologies in the different section of information management process.



Picture 12-23: Use of digital technologies in CFO's tasks

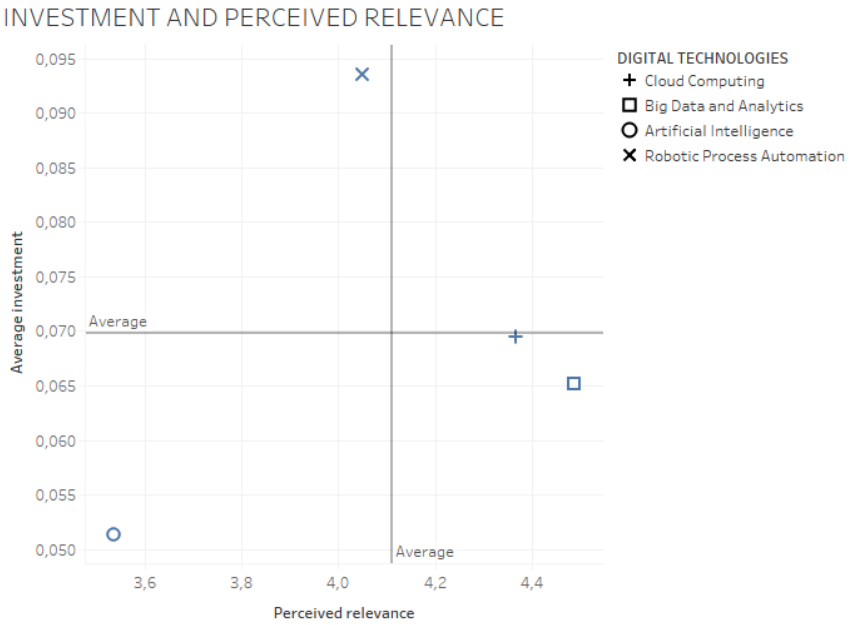
The analysis of CFO's task is focused on the activities involved in Data Analysis and Data Usage stages of the Information Management Process previously explained.

As far as the CFO's tasks are concerned, the use of digital technology presents some notable insights (Picture 12-23). **Big Data and Analytics** is the most exploited technology characterised by strong use in each activity. **Cloud Computing** comes immediately after and presents an even use among the different activities as well.

As regard **Artificial Intelligence**, its application seems connected to complex issues mostly about prediction of future events; thus, Decision Making support, Forecasting, Risk Analysis; and Sensitivity Analysis. These tasks are characterised by strong quantitative analysis of many data sources which require objectivity and analytical skills. Due to this, Artificial Intelligence seems to be a suitable tool to support CFO.

Eventually, once again, **Robotics Process Automation** is mainly used in routinized activities such as Auditing, Control, Cost Analysis and Forecasting.

The picture provided clearly shows how much the relevance of these digital technologies is arising and it is going to grow up for several years coming. For this reason, it is suggested to CFOs who do not apply yet digital tools to carefully plan investments and thoroughly defines the future company's digitalization process.



Picture 12-24: Investments and perceived relevance

Now that the relevance and application of digital technologies have been discussed, one last step is required to assess the big picture of Digital Technology and CFOs: investments. Investments, together with training, might be considered as the key indicator when discussing about future of company's resources. Investments imply real and concrete actions based upon clear perspectives about the future.

Picture 12-24 shows the average investments planned in the four digital technologies. The average investment is computed as the incremental or decremental average percentual investment respect to the previous year regarding the digital technology discussed. On the other axis, Perceived relevance is defined as how much CFOs perceive digital technology as an impellent issue.

Obviously, the graph is an approximation, far from being considered as a responsibility of CFOs. This is due for several reasons: (1) Investments are not fully accountable to CFOs decision making but is the result of consensus and bargaining within the company's C-level management; (2) The average investment is computed as a differential, thus, companies already strongly involved in investment in digital technology might result as still respect to other companies which have just started investing; (3) CFOs perception might be personal and not shared by other company's departments, albeit it is fair to assume shared cultures and belief within the same organization.

As regard **Artificial Intelligence**, it covers the bottom-left side of the plot, implying consistency between investments and perceived relevance. The main reason might be led by the infancy stage of this technology and the its unclear application yet.

Robotics Process Automation is the technology with the highest investment although it presents a perceived relevance below the average. Probably this is the result of a current trend in leaning Finance Department and making more efficient non-value-added processes. In this context, RPA is just a digital tool in implementing efficient solution and comes along with organizational and strategic leverages.

Cloud Computing and **Big Data Analytics** are perceived as the most relevant technologies for the future of businesses, however, according to the plot in Picture 12-

24, their investment is below the mean value. This is not necessarily suggesting inconsistency. Indeed, the graph might be biased by the outlier's value of Robotics Process Automation. Moreover, Cloud Computing and Big Data and Analytics might be considered as mature technologies, even if not yet fully explored and exploited, where companies are already investing money, making the differential tights respect to the previous year.

On average companies have planned incremental investments of 7% on digital technologies compared to the previous year budget.

13 RESULTS FROM JD-R MODEL

Before going through the results of PLS – SEM application, some preliminary steps are required in order to validate the questionnaire and to check the minimum sample size requirements.

13.1 RELIABILITY CHECK OF THE QUESTIONNAIRE

The reliability check focuses on those standard questions applied to the JD–R model evaluation. In fact, these questions have been formulated according to theoretical background and previous literature. Questions related to the construct "Relevance of digital technologies" have been defined and set up by the authors, since this construct investigates aspects not related to the theoretical JD–R.

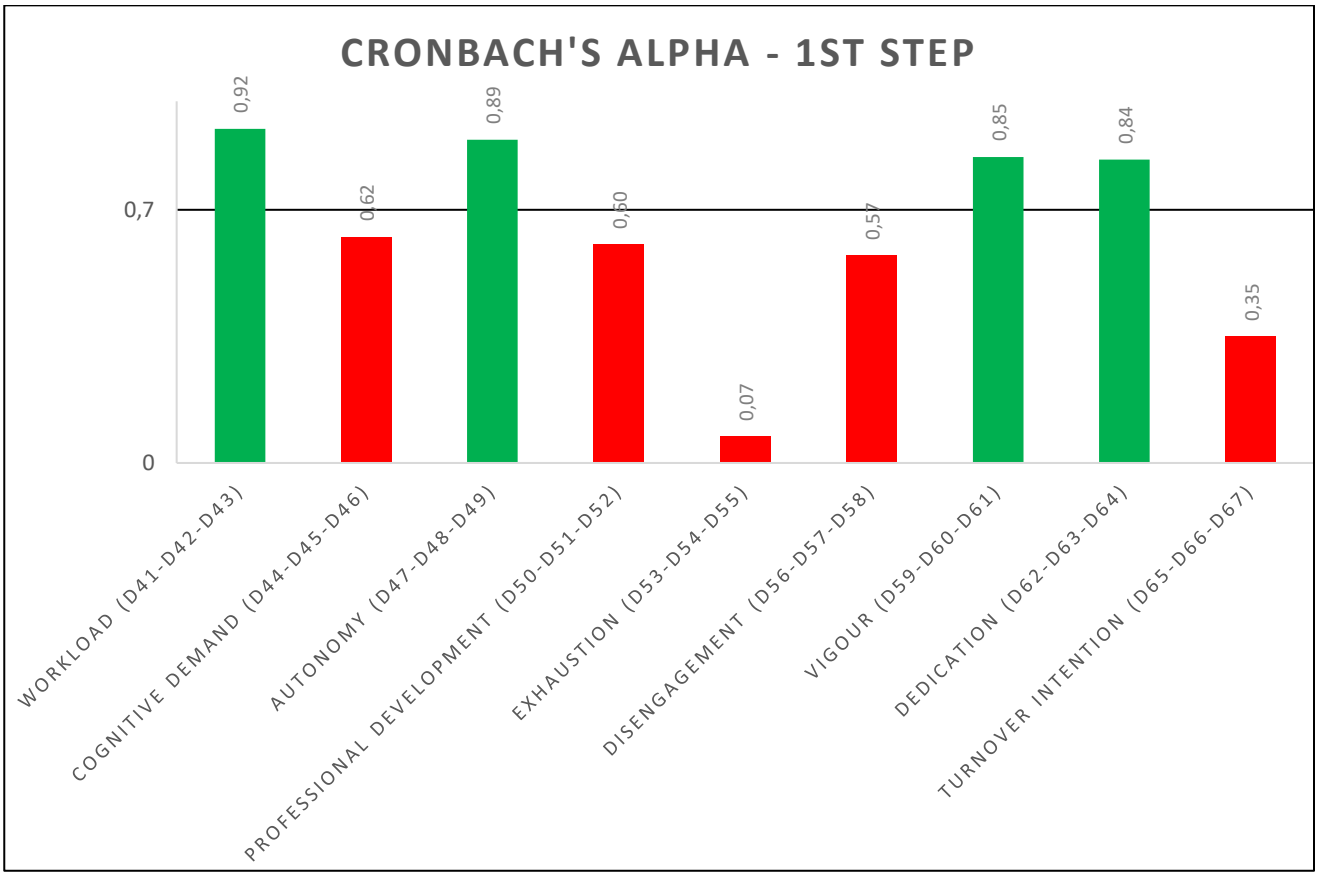
Therefore, the reliability check concerns about questions related to "workload", "cognitive demand", "autonomy", "professional development", "exhaustion", "disengagement", "vigour", "dedication", "turnover intention" variables of JD–R model.

The reliability check is accomplished through the evaluation of **internal consistency of scales** adopted. As explained in the previous chapters, the questionnaire is composed of 9 scales and each scale has been evaluated with 3 questions. **Cronbach's alpha** has been chosen as parameter of internal consistency of scales (Bakker, Deremouti& Verbeke, 2004).

The reliability check of the questionnaire followed two steps: first, all Cronbach's alphas were calculated; second, if the Cronbach's alpha of a scale was below 0,7 threshold (Hair, Hult, Ringle, Sarsedt, 2017), Cronbach's alpha was calculated again combining two out of three questions of the scale per time and choosing the two questions with the highest coefficient. At the end of the second step, the scales with Cronbach's alpha values higher than 0,7 were considered as reliable and as part of the validated questionnaire.

Therefore, considering the results of the questionnaire related to the investigation of psychological wellbeing, Cronbach's alpha of each scale was calculated. The calculation of Cronbach's alpha was supported by Stata/SE 14.1 software.

As regards the first step, Cronbach's alphas of all the scales are showed in Picture 13-1. Between the parentheses in the graphs, which questions for each scale have been specified.

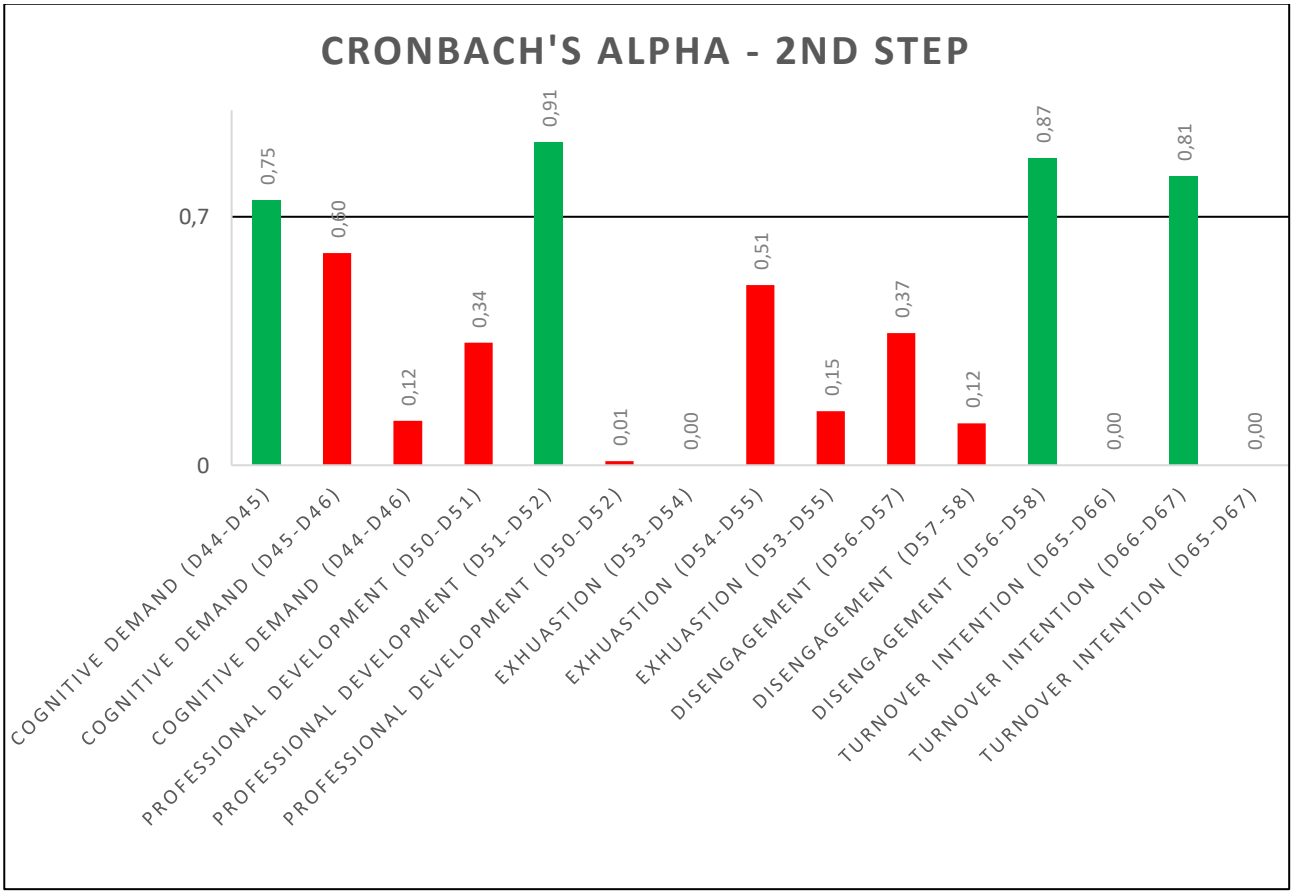


Picture 13-1: Cronbach's alpha of scales - First step

As result of the first step, four scales out of nine showed values higher than 0,7. These scales are: "workload", "autonomy", "vigour", "dedication". Consequently, these scales were validated keeping all the three questions submitted to the participant of the survey.

Then, the second step was required for "cognitive demand", "professional development", "exhaustion", "disengagement", "turnover intention" scales. For each of

them, three Cronbach's alphas were calculated, considering the combination of two questions out of the original three. Cronbach's alphas of these scales are showed in Picture 13-2. In the horizontal axes, the questions considered have been reported between parentheses close to the scale.

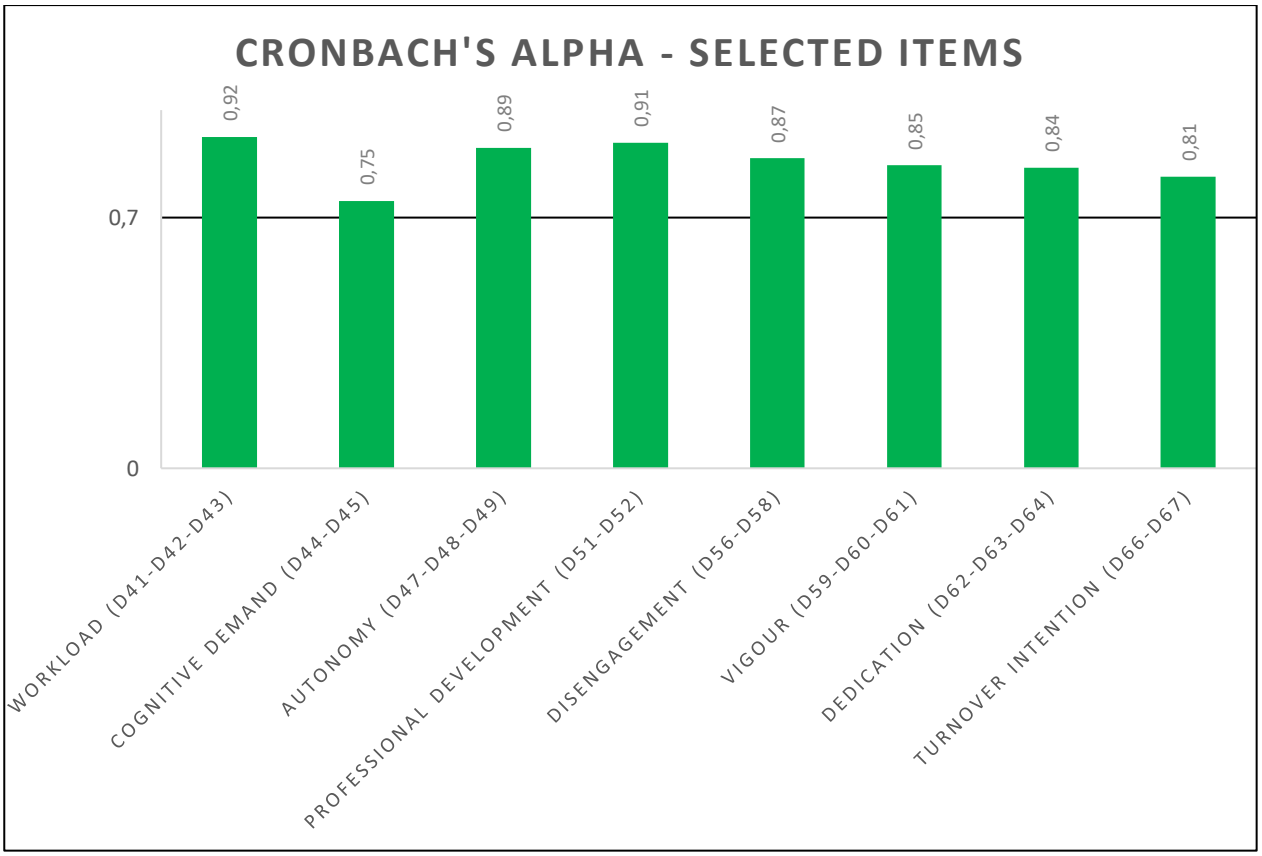


Picture 13-2: Cronbach's alpha of scales - Second step

For each scale, the two questions showing the highest Cronbach's alpha were chosen to represent the scale. At the end of the second step, all the scales showed Cronbach's alphas higher than 0.7 threshold, except for "exhaustion" scale. In the best case (considering question 2 and 3), "exhaustion" showed a highest Cronbach's alpha of 0,5072. Due to low and poor internal consistency, "**exhaustion" has been removed from the research model of JD–R.** In fact, this scale did not present a good level of reliability. Hypothetically, the causes related to the incontinency of the scale may be explained by

the small size of the sample or by the choice of the questions for the evaluation of the scale.

Eventually, the scales which showed good level of reliability were considered valid within the questionnaire and are showed in the Picture 13-3.



Picture 13-3: Cronbach's alpha - Selected items

Therefore, the questionnaire was validated showing good internal consistency within each scale. As can be seen from Picture 13-3, Cronbach's alpha coefficients are included in the range from 0,7462 ("cognitive demand") to 0,9246 ("workload"). The final version of the questionnaire was composed of eight scales, four of them made up of three questions and four of them of two questions. In total, seven questions were discarded from the original version of the questionnaire.

13.2 CONTROL VARIABLES

In order to finally validate the questionnaire and the model, control variables were checked. “Age”, “gender”, “academic field”, “tenure” of the respondents and “revenues of the company” were chosen as control variables of the model. “Turnover intention” was selected as dependent variable of the model. Therefore, an analysis of correlations between these variables and turnover intention was developed. As shown in Table 13-1, analysis revealed very low coefficients of correlations.

Table 13-1: Correlation between control variables and Turnover intention

	Turnover intention
Age	0.13
Gender	-0.07
Academic field	-0.05
Tenure	0.20
Revenues of the company	-0.12

This analysis (Table 13-1) revealed that chosen control variables were not substantially related to the model components, and that inclusion of these variables in the structural equation model did not significantly affect the results. They were therefore omitted from further analyses.

13.3 DESCRIPTIVE STATISTICS

In the Table 13-2, some descriptive statistics have been reported. In the first column, the range of the answers are described for each scale. In the second and third column, the mean and the standard deviation of each scale are reported. In the last columns, the intercorrelations between the scales are described. On the diagonal of Table 13-2, internal consistencies (Cronbach’s alpha) of the scales are showed.

Table 13-2: Internal consistency of the scales

	Range	μ	σ	1	2	3	4	5	6	7	8	9	10	11	12
1. Cloud Computing	(1-7)	4,51	1,49	/											
2. Big Data & Analytics	(1-7)	5,12	1,12	0,39	/										
3. Artificial Intelligence	(1-7)	4,03	1,43	0,43	0,33	/									
4. Robotics Process Automation	(1-7)	3,97	1,37	0,43	0,28	0,71	/								
5. Workload	(1-7)	3,42	1,35	0,39	-0,03	0,07	0,07	(0,92)							
6. Cognitive demand	(1-7)	4,54	1,38	0,38	0,32	0,19	-0,10	0,48	(0,75)						
7. Autonomy	(1-7)	4,43	1,18	0,43	0,32	0,28	0,30	-0,18	0,00	(0,89)					
8. Professional development	(1-7)	5,26	1,13	0,38	0,33	0,30	0,44	0,04	0,17	0,37	(0,91)				
9. Disengagement	(1-7)	3,29	0,96	-0,48	-0,24	-0,29	-0,18	-0,01	-0,23	-0,62	-0,45	(0,87)			
10. Vigour	(1-7)	3,90	0,90	0,39	0,03	0,20	0,19	0,20	0,04	0,20	0,31	-0,53	(0,85)		
11. Dedication	(1-7)	4,19	0,96	0,42	0,11	0,29	0,26	-0,03	-0,02	0,63	0,43	-0,66	0,65	(0,84)	
12. Turnover intention	(1-7)	3,88	0,99	-0,46	-0,15	-0,34	-0,28	-0,01	-0,02	-0,62	-0,54	0,72	-0,65	-0,88	(0,81)

The means (μ) and standard deviations (σ) values of each indicator are measured according to the results of the validated questions of the respective indicator.

The construct "**Relevance of digital technologies**" requires a deeper understanding. It is composed by the four indicators. "Cloud Computing", "Robotics Process Automation", "Big Data and Analytics", "Artificial Intelligence" indicators are measured by four questions (D26, D28, D30, D32) within the questionnaire. These questions, focused on the relevance of each digital technology in the application to the main tasks related to CFO profession, were not formulated according to standardised questions. Because of this reason, no Cronbach's alpha has been computed.

13.4 Definition of Job Demands – Resources path model

Once, validated the questionnaire at the base of the model, PLS–SEM theory could be applied. First, the Job demand-resource research model had to be structured consistently with a PLS path model. There are six constructs and nine items. Each

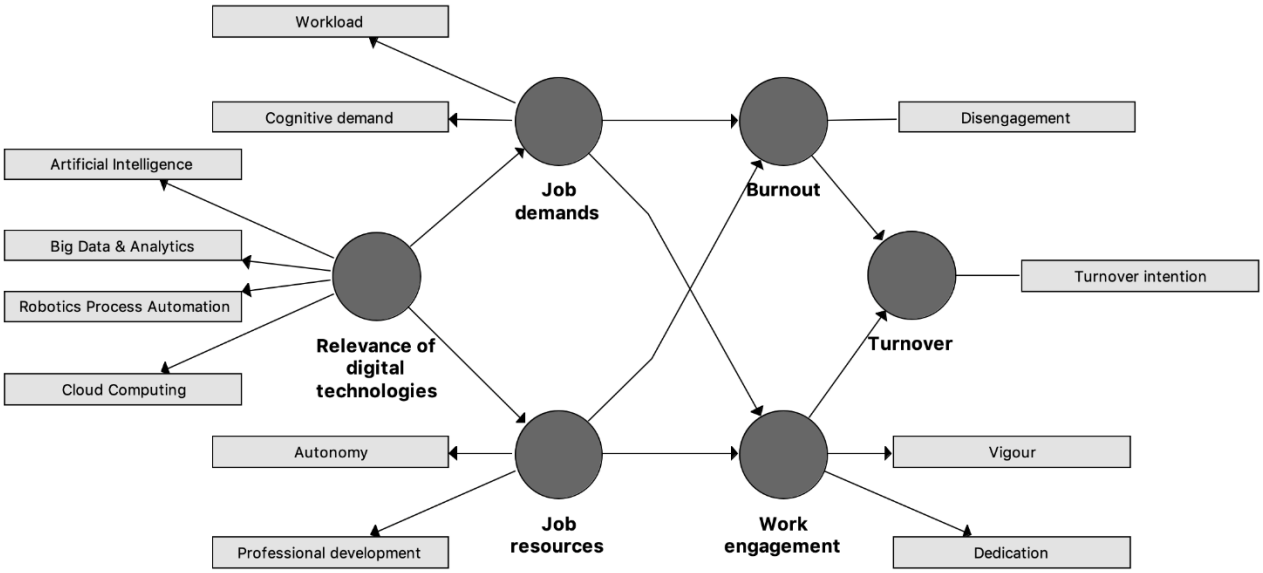
construct is measured by single or multi items. Eight out of nine items in the path model are measured by the scales previously mentioned and validated.

Particularly, the path research model is composed by:

- "Job demands": multi-item construct; "cognitive demand" and "workload" are the indicators;
- "Job resources": multi-item construct; "autonomy" and "professional development" are the indicators;
- "Burnout": single-item construct; disengagement is the indicator;
- "Work engagement": multi-item construct; "dedication" and "vigour" are the indicators;
- "Turnover": single-item construct; "turnover intention" is the indicator;
- "Relevance of digital technologies: multi-item construct; "Cloud Computing", "Robotics Process Automation", "Big Data and Analytics", "Artificial Intelligence" are the indicators.

Particularly, the input of the model is represented by the relevance of the four digital technologies, while, the final outcome of the model is represented by the indicator "turnover intention". "Relevance of Digital Technologies" is aimed at connecting the two sections of the research, the former related to the study of the evolution brought by digital technologies over the professional role, the latter to the investigation of the impact of digital technologies over the psychological wellbeing. In this way, the model is able to predict if the adoption of digital technologies increases or decreases the turnover intention of the CFO and what are the factors that mediate this relationship.

Then, all the variables of the PLS path model have been described. As a result, the Picture 13-4 shows the PLS–SEM path model of the JD–R research model, implemented through the SmartPLS 3 software.



Picture 13-4: JD-R path model

In Picture 13-4, the constructs are represented as darker grey circles, while the indicators are represented as lighter grey rectangles. The eight hypotheses at the basis of the model are represented by the arrows among the dark grey circles. The hypotheses express the relationships between the constructs and will be evaluated by the path coefficients. Particularly, six out of eight hypotheses are related to the Job demand-resource model, while two hypotheses connect the construct "relevance of digital technologies" to the model.

As regards the relationship between each construct and its indicators, the **reflective measurement model** has been adopted. In fact, in this case the indicators have been selected from those measurable variables available in the domain of the construct, according with the purpose of the study and consistently with the literature review. The indicators selected can be considered as representative of the domain of the construct and they are interchangeable, without impacting over the meaning of the construct itself. Therefore, according to the theory, the indicators adopted in the model are reflective indicators.

The relationships between each construct and its indicators are represented by the arrows connecting the circles with the rectangles. These relationships will be evaluated by the outer loadings.

There are four different mediating effects. “Job demands” can be defined as a moderator variable considering the indirect relationship between “relevance of digital technologies” and “burnout”. “Job resources” can be defined as a moderator variable considering the indirect relationship between “relevance of digital technologies” and “work engagement”. “Burnout” can be defined as a moderator variable considering the indirect relationship between “job resource” and “turnover”. Eventually, “work engagement” can be defined as a moderator variable considering the indirect relationship between “job demands” and “turnover”.

13.5 Minimum sample size requirements validation

After having defined the PLS path model and before going through the analysis of the results, a further step is required concerning the size of the sample. Therefore, the sample of 41 completed observations was tested with the two different methods presented in the previous chapter.

First, Barclay et al. (1995) developed the ten times rule of thumb. In the path model, the largest number of structural paths leading to an endogenous construct is two. Thus, in this study the sample size of 41 was sufficiently high for PLS requirements and the sample was considered as validated.

Second, following Cohen’s (1992) recommendations for multiple OLS regression analysis, 26 observations are required in order to detect R^2 values of around 0.25, assuming a significance level of 10% and a statistical power of 80%. Therefore, also in this case the sample was considered as sufficiently high for PLS requirements and was validated.

The validation of minimum sample size allowed to go further with the analysis of the results from PLS-SEM.

13.6 PLS – SEM RESULTS OF MEASUREMENT MODEL

In this chapter, the results of the reflective measurement model are going to be analysed. The results are achieved through the application of PLS algorithm. In essence, the PLS algorithm is a sequence of regressions in terms of weight vectors. The weight vectors obtained at convergence satisfy fixed point equations.

The set-up of PLS algorithm includes basic settings and advanced settings, here described:

- **path weighting setting**: it is the recommended approach, since it provides the highest R^2 value for endogenous latent variables and is generally applicable for all kinds of PLS path model specifications and estimations;
- **300 as maximum iterations**: this parameter represents the maximum number of iterations that will be used for calculating the PLS results. This number should be sufficiently large (e.g., 300 iterations). When checking the PLS-SEM result, one must make sure that the algorithm did not stop because the maximum number of iterations was reached but due to the stop criterion.
- **10^{-7} as stop criterion**: the PLS algorithm stops when the change in the outer weights between two consecutive iterations is smaller than this stop criterion value (or the maximum number of iterations is reached). This value should be sufficiently small (e.g., 10^{-5} or 10^{-7}).
- As regards advanced settings, the **initial outer weights** are set to +1.

The choice of basic and advanced settings is supported by the default settings provided by the software and by the suggestions provided by the authors Hair *et al.* (2017).

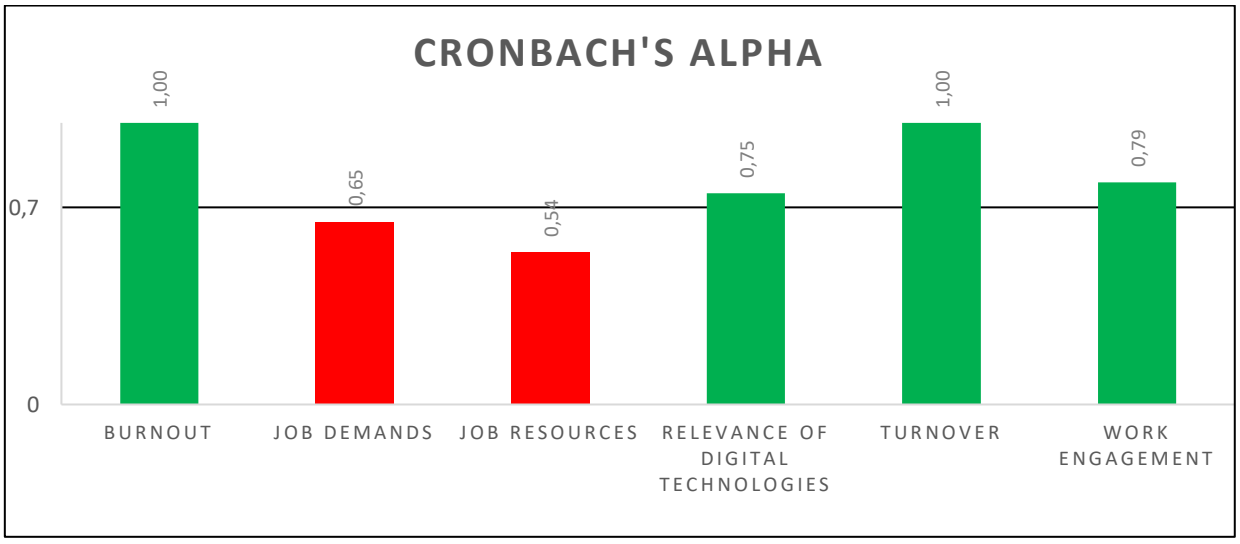
As explained previously, the measurement model is going to be studied from internal consistency, convergent validity, divergent validity perspectives.

13.6.1 Internal consistency reliability

As regards internal consistency, Cronbach's alpha of the constructs and composite reliability have been considered as relevant measures. The results in the Table 13-3 and Picture 13-5 showed the composite reliabilities and Cronbach's alpha values.

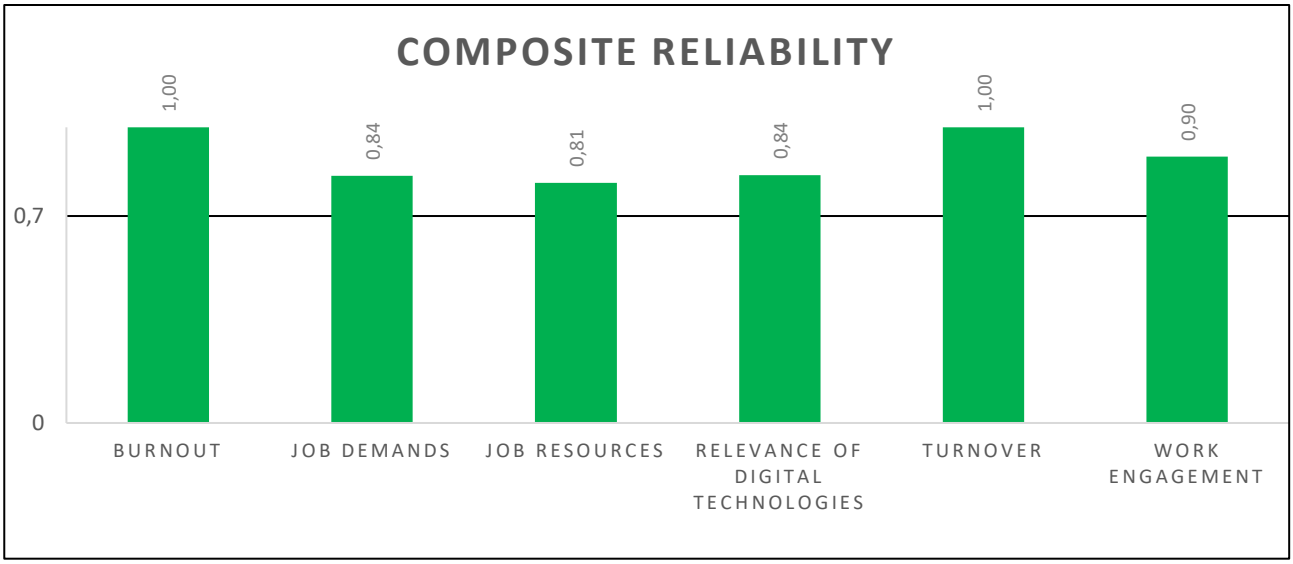
Table 13-3: Cronbach's alpha of constructs

	Cronbach's Alpha	Composite Reliability
Burnout	1,000	1,000
Job demands	0,649	0,837
Job resources	0,540	0,812
Relevance of digital technologies	0,750	0,838
Turnover	1,000	1,000
Work engagement	0,789	0,901



Picture 13-5: Cronbach's alpha of constructs

As far as Cronbach's alpha measure, some constructs show values below the threshold of 0, 7. Particularly, these constructs are "job demands" and "job resources".



Picture 13-6: Composite reliability of constructs

As far as composite reliability measure, all the constructs were above 0,70 recommended threshold (Picture 13-6).

Remembering that Cronbach's alpha is inclined to underestimate while composite reliability is inclined to overestimate internal consistency, the results can be considered as **acceptable**.

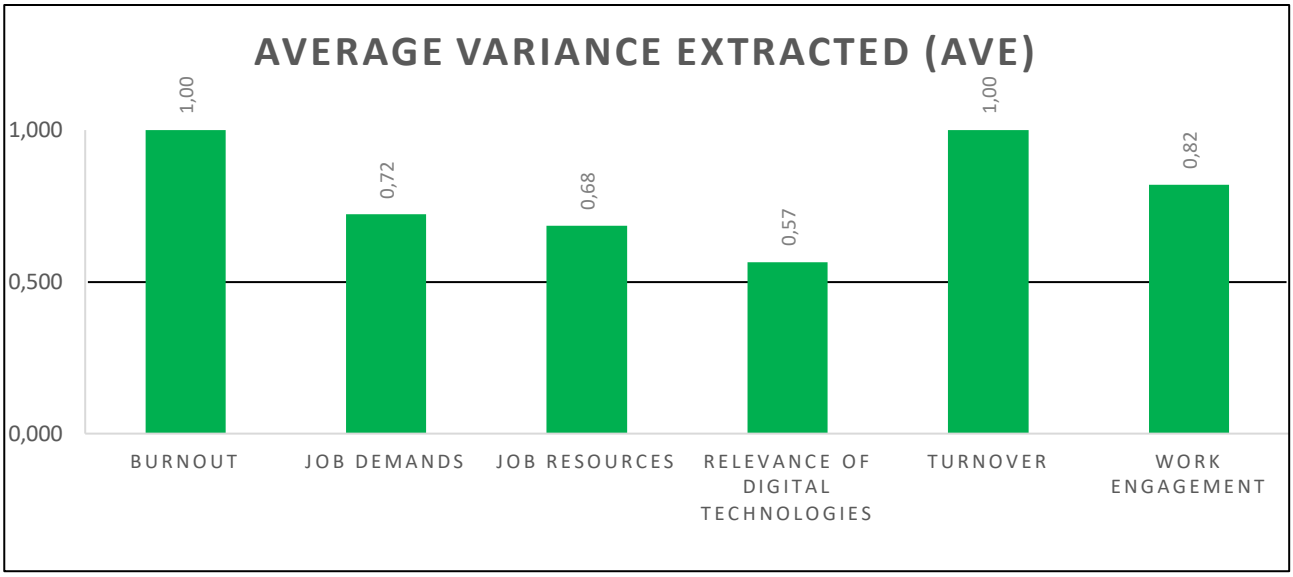
13.6.2 Convergent validity

As regards convergent validity, AVE and indicator reliability have been considered as relevant measures and their results are showed in Table 13-4 and Picture 13-7.

Table 13-4: AVE of constructs

	Average Variance Extracted (AVE)
Burnout	**1,000**
Job demands	**0,722**
Job resources	**0,684**
Relevance of digital technologies	**0,565**
Turnover	**1,000**
Work engagement	**0,819**

Results from JD-R model



Picture 13-7: AVE of constructs

Analysing the results from Picture 13-7, the AVE measures of the constructs of the model were all **above the 0.50 acceptability level**.

Table 13-5: Indicator reliability

	Burnout	Job demands	Job resources	Relevance of digital technologies	Turnover	Work engagement
Artificial Intelligence				**0,767**		
Autonomy			**0,857**			
Big Data & Analytics				**0,670**		
Cognitive demand		**0,943**				
Dedication						**0,945**
Disengagement	**1,000**					
Professional development			**0,796**			
Robotics Process Automation				**0,745**		
Turnover intention					**1,000**	
Vigour						**0,864**
Workload		**0,746**				
Cloud Computing				**0,818**		

As regard indicator reliability, standardized outer loadings were analyzed. They were **all above 0,708 threshold**, except for the outer loading that connected "Big Data & Analytics" to "relevance of digital technologies". In this case, the value was 0,67 (the red one in Table 13-5).

More in detail, the square of a standardized indicator's outer loading represents how much of the variation of an indicator is explained by the construct and is described as the variance extracted from the indicator. The latent variable "relevance of digital technologies" is able to explain 45% of the variance of "Big Data & Analytics". Moreover, theory suggests considering to remove outer loadings between 0,4 and 0,7 values if internal consistency thresholds are not satisfied, while it suggests to eliminate always indicators with outer loadings below 0,4 value. Therefore, even though the outer loading of the indicator "Big Data & Analytics" is below the threshold, it was decided to keep the indicator because the **convergent validity of the measures was confirmed**.

13.6.3 Discriminant validity

As regards discriminant validity, cross-loadings criterion and Fornell-Larcker criterion is considered as relevant measures and their results are showed respectively in Table 13-6 and Table 13-7.

Table 13-6: Cross-loadings criterion

	Burnout	Job demands	Job resources	Relevance of digital technologies	Turnover	Work engagement
Artificial Intelligence	-0,292	0,170	0,351	0,767	-0,344	0,277
Autonomy	-0,621	-0,068	0,857	0,455	-0,616	0,500
Big Data & Analytics	-0,243	0,232	0,390	0,670	-0,152	0,087
Cognitive demand	-0,226	0,943	0,095	0,305	-0,024	0,001
Dedication	-0,657	-0,031	0,646	0,377	-0,882	0,945
Disengagement	1,000	-0,176	-0,656	-0,427	0,717	-0,666
Professional development	-0,454	0,144	0,796	0,481	-0,542	0,419
Robotics Process Automation	-0,178	-0,053	0,440	0,745	-0,279	0,256
Turnover intention	0,717	-0,021	-0,702	-0,427	1,000	-0,865
Vigour	-0,531	0,106	0,300	0,289	-0,648	0,864
Workload	-0,011	0,746	-0,095	0,205	-0,007	0,064
Cloud Computing	-0,479	0,436	0,490	0,818	-0,456	0,442

As far as cross-loadings criterion, for each construct the outer loadings of the indicators were higher than any of its cross-loadings on other constructs. It is possible to verify comparing the values of the outer loadings of the indicator with its construct to the other outer loadings in the same row in Table 13-6 with other different constructs. Consistently, each indicator showed a higher correlation with the proper construct.

Table 13-7:Fornell-Larcker criterion

	Burnout	Job demands	Job resources	Relevance of digital technologies	Turnover	Work engagement
Burnout	1,000					
Job demands	-0,176	0,850				
Job resources	-0,656	0,036	0,827			
Relevance of digital technologies	-0,427	0,310	0,564	0,752		
Turnover	0,717	-0,021	-0,702	-0,427	1,000	
Work engagement	-0,666	0,025	0,559	0,375	-0,865	0,905

As far as Fornell-Larcker criterion (Table 13-7), the square root of the AVE for each construct (value on the diagonal) was greater than each inter-construct correlation (values on the column and on the row).

The evaluation of these two measures provided sufficient **support for discriminant validity** (Mura, Lettieri, Radaelli & Spiller, 2016).

Overall, the research model can be considered as validated and reliable, having evaluated internal consistency, convergent and discriminant validity perspectives.

13.7 PLS – SEM RESULTS OF STRUCTURAL MODEL

In this chapter, the results of the structural model from SmartPLS 3 are going to be analysed. The structural model evaluation is divided into steps, explained in the chapter before.

13.7.1 Step 1: collinearity

In the first step, collinearity between the constructs is evaluated calculating VIF measure. The values are reported in Table 13-8.

Table 13-8: VIF values

	VIF
Artificial Intelligence	**2,150**
Autonomy	**1,159**
Big Data & Analytics	**1,229**
Cognitive demand	**1,300**
Dedication	**1,736**
Disengagement	**1,000**
Professional development	**1,159**
Robotics Process Automation	**2,106**
Turnover intention	**1,000**
Vigour	**1,736**
Workload	**1,300**
Cloud Computing	**1,391**

All VIF values of the constructs are below the recommended threshold of 3.3. Therefore, the constructs are **not affected by collinearity issues**.

13.7.2 Step 2: Path coefficients, indirect effects, total effects and bootstrapping

The study of relationships among the constructs represents the core part of the study of the results from PLS-SEM analysis. Indeed, the study of the relationships allow to confirm or to reject the hypotheses at the base of the model.

The study of the relationship among the constructs is divided into two steps: firstly, path coefficients, indirect effects, total effects are qualitatively evaluated; secondly, to assess the statistical analysis of the relationships, a bootstrap analysis is performed.

13.7.2.1 Path coefficients, indirect effects, total effects

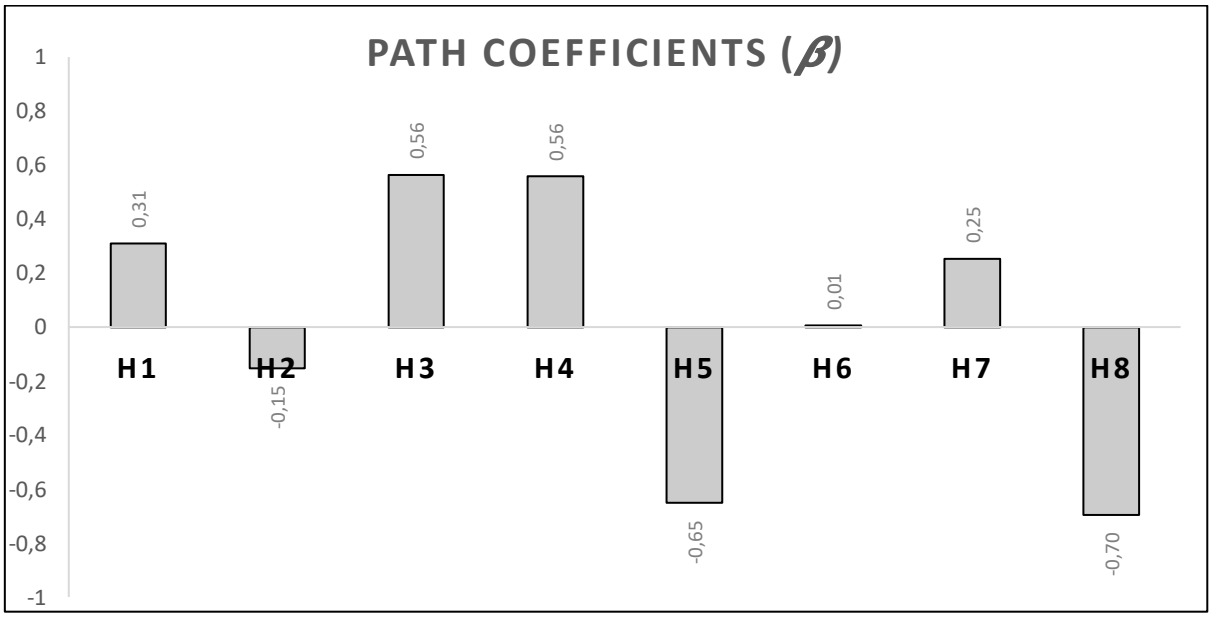
As far as the first step, the following graphs show the results of path coefficients (Table 13-9; Picture 13-8), indirect effects (Table 13-10; Table 13-11), total effects (Table 13-12).

The relationships were considered positive and relevant when above 0.2, while negative and relevant when below -0.2 thresholds. The relationships were considered positive and marginal when between 0.1 and 0.2 values, while negative and marginal when between -0.1 and -0.2 values. When the values were close to 0, the relationships were considered as not relevant (Mura, Lettieri, Radaelli & Spiller, 2016).

Table 13-9 focuses on the **path coefficients**, i.e. the direct effects between the constructs.

Table 13-9: Path coefficients - Direct effects

	Burnout	Job demands	Job resources	Relevance of digital technologies	Turnover	Work engagement
Burnout					0,253	
Job demands	-0,152					0,005
Job resources	-0,651					0,558
Relevance of digital technologies		0,310	0,564			
Turnover						
Work engagement					-0,697	



Picture 13-8: Path coefficients – Direct effects

As it possible to notice from the values of Table 13-9, the analysis suggests that:

- "Relevance of digital technologies" → "Job demands" (H1): positive relevant relationship;
- "Job demands" → "Burnout" (H2): negative marginal relationship;
- "Relevance of digital technologies" → "Job resources" (H3): positive relevant relationship;
- "Job resources" → "Work engagement" (H4): positive relevant relationship;

- "Job resources" → "Burnout" (H5): negative relevant relationship;
- "Job demands" → "Work engagement" (H6): not relevant relationship;
- "Burnout" → "Turnover" (H7): positive relevant relationship;
- "Work engagement" → "Turnover" (H8): negative relevant relationship.

From the analysis of path coefficients, only H6 hypothesis is not relevant. Therefore, Job demands, measured by cognitive demand and workload, has no direct effect to work engagement, measured by vigour and dedication.

The following tables focuses on the **indirect effects** between the constructs. The indirect effects are allowed by a mediator variable. In Table 13-10 the specific indirect effects are showed.

Table 13-10: Path coefficients -Specific Indirect effects

	Specific Indirect Effects
Relevance of digital technologies → Job demands → Burnout	-0,047
Relevance of digital technologies → Job resources → Burnout	-0,367
Relevance of digital technologies → Job demands → Burnout → Turnover	-0,012
Relevance of digital technologies → Job resources → Burnout → Turnover	-0,093
Relevance of digital technologies → Job demands → Work engagement → Turnover	-0,001
Relevance of digital technologies → Job resources → Work engagement → Turnover	-0,219
Relevance of digital technologies → Job demands → Work engagement	0,002
Relevance of digital technologies → Job resources → Work engagement	0,315

In Table 13-11 the total indirect effects are showed. The total indirect effects are the sum of the specific indirect effect of each construct.

Table 13-11: Path coefficients - Total indirect effects

	Burnout	Job demands	Job resources	Relevance of digital technologies	Turnover	Work engagement
Burnout						
Job demands					-0,042	
Job resources					-0,554	
Relevance of digital technologies	-0,414				-0,325	0,316
Turnover						
Work engagement						

As it possible to notice from the values of Table 13-11, the analysis suggests that:

- "Job demands" → "Turnover": not relevant effect, burnout is the mediator variable;
- "Job resources" → "Turnover": negative relevant effect, work engagement is the mediator variable;
- "Relevance of digital technologies" → "Burnout": negative relevant effect, job demands and job resources are the mediator variables;
- "Relevance of digital technologies" → "Work engagement": positive relevant effect, job resources and job demands are the mediator variables;
- "Relevance of digital technologies" → "Turnover": negative relevant effect, job demands, job resources, burnout and work engagement are the mediator variables.

Table 13-12 provides the big picture about the **total effects** between the constructs, considering both direct and indirect effects.

Table 13-12: Path coefficients - Total effects

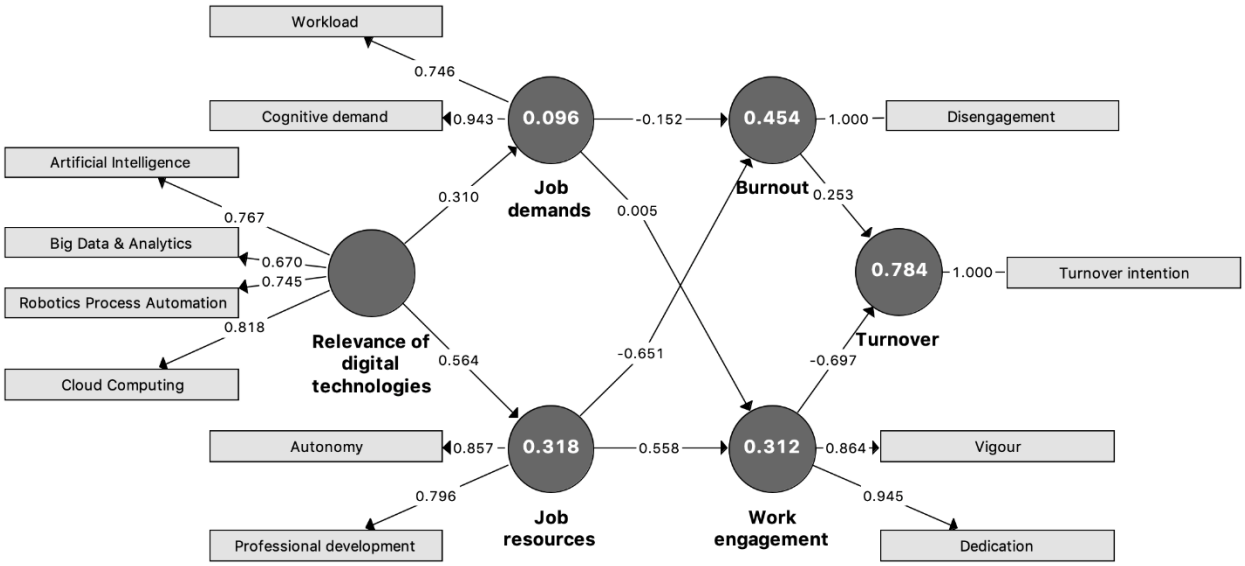
	Burnout	Job demands	Job resources	Relevance of digital technologies	Turnover	Work engagement
Burnout					0,253	
Job demands	-0,152				-0,042	0,005
Job resources	-0,651				-0,554	0,558
Relevance of digital technologies	-0,414	0,310	0,564		-0,325	0,316
Turnover						
Work engagement					-0,697	

Therefore, the values in Table 13-12 provide a comprehensive understanding of the relationships surrounding the research model, summarizing the direct and indirect ones.

A qualitative analysis of total effects values suggests that only two relationships within the model can be described as not relevant. In particular, “job demands” neither has relevant impact over “turnover” nor has relevant effect over “work engagement”.

Overall, the only relevant link between “relevance of digital technologies” and “turnover” is represented by the mediation of “job resources” and “work engagement”.

Picture 13-9 gives a visual representation of the research model. The relationships among the variables are evaluated by the path coefficients and outer loadings on the respective arrows. Inside the circles of the endogenous latent variables, R^2 coefficients are showed; these coefficients are going to be examined in the next step.



Picture 13-9: JD-R with Path coefficients

13.7.2.2 Bootstrapping

In the second step of relationship analysis, since PLS does not require any assumptions about the distribution of the observed variables, in order to assess the

statistical significance of the path coefficients, indirect effects and total effects, a **bootstrap** re-sampling procedure was performed. As explained in the previous chapter, bootstrapping is a non-parametric procedure that allows testing the statistical significance of various PLS-SEM results. In order to setup the bootstrapping, basic settings and advanced settings were defined. As regards basic settings, the following parameters were chosen:

- **5000 subsamples:** to ensure stability of results, the number of bootstrap subsamples should be large. For the final results preparation, it is worth to use a large number of bootstrap subsamples (e.g., 5,000);
- **Do parallel processing:** this option runs the bootstrapping routine on multiple processors (if your computer device offers more than one core). Using parallel computing allows to reduce computation time;
- **No sign changes**: this option sets the method for dealing with sign changes during the bootstrap iterations. Choosing no sign changes option, sign changes in the resamples will be ignored and the results are taken as they are. This is the most conservative estimation option and the recommended choice when running the bootstrapping routine;
- **Complete bootstrapping for amount of results:** All available results for bootstrapping are assembled.

As regards advanced settings, the following parameters were chosen:

- **Bias-Corrected and Accelerated (BCa) Bootstrap as confidence interval method:** it is the most stable method that does not need excessive computing time;
- **Two tailed test:** this setting option specifies if the creation of bootstrap confidence intervals uses a one-sided or two-sided significance test. Two-sided significance test was chosen;
- **10% significance level:** this option specifies the significance level of confidence interval computations. The choice of 10% as significance level is influenced by the parameters extracted from the representativeness of the sample. Since the parameters showed a confidence level of 10%, the decision of the significance level of confidence interval computation in PLS

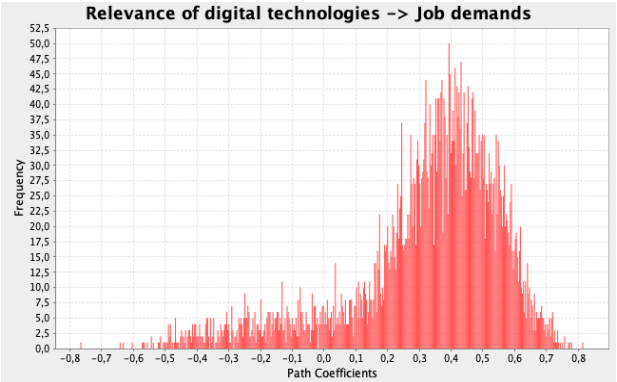
was taken consistently with that value. Moreover, considering the exploratory nature of this study, a significance level of 10% is commonly adopted (Hair *et al.*,2017).

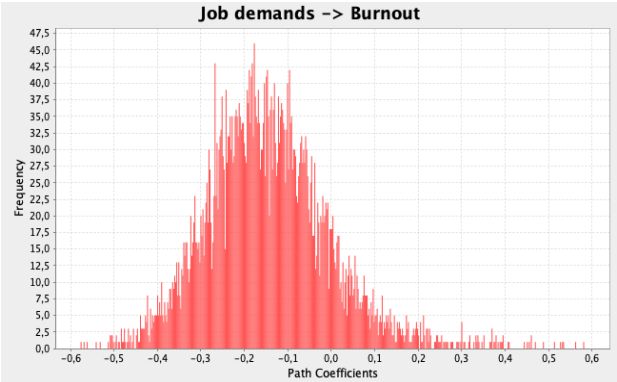
The choice of basic and advanced settings is supported by the default settings provided by the software and by the suggestions provided by the authors Hair *et al.* (2017).

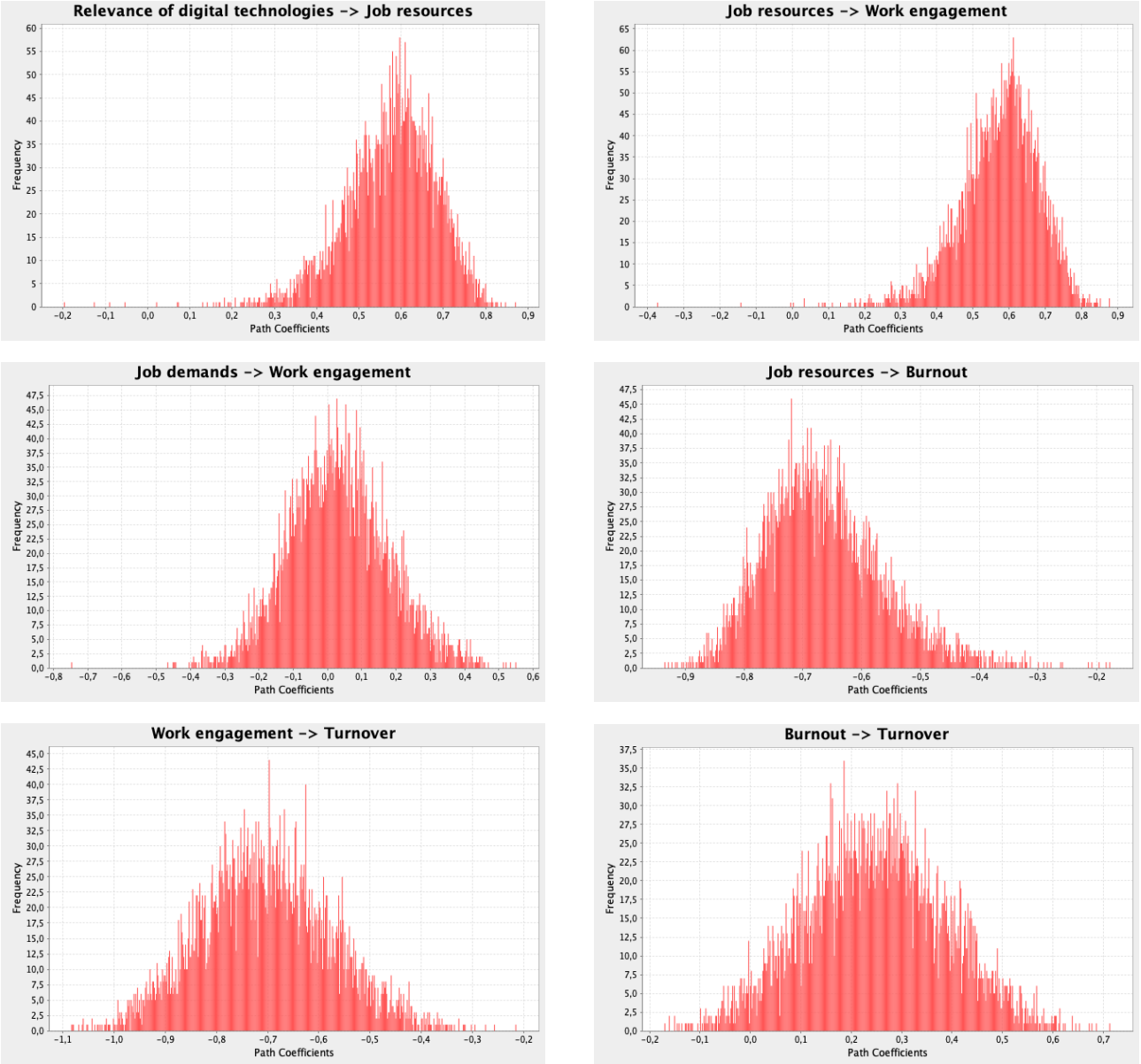
Therefore, the bootstrap procedure allows to study the statistical significance of path coefficients, indirect effects, total effects. In this research, the statistical significance is going to be evaluated through **p-values** (i.e. probability values) (Hair et al., 2017).

The distributions resulted from the 5000 sub-samples randomly generated from the original sample.

In Picture 13-10, the distributions of path coefficients are depicted. These pictures provide a qualitative analysis of the bootstrapping distributions. However, it is preferred the quantitative analysis provided by tables to support the statistical validity. Thus, Picture 13-10 is reported as example of qualitative analysis, however the successive distributions (indirect effects and total effects) will not be included in this report.







Picture 13-10: Bootstrapping of path coefficients

Table 13-13 provides a comprehensive picture of the distributions represented above. Particularly, the values in the table extract information from those distributions.

Table 13-13 focuses on p-values as statistical values. In the first column of the table, the original values of path coefficients are showed, while in the second column the average values of path coefficients are computed from the 5000 bootstrap samples (column Sample Mean). The results from the original sample and from the bootstrap samples slightly differ since bootstrapping builds on randomly drawn bootstrap samples, which will differ every time the procedure is run. The differences in the overall

bootstrapping results are marginal. In the other columns, standard deviation and p-values are calculated.

The disposition of the columns within Table 13-13 will characterize also the following tables (Table 13-14; Table 13-15; Table 13-16) describing p-value for indirect and total effects.

Table 13-13: Statistical values of bootstrapping of path coefficient

	Original Sample μ	Bootstrap Sample μ	σ	P - values
Relevance of digital technologies → Job demands (H1)	0,310	0,321	0,244	0,205
Job demands → Burnout (H2)	-0,152	-0,145	0,142	0,285
Relevance of digital technologies → Job resources (H3)	0,564	0,575	0,107	0,000
Job resources → Work engagement (H4)	0,558	0,573	0,109	0,000
Job resources → Burnout (H5)	-0,651	-0,664	0,100	0,000
Job demands → Work engagement (H6)	0,005	0,031	0,146	0,971
Burnout → Turnover (H7)	0,253	0,247	0,138	0,067
Work engagement → Turnover (H8)	-0,697	-0,704	0,126	0,000

As regards the evaluation of p-values, when assuming a significance level of 10%, the p-value must be smaller than 0.1 to conclude that the relationship under consideration is significant. Therefore, analyzing the values from the Table 13-13, the path coefficients related to these following relationships “job demands” → “burnout” (p value = 0,285), “job demands” → “work engagement” (p-value = 0,971), “relevance of digital technologies” → “job demands” (p-value = 0,205) are not significant. All the other path coefficients can be considered as **statistically significant**.

As a result of statistical analysis of path coefficients, it is possible to assess the statistical significance of hypotheses at the basis of the model. All the hypotheses are statistically significant, **except for H1** (“relevance of digital technologies” → “job demands”), **H2** (“job demands” → “burnout”), **H6** (“job demands” → “work engagement”), hypotheses.

In the following section, the analysis goes further and the focus is moved to indirect effects and total effect to provide a comprehensive and deep overview of the model.

The Table 13-14 below focuses on p-values as statistical values of the specific indirect effects between the constructs.

Table 13-14: Statistical values of bootstrapping of specific indirect effects

	Original Sample μ	Bootstrap Sample μ	σ	P -values
Relevance of digital technologies → Job demands → Burnout	-0,047	-0,057	0,063	0,457
Relevance of digital technologies → Job resources → Burnout	-0,367	-0,385	0,103	0,000
Relevance of digital technologies → Job demands → Burnout → Turnover	-0,012	-0,011	0,016	0,448
Relevance of digital technologies → Job resources → Burnout → Turnover	-0,093	-0,101	0,069	0,177
Relevance of digital technologies → Job demands → Work engagement → Turnover	-0,001	-0,011	0,039	0,976
Relevance of digital technologies → Job resources → Work engagement → Turnover	-0,219	-0,233	0,081	0,007
Relevance of digital technologies → Job demands → Work engagement	0,002	0,017	0,055	0,976
Relevance of digital technologies → Job resources → Work engagement	0,315	0,331	0,093	0,001

The results from Table 13-14 suggest that the specific indirect effects "relevance of digital technologies" → "job resources" → "burnout"; "relevance of digital technologies" → "job resources" → "work engagement" → "turnover"; "relevance of digital technologies" → "job resources" → "work engagement" are the only ones statistically significant. All the other has p-values above 0,1 and are considered as not statistically significant.

Therefore, the only path that connects the initial construct "relevance of digital technologies" to the final construct "turnover" is represented by "relevance of digital technologies" → "job resources" → "work engagement" → "turnover".

Table 13-15 focuses on p-values as statistical values of the total indirect effects between the constructs.

Table 13-15: Statistical values of bootstrapping of total indirect effects

	Original Sample μ	Bootstrap Sample μ	σ	P - values
Burnout → Turnover				
Job demands → Burnout				
Job demands → Turnover	-0,042	-0,049	0,113	0,708
Job demands → Work engagement				
Job resources → Burnout				
Job resources → Turnover	-0,554	-0,577	0,091	0,000
Job resources → Work engagement				
Relevance of digital technologies → Burnout	-0,414	-0,442	0,083	0,000
Relevance of digital technologies → Job demands				
Relevance of digital technologies → Job resources				
Relevance of digital technologies → Turnover	-0,325	-0,356	0,096	0,001
Relevance of digital technologies → Work engagement	0,316	0,348	0,104	0,002
Work engagement → Turnover				

Analyzing Table 13-15, only the total indirect effect "job demands" → "turnover" is considered statistically not significant. All the other total indirect effects are statistically significant. Particularly, the relationship "relevance of digital technologies" → "turnover", thus between the input and the output of the model, is revealed as significant.

The Table 13-16 focuses p-values as statistical values of the total effects.

Table 13-16: Statistical values of bootstrapping of total effects

	Original Sample μ	Bootstrap Sample μ	σ	P - values
Burnout → Turnover	0,253	0,247	0,138	0,067
Job demands →Burnout	-0,152	-0,145	0,142	0,285
Job demands →Turnover	-0,042	-0,049	0,113	0,708
Job demands →Work engagement	0,005	0,031	0,146	0,971
Job resources →Burnout	-0,651	-0,664	0,100	0,000
Job resources →Turnover	-0,554	-0,577	0,091	0,000
Job resources →Work engagement	0,558	0,573	0,109	0,000
Relevance of digital technologies →Burnout	-0,414	-0,442	0,083	0,000
Relevance of digital technologies →Job demands	0,310	0,321	0,244	0,205
Relevance of digital technologies →Job resources	0,564	0,575	0,107	0,000
Relevance of digital technologies →Turnover	-0,325	-0,356	0,096	0,001
Relevance of digital technologies →Work engagement	0,316	0,348	0,104	0,002
Work engagement →Turnover	-0,697	-0,704	0,126	0,000

Table 13-16 reports the relationships between the constructs provides a summary about previous values. “Job demands” → “burnout”, “job demands” → “turnover”, “job demands” → “work engagement”, “relevance of digital technologies” → “job demands” have been confirmed to be not statistically significant. All the other relationships are considered as **significant**.

Going through these results, it is possible to notice that all not statistically significant relationships include the construct “job demands”. On the one hand, This aspect seems to suggest that the choice of the indicators (“workload” and “cognitive demand”) in the research model were not the proper ones for the investigation of the psychological conditions of CFOs. On the other hand, these results might be explained with the absence of increasing in job demands because of introduction of digital technologies.

13.7.3 Step 3: R^2

In the third step, R^2 coefficients are evaluated to analyse the degree of the explained variance of each endogenous construct. These results are reported in Table 13-17 and in the Picture 13-11.

Table 13-17: R^2 values

	R^2
Burnout	0,454
Job demands	0,096
Job resources	0,318
Turnover	0,784
Work engagement	0,312

Picture 13-11: R^2 values

Considering the rule of thumb, R^2 values for endogenous latent variables of the research model are described as substantial, moderate, or weak:

- "Burnout": weak R^2 value;
- "Job demands": close to 0;
- "Job resources": weak R^2 value;
- "Turnover": substantial R^2 value;
- "Work engagement": weak R^2 value.

The low R^2 values of the endogenous latent variables of the model can be explained by the low number of paths pointing toward each construct. In fact, the more paths pointing toward a target construct, the higher its R^2 value. However, in this research model each endogenous construct is pointed by only two different paths.

Moreover, the low R^2 value of "job demands" construct confirms the problems related to this construct and already highlighted during the analysis of relationships.

In addition, in exploratory empirical analysis, it is usually considered as acceptable a R^2 with values within "weak" range.

Furthermore, a positive result is showed by "turnover" construct with a high R^2 value. This suggests that the previous constructs and paths have been to explain a high percentage of variance, indicating high levels of predictive accuracy.

13.7.4 Step 4: f^2

In the fourth step, the change in the R^2 value when a specified exogenous construct is omitted from the model is assessed. This measure is represented by f^2 values.

The results are reported in Table 13-18. Particularly, the table shows the f^2 values for all combinations of endogenous constructs (represented by the columns) and corresponding exogenous (i.e. predictor) constructs (represented by the rows).

Table 13-18: f^2 values

	Burnout	Job demands	Job resources	Relevance of digital technologies	Turnover	Work engagement
Burnout					**0,165**	
Job demands	0,042					**0,000**
Job resources	**0,775**					**0,452**
Relevance of digital technologies		0,106	**0,466**			
Turnover						
Work engagement					**1,251**	

Considering the guidelines from theory, f^2 values are described as small, medium and large effects:

- "Burnout" has medium effect on "turnover";
- "Job demands" has small effect on "burnout" and no effect on "work engagement";
- "Job resources" has large effect on "burnout" and large effect on "work engagement";
- "Relevance of digital technologies" has small effect on "job demands" and large effect on "job resources";
- "Work engagement" has large effect on "turnover".

Even the results of f^2 values highlights issues related to "job demands" construct. Particularly, it is underlined by the different impact of "job demands" respect to "job resources" to "burnout" and "work engagement", and by the different impact of "relevance of digital technologies" to "job demands" respect to "job resources".

13.7.5 Step 5: Q^2

In the fifth step, in addition to evaluating the magnitude of the R^2 values as a criterion of predictive accuracy, we examined Stone-Geisser's Q^2 value. This measure is an indicator of the model's out-of-sample predictive power.

In order to obtain Q^2 value, blindfolding procedure is required. In order to setup blindfolding, basic settings were defined. In particular, the omission distance was settled to 7, as suggested by default by the software *SmartPLS 3* and as supported by Hair *et al.* (2017).

Table 13-19 reports Q^2 values. In Table 13-19, SSO shows the sum of the squared observations, SSE the sum of the squared prediction errors, and the last column (i.e., 1 – SSE/SSO) the final value Q^2, which it is adopted to judge the model's predictive relevance with regard to each endogenous construct.

Table 13-19: Q^2 values

	SSO	SSE	Q^2 =(1-SSE/SSO)
Burnout	41,000	25,080	**0,388**
Job demands	82,000	79,662	**0,029**
Job resources	82,000	66,571	**0,188**
Relevance of digital technologies	164,000	164,000	
Turnover	41,000	12,995	**0,683**
Work engagement	82,000	66,101	**0,194**

As can be seen from the table, the Q^2 values of all four endogenous constructs are above zero. More precisely, "turnover" has the highest Q^2 value (0,683), followed by "burnout" (0,388), "work engagement" (0,194), "job resources" (0,188) and finally "job demands" (0,029).

Therefore, "job demands" has the lowest value, really close to zero. This means almost no predictive relevance for this construct.

Overall, these results provide clear support for the model's predictive relevance regarding the endogenous latent variables.

13.7.6 Step 6: q^2

In the sixth step, the relative impact of Q^2 values is evaluated through the calculation of q^2 effect size.

However, the sixth step of structural model evaluation is not developed within this research. Some reasons are provided in order to explain this choice.

First, all steps of structural model developed so far have provided consistent results. Each further step of the analysis has just confirmed the previous results achieved. In particular, Q^2 values showed consistent results according to the previous steps, thus the deepening of Q^2 is not required.

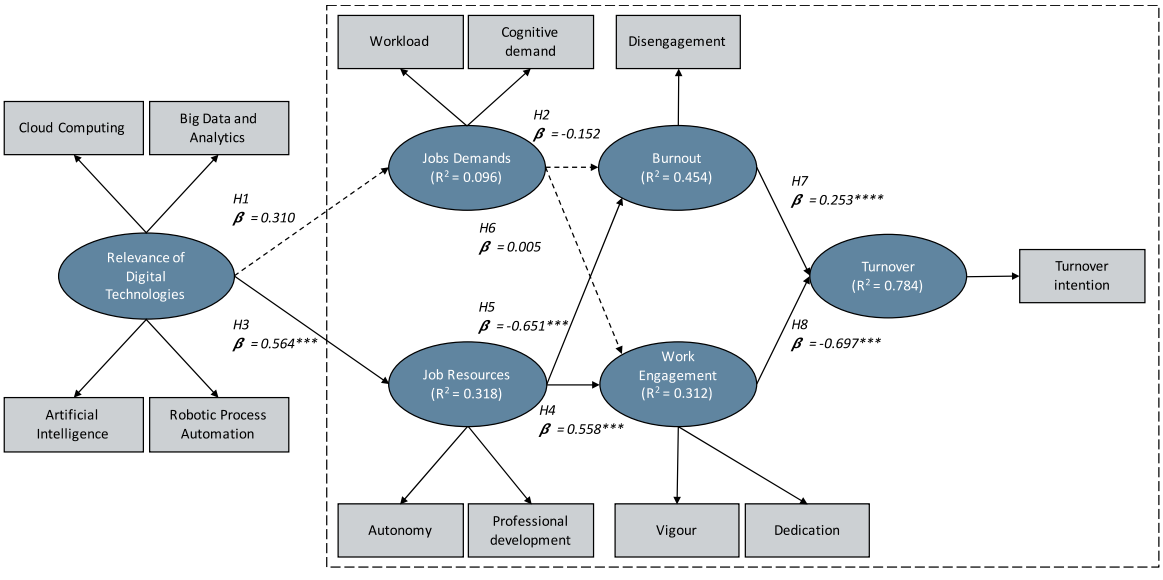
Second, other analyses of previous researchers applying PLS–SEM method stopped to the evaluation of path coefficients and R^2 values for the assessment of the structural model (Mura, Lettieri, Radaelli, Spiller, 2016).

13.8 CONCLUSIONS

The assessment of JD-R research model is completed. The evaluation of the measurement model has allowed to demonstrate the reliability and the validity of the model. Then, the evaluation of the structural model has allowed to go further and analyse deeply the different variables and relationships within the model.

Picture 13-12 provides comprehensive insights about the research model. In particular, in the image the main significant measures as path coefficients (β) and R^2 are displayed.

The dotted arrows between the constructs represent the not validated hypotheses. The number of asterisks close to the path coefficients reflect the p-values (Mura, Lettieri, Radaelli & Spiller, 2016).



Notes: $*p < 0.05$; $**p < 0.01$; $***p < 0.001$; $****p < 0.10$

Picture 13-12: Significant coefficients and R^2 values of JD-R

Picture 13-12 allows to review and to provide final considerations about the hypotheses at the basis of the model, built from the literature in the previous chapters.

H1. The use of Digital Technologies in CFO's role increases Job Demands

The use of digital technologies of CFO, expressed by the construct "relevance of digital technologies", had no statistically significant relationships with "job demands". Therefore, this hypothesis was **not validated** within this research.

H2. CFO's burnout is positively related to Job demands as workload and cognitive demand

"Job demands" had no statistically significant relationships with "burnout". Therefore, this hypothesis was **not validated** within this research.

H3. The use of Digital Technologies in CFO's role increases Job Resources

"Job resources" was significantly and positively affected by the use of digital technologies of CFO, expressed by the construct "relevance of digital technologies". Therefore, this hypothesis was **validated** and **confirmed** within this research.

H4. CFO's engagement is positively related to job resources as autonomy and personal development

"Work engagement" was significantly and positively affected by "job resources". Therefore, this hypothesis was **validated** and **confirmed** within this research.

H5. Job resources is negatively related to burnout

"Burnout" was significantly and negatively affected by "job resources". Therefore, this hypothesis was **validated** and **confirmed** within this research.

H6. Job demands is negatively related to work engagement

"Job demands" had no statistically significant relationships with "work engagement". Therefore, this hypothesis was **not validated** within this research.

H7. Burnout is positively related to CFO's turnover intention

CFO's "turnover" was significantly and positively affected by "burnout". Therefore, this hypothesis was **validated** and **confirmed** within this research.

H8. Engagement is negatively related to CFO's turnover intention

CFO's "turnover" was significantly and negatively affected by "work engagement". Therefore, this hypothesis was **validated** and **confirmed** within this research.

Overall, five out of eight research hypotheses were validated and confirmed within the research model, investigated through a research questionnaire and by the application of PLS–SEM methodology.

All the results showed Picture 13-12 are supported by the different steps of the methodology which are directed toward the same conclusions, increasing the validity of this model. Specifically, focusing on the input and output of the model, the path "relevance of digital technologies" → "job resources" → "work engagement" → "turnover" is statistically significant that moves along all the model. On the other hand, the path "relevance of digital technologies" → "job demands" → "burnout" → "turnover" has always been rejected.

Therefore, these results allow to state that an increase of CFO's adoption of digital technologies is able to reduce CFO's turnover within the company.

14 RESULTS FROM AMO MODEL

In this chapter, PLS–SEM methodology is going to be applied to AMO research model (Radaelli, Lettieri, Mura, Spiller, 2014). Before going through the results of PLS-SEM application, some preliminary steps are required.

Since the theoretical background and the previous literature about the model did not provide suggestions for standard questionnaires, the questions aimed at the investigation of the model's variables have been defined and set up by the authors. The questions adopted in the model focus on the core aspects of the model.

The reliability check of the questions through the calculation of Cronbach's alphas was not developed for AMO research model. Two are the main reasons driving this choice: (1) The questions are not related to standard questionnaires; (2) The questions are not focused on psychological aspects but on practical use of digital technologies.

Then, the preliminary steps will evaluate control variables impact and the minimum sample size requirements.

14.1 CONTROL VARIABLES

"Age", "gender", "academic field", "tenure of the respondents" and "revenues of the company" were chosen as control variables. "Digital CFO" was chosen as dependent variable. An analysis of correlations between these variables and Digital CFO was developed with Stata/SE 14.1 software (Table 14-1).

Table 14-1: Correlation between control variables and Digital CFO

	Digital CFO
Age	-0.13
Gender	-0.04
Academic field	0.11
Tenure	-0.14
Revenues of the company	0.27

This analysis revealed very low coefficients of correlations. Thus, the control variables used in this study do not impact on the model output and were therefore omitted from further analyses.

14.2 DESCRIPTIVE STATISTICS

In Table 14-2, descriptive statistics have been reported. In the first column, the range of the answers is described. In the second and third column, the mean and the standard deviation have been calculated. In the columns 1 - 11, the intercorrelations between the variables are reported.

Table 14-2: Internal consistency of the scales

	Range	**μ**	**σ**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1. Growing relevance of digital technologies in Finance department	(1-7)	5,80	0,59	1										
2. Impact of disruptive forces	(1-7)	5,35	0,91	0,45	1									
3. Perceived relevance of digital technologies	(1-7)	4,11	1,22	0,53	0,61	1								
4. Area of influence of CFO	(1-7)	4,84	0,95	0,33	0,57	0,59	1							
5. Digital communication	(1-7)	5,00	1,13	0,40	0,55	0,46	0,64	1						
6. Digital Finance Department	(1-7)	4,41	1,25	0,24	0,33	0,22	0,35	0,38	1					
7. Data collection	(1-7)	4,65	1,19	0,12	0,50	0,42	0,37	0,30	0,17	1				
8. Data analysis	(1-7)	4,58	1,16	0,22	0,54	0,58	0,47	0,33	0,08	0,79	1			
9. Data usage	(1-7)	4,54	1,29	0,27	0,51	0,68	0,41	0,36	0,12	0,70	0,76	1		
10. Data storage	(1-7)	4,30	1,46	0,20	0,52	0,41	0,34	0,32	0,13	0,74	0,73	0,70	1	
11. Digital CFO	(1-7)	4,90	1,03	0,41	0,38	0,49	0,34	0,44	0,22	0,28	0,39	0,39	0,12	1

The means (μ) and standard deviations (σ) values of each indicator are measured according to the results of the questions of the respective indicator.

Particularly, "growing relevance of digital technologies" takes into account the results of question D22 of the questionnaire. It expressed the perceived growing relevance of the digital technologies in the Finance Department.

"Impact of disruptive forces" takes into account the results of question D16. This question investigated how much the selected forces were disrupting the CFO role, according to recipients' perception.

"Perceived relevance of digital technologies" takes into account the results of question D24. The chosen question concerned about the relevance perceived by the CFO of chosen digital technologies.

"Area of influence of CFO" takes into account the results of question D13. This question is related to the impact of digital technologies in expanding the area of influence of CFO in IT investments, operations management, communication, strategic decision-making.

"Digital communication" takes into account the results of question D23. This question expressed the degree of communication and knowledge sharing allowed by digital technologies among the different departments of the company.

"Digital Finance Department" takes into account the results of question D14. This question asked if the Finance Department of each questioned CFO could be defined as a Digital Finance Department.

"Data collection" takes into account the results of question D37. "Data analysis" takes into account the results of question D38. "Data usage" takes into account the results of question D39. "Data storage" takes into account the results of question D40. These questions together concerned the adoption of digital technologies within the Information Management Process (Ogiela, 2015).

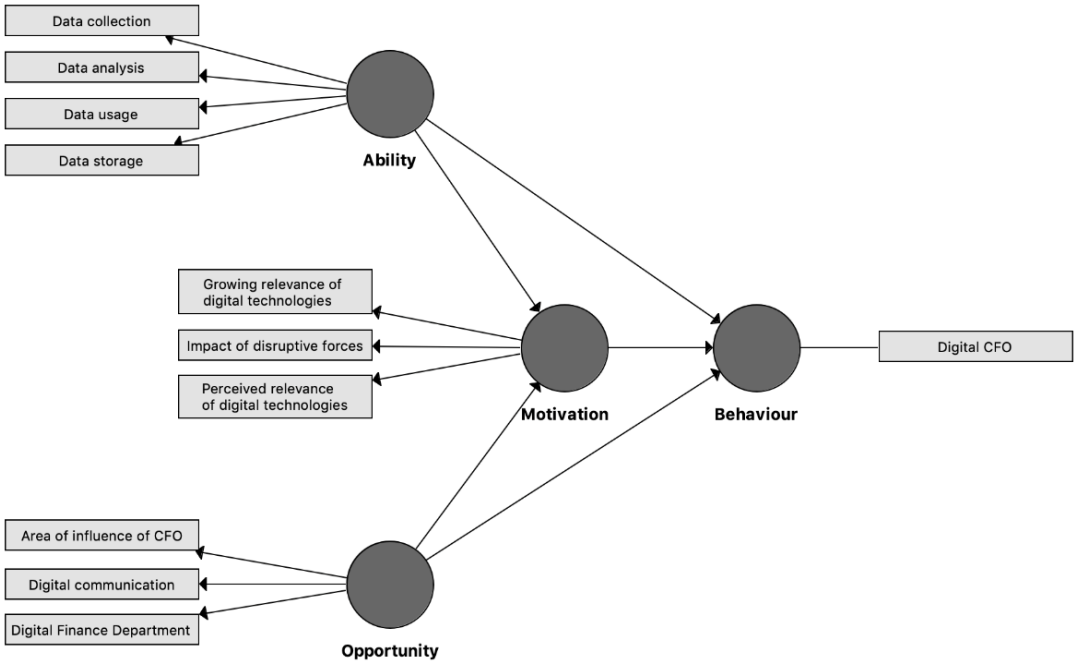
"Digital CFO" takes into account the results of question D13. This question asked if each questioned CFO recognized himself/herself as a Digital CFO.

14.3 Definition of Ability-Motivation-Opportunity path model

According to PLS path model theory, overall AMO research model is composed of 4 constructs and 11 items. Particularly, the path research model is composed by:

- "Motivation": multi-item construct; "growing relevance of digital technologies", "impact of disruptive forces", "perceived relevance of digital technologies" are the indicators;
- "Opportunity": multi-item construct; "area of influence of CFO", "digital communication", "Digital Finance Department" are the indicators;
- "Ability": multi-item construct; "data collection", "data analysis", "data usage", "data storage" are the indicators;
- "Behaviour": single-item construct; "Digital CFO" is the indicator.

In Picture 14-1, AMO research model is represented consistently with a PLS path model through the application of SmartPLS 3 software.



Picture 14-1: AMO path model

The **reflective measurement model** has been adopted to express relationships between constructs and items. In fact, the indicators selected can be considered as representative of the domain of the construct and interchangeable. The indicators have been chosen to provide a complete overview and estimation of each construct.

As represented in the image above, there are five direct relationships between the constructs which represent the hypotheses at the base of the research model. Three relationships connect the input (determinants of behaviour) to the output (behaviour) of the model. The other two relationships are aimed at explaining and understanding how the determinants are correlated each other.

Moreover, there are two mediating or indirect effects. “Motivation” can be defined as a moderator variable considering the indirect relationship between “ability” and “behaviour” and between “opportunity” and “behaviour”.

Therefore, both direct and indirect effects are going to be studied in the next chapters.

14.4 MINIMUM SAMPLE SIZE REQUIREMENTS VALIDATION

The sample applied to the model is composed of 41 completed observations. Two methods have been applied to test minimum sample size.

According to the ten times rule of thumb, in path model the largest number of structural paths leading to an endogenous construct is three. Thus, in this study the sample size of 41 was sufficiently high for PLS requirements and the sample was considered as validated.

According to Cohen’s (1992) recommendations for multiple OLS regression analysis, 26 observations are required in order to detect R^2 values of around 0,25, assuming a significance level of 10% and a statistical power of 80%. Therefore, the sample was considered as sufficiently high for PLS requirements and was validated.

14.5 PLS – SEM RESULTS OF MEASUREMENT MODEL

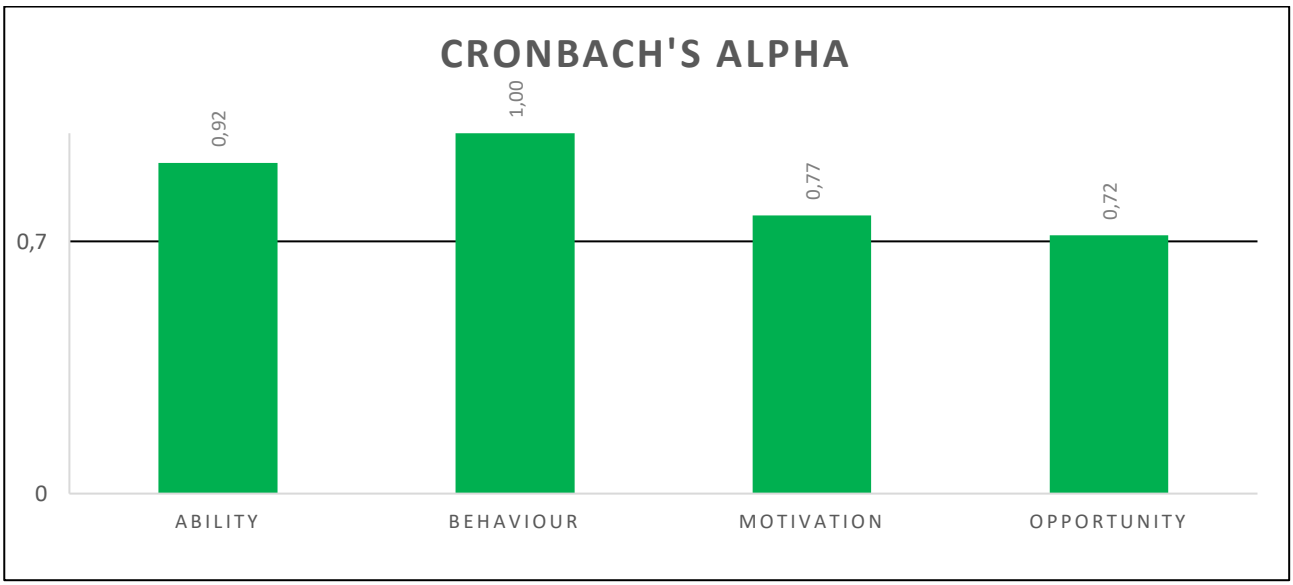
The measurement model is going to be studied from internal consistency, convergent validity, divergent validity perspectives. The same basic and advanced settings adopted for the application of PLS–SEM methodology to JD–R research model described in the previous chapter are going to be adopted.

14.5.1 Internal consistency reliability

Internal consistency reliability is evaluated through Cronbach's alpha and composite reliability measures. Table 14-3, Picture 14-2 and Picture 14-3 show the results achieved.

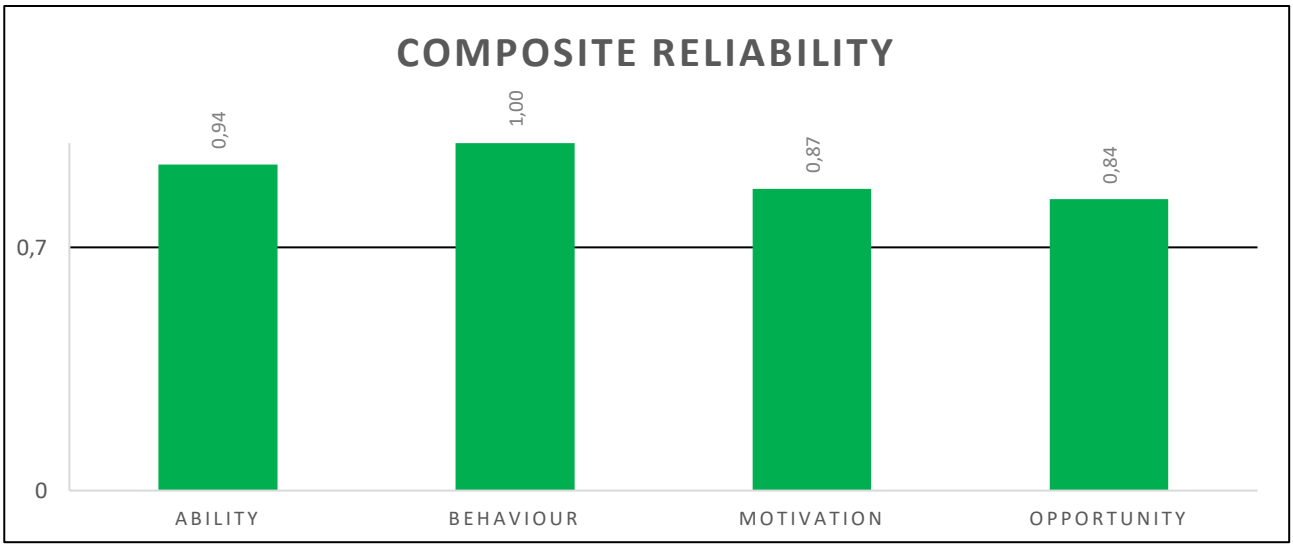
Table 14-3: Reliability of the constructs

	Cronbach's Alpha	Composite Reliability
Ability	**0,917**	**0,938**
Behaviour	**1,000**	**1,000**
Motivation	**0,773**	**0,868**
Opportunity	**0,717**	**0,839**



Picture 14-2: Cronbach's alpha of the constructs

As far as Cronbach's alpha measure, values are above threshold of 0.7 (Picture 14-2).



Picture 14-3: Composite reliability of the constructs

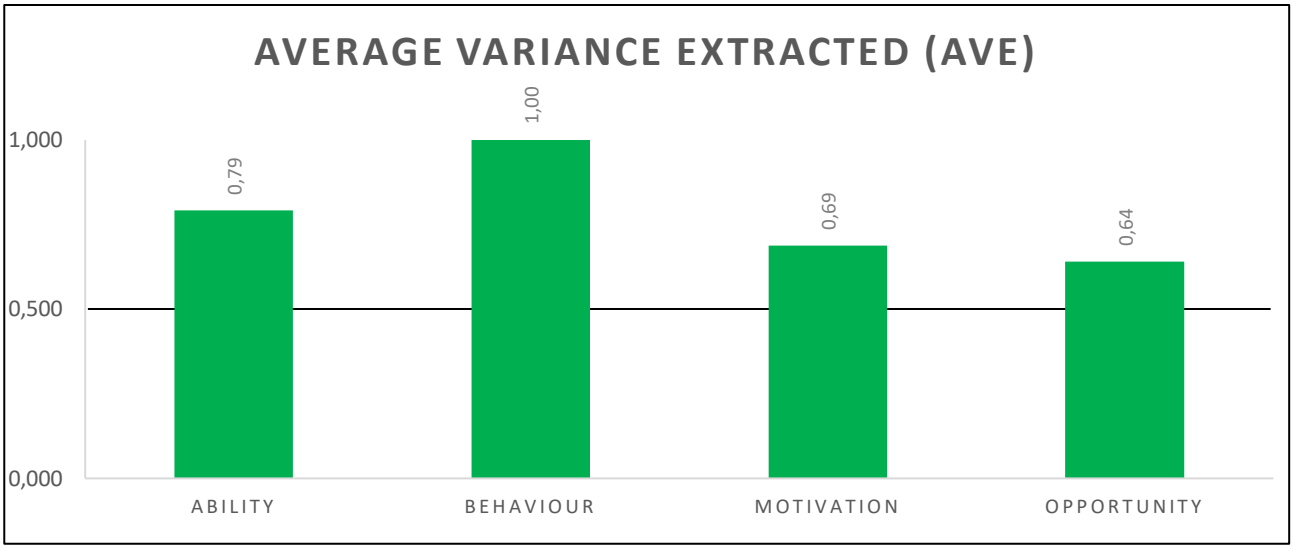
As far as composite reliability measure, values are above threshold of 0,7 (Picture 14-3). Therefore, **internal consistency of the constructs is confirmed.**

14.5.2 Convergent validity

AVE and indicator reliability have been considered as relevant measures for the evaluation of convergent validity. AVE results are showed in Table 14-4 and Picture 14-4

Table 14-4: AVE of constructs

	Average Variance Extracted (AVE)
Ability	**0,792**
Behaviour	**1,000**
Motivation	**0,688**
Opportunity	**0,640**



Picture 14-4: AVE of constructs

As shown in Picture 14-4, the AVE measures of the constructs of the model were all above the 0.50 acceptability level.

Table 14-5 reports Indicator reliability values.

Table 14-5: Indicator reliability

	Ability	Behaviour	Motivation	Opportunity
Area of influence of CFO				**0,875**
Data analysis	**0,922**			
Data collection	**0,890**			
Data storage	**0,863**			
Data usage	**0,900**			
Digital CFO		**1,000**		
Digital Finance Department				**0,611**
Digital communication				**0,885**
Growing relevance of digital technologies			**0,741**	
Impact of disruptive forces			**0,851**	
Perceived relevance of digital technologies			**0,886**	

As regards indicator reliability, standardized outer loadings were analyzed. They were all above 0,708 threshold, except for the outer loading that connected "Digital Finance Department" to "opportunity" construct. In this case, the value was 0,61 (the only red one in Table 14-5). Since the internal consistency threshold was satisfied and theory obliges to remove an indicator only if the outer loading is below 0,4 values, it was decided to keep "Digital Finance Department" indicator. Thus, **convergent validity of measures was confirmed.**

14.5.3 Discriminant validity

Cross-loadings criterion (Table 14-6) and Fornell-Larcker (Table 14-7) criterion have been considered as relevant measures for evaluation of discriminant validity. Their results are showed in the tables below.

Table 14-6: Cross-loadings criterion

	Ability	Behaviour	Motivation	Opportunity
Area of influence of CFO	0,450	0,344	0,622	0,875
Data analysis	0,922	0,393	0,563	0,401
Data collection	0,890	0,280	0,447	0,362
Data storage	0,863	0,116	0,476	0,352
Data usage	0,900	0,387	0,616	0,395
Digital CFO	0,348	1,000	0,515	0,433
Digital Finance Department	0,135	0,221	0,320	0,611
Digital communication	0,366	0,441	0,568	0,885
Growing relevance of digital technologies	0,233	0,407	0,741	0,414
Impact of disruptive forces	0,575	0,382	0,851	0,622
Perceived relevance of digital technologies	0,606	0,492	0,886	0,559

As far as cross-loadings criterion, for each construct the outer loadings of the indicators were higher than any of its cross-loadings on other constructs. Therefore, each indicator showed a higher correlation with the proper construct.

Table 14-7: Fornell-Larcker criterion

	Ability	Behaviour	Motivation	Opportunity
Ability	0,894			
Behaviour	0,348	1,000		
Motivation	0,598	0,515	0,828	
Opportunity	0,425	0,433	0,652	0,800

As regards Fornell-Larcker criterion (Table 14-7), overall the square roots of the AVEs for the reflective constructs “ability”, “behavior”, “motivation”, “opportunity” are all higher than the correlations of these constructs with other latent variables in the path model, thus indicating all constructs are valid measures of unique concepts.

The evaluation of these two measures provided sufficient **support for discriminant validity** (Mura, Lettieri, Radaelli & Spiller, 2014).

Overall, the research model can be considered as validated and reliable, having evaluated internal consistency, convergent and discriminant validity perspectives.

14.6 PLS – SEM RESULTS OF STRUCTURAL MODEL

The structural model evaluation is divided into steps and is accomplished through the application of SmartPLS 3.

The same basic and advanced settings adopted for the application of PLS–SEM methodology to JD–R have been implemented.

14.6.1 Step 1: collinearity

In the first step, collinearity between the constructs is evaluated calculating VIF measure. The values are showed in the Table 14-8.

Table 14-8: VIF values

	VIF
Area of influence of CFO	**1,737**
Data analysis	**3,543**
Data collection	**3,175**
Data storage	**2,677**
Data usage	**2,714**
Digital CFO	**1,000**
Digital Finance Department	**1,198**
Digital communication	**1,782**
Growing relevance of digital technologies	**1,445**
Impact of disruptive forces	**1,654**
Perceived relevance of digital technologies	**1,847**

Analyzing the values above, all VIF values of the constructs are below the recommended threshold of 3.3. Just one value (Data analysis) overtake the threshold. However the value stay below the recommended value of 5 settled by Hair, Hult, Ringle & Sarstedt (2016), thus it has been considered as acceptable.

Therefore, the constructs are **not affected by collinearity issues**.

14.6.2 Step 2: Path coefficients, indirect effects, total effects and bootstrapping

The second step focus on the study of relationships among the constructs. In particular, this kind of analysis allows to confirm or to reject the hypotheses at the base of the model.

In AMO research model, there are five direct relationships, evaluated by path coefficients, and two indirect effects.

The study of the relationship among the constructs is divided into two steps: first, path coefficients are qualitatively evaluated; second, to assess the statistical analysis of the relationships, a bootstrap analysis is performed.

14.6.2.1 Path coefficients, indirect effects, total effects

As far as the first step, the Table 14-9 and Picture 14-5 show path coefficients results.

Table 14-9: Path coefficients - Direct effects

	Ability	Behaviour	Motivation	Opportunity
Ability		0,054	0,392	
Behaviour				
Motivation		0,374		
Opportunity		0,166	0,485	

Picture 14-5: Path coefficients - Direct effects

As it possible to notice from the graph, the analysis suggests that:

- "Ability" → "Behaviour" (H1): not relevant relationship;
- "Motivation" → "Behaviour" (H2): positive relevant relationship;
- "Opportunity" → "Behaviour" (H3): positive marginal relationship;
- "Ability" → "Motivation" (H4): positive relevant relationship;
- "Opportunity" → → "Motivation" (H5): positive relevant relationship.

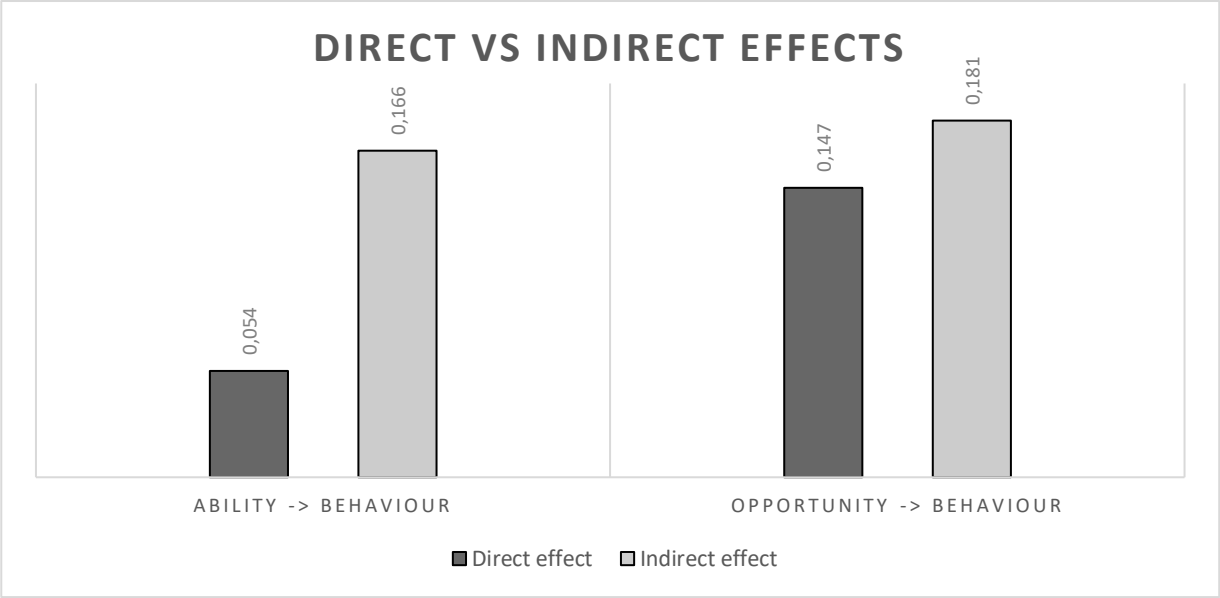
From a qualitative analysis of path coefficients, only H1 hypothesis ("Ability" → "Behaviour"; $\boldsymbol{\beta} = 0{,}05$) is not relevant. Therefore, "ability", measured by "data collection", "data analysis", "data usage", "data storage", has no direct effect to "behaviour", measured by "Digital CFO".

Table 14-10 focuses on the **indirect effects** between the constructs. The indirect effects are allowed by a mediator variable.

Table 14-10: Path coefficients - Indirect effects

	Specific Indirect Effects
Ability → Motivation → Behaviour	0,147
Opportunity → Motivation → Behaviour	0,181

The analysis of the indirect effects suggests that both are positive marginal effects. Moreover, interesting insights are provided by the evaluation of indirect relationships; they are showed in Picture 14-6.



Picture 14-6: Direct and indirect effects comparison

As shown in Picture 14-6, comparing the direct to the indirect effects, it is possible to notice that the constructs "ability" and "opportunity" have higher effects on "behaviour" indirectly, through "motivation" as mediator variable. Therefore, "ability" and "opportunity" are able to increase a digital "behaviour" enhancing "motivation".

Table 14-11 provides the big picture about the **total effects** between the constructs, considering both direct and indirect effects.

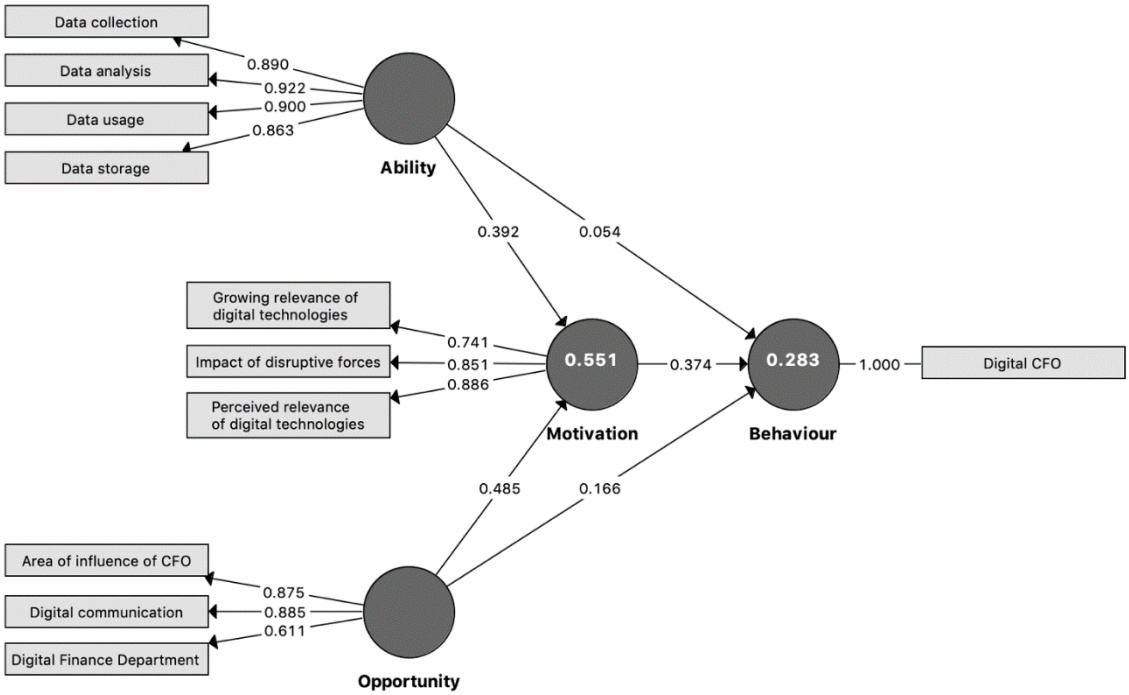
Table 14-11: Path coefficients - Total effects

	Ability	Behaviour	Motivation	Opportunity
Ability		0,201	0,392	
Behaviour				
Motivation		0,374		
Opportunity		0,347	0,485	

Table 14-11 provides a comprehensive understanding of the constructs and the relationships surrounding the research model, summarizing the direct and indirect ones.

The analysis of total effects values suggests that all total effects are positive and relevant. Therefore, considering both direct and indirect effects all the constructs seem to be positively correlated.

Picture 14-7 gives a visual representation of the research model. The relationships among the variables are evaluated by the path coefficients and outer loadings on the respective arrows. Inside the circles of the endogenous latent variables, R^2 coefficients are showed; these coefficients are going to be examined in the next step of structural model evaluation.



Picture 14-7: AMO with path coefficients

14.6.2.2 Bootstrapping

In the second step of path coefficient analysis, since PLS does not require any assumptions about the distribution of the observed variables, in order to assess the statistical significance, a **bootstrap** re-sampling procedure was performed.

As regards bootstrap procedure, the same basic and advanced settings adopted for the application of PLS–SEM methodology to JD–R have been implemented though *SmartPLS 3* software. The statistical significance of path coefficients, indirect effects, total effects are going to be evaluated through the assessment of **p-values.**

Table 14-12 focuses on p-values as statistical values of the distributions.

Table 14-12: Statistical values of bootstrapping of path coefficients

	Original Sample μ	Bootstrap Sample μ	σ	P - values
Ability → Behaviour (H1)	0,054	0,058	0,149	**0,717**
Motivation → Behaviour (H2)	0,374	0,373	0,199	**0,060**
Opportunity → Behaviour (H3)	0,166	0,161	0,211	**0,430**
Ability →Motivation (H4)	0,392	0,396	0,116	**0,001**
Opportunity → Motivation (H5)	0,485	0,499	0,091	**0,000**

As regards the evaluation of p values, when assuming a significance level of 10%, the p-value must be smaller than 0,1 value. Thus, analyzing the values from Table 14-12, "Ability" → "Behaviour" (p-value = 0,717) and "Opportunity" → "Behaviour" (p-value = 0,430) path coefficients are not statistically significant.

As a result of statistical analysis of path coefficients, it is possible to assess that only H1 ("motivation" → "behaviour") is **statistically significant**. All the other path coefficients can be considered as statistically significant.

As a result of statistical analysis of path coefficients, it is possible to assess the statistical significance of hypotheses at the basis of the model. All the hypotheses are statistically significant, except for H1 ("ability" → "motivation"), H3 ("opportunity" → "motivation") hypotheses.

In the following section, the analysis goes further and the focus is moved to indirect effects and total effect to provide a comprehensive and deep overview of the model.

Table 14-13 focuses on p-values as statistical values of the distributions.

Table 14-13: statistical values of bootstrapping of indirect effects

	Original Sample μ	Bootstrap Sample μ	σ	P - values
Ability → Motivation → Behaviour	0,147	0,150	0,100	**0,144**
Opportunity → Motivation → Behaviour	0,181	0,182	0,098	**0,066**

Analyzing the results from Table 14-13, "ability" → "motivation" → "behaviour" indirect effect is not statistically significant (p-value= 0,144), while "opportunity" → "motivation" → "behaviour" is statistically significant (p-value= 0,066).

Table 14-14 focuses p-values as statistical values of the total effects.

Table 14-14: Statistical values of bootstrapping of total effects

	Original Sample μ	Bootstrap Sample μ	σ	P - values
Ability → Behaviour	0,201	0,208	0,122	**0,101**
Ability → Motivation	0,392	0,396	0,116	**0,001**
Motivation → Behaviour	0,374	0,373	0,199	**0,060**
Opportunity → Behaviour	0,347	0,343	0,182	**0,057**
Opportunity → Motivation	0,485	0,499	0,091	**0,000**

From the results of Table 14-14, "ability" → "behaviour" total effect is the only one as not statistically significant. It is consistent with previous results, since both direct and indirect effect between "ability" and "behaviour" were not statistically significant.

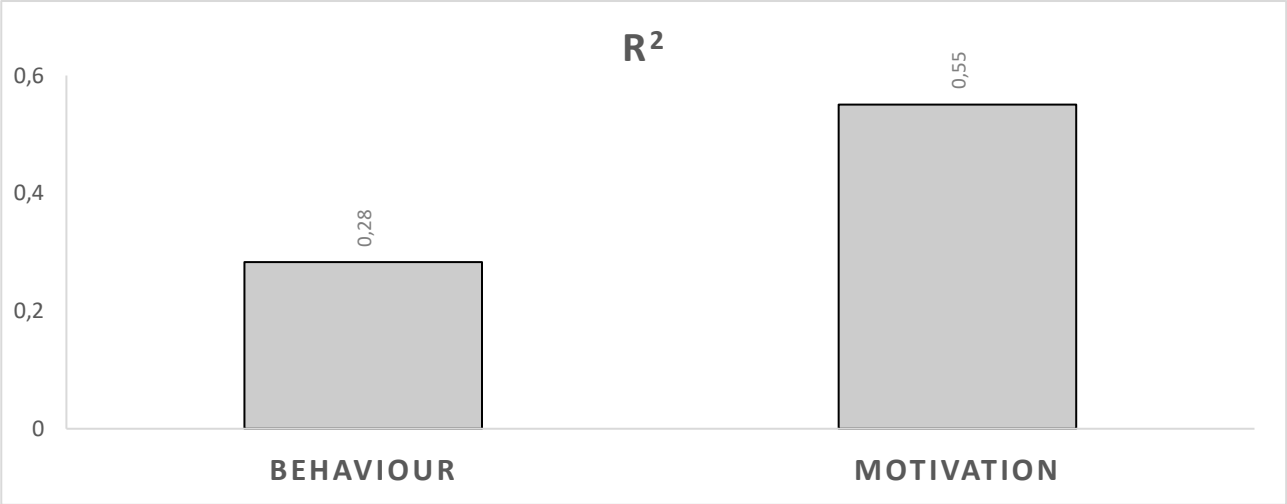
14.6.3 Step 3: R^2

In the third step, R^2 coefficients are evaluated to analyse the degree of the explained variance of each endogenous construct.

In AMO research model, "behaviour" and "motivation" are the endogenous constructs. The results are reported in Table 14-15 and Picture 14-8.

Table 14-15: R^2 value

	R^2
Behaviour	0,283
Motivation	0,551



Picture 14-8: R^2 values

Considering the rule of thumb, R^2 value of endogenous latent variables can be described as:

- "Behaviour": weak R^2 value;
- "Motivation": moderate R^2 value.

First, the low R^2 value of "behaviour" endogenous latent variable may be explained by the low number of determinants at the basis of the theoretical model. In fact, as explained in AMO literature review, one of the limitations of the framework is its simplistic nature, aimed at understanding a particular attitude from only three kinds of determinants. In this way, the unexplained variance can be addressed to model's limitation.

Second, the moderate R^2 value of "motivation" is the result by proper choices for the measured variables. In fact, chosen items of "ability" and "opportunity" constructs have allowed to explain more than half variance of "motivation", even though only two pointing paths.

Overall, the weak and moderate of R^2 values may be explained by the low numbers of constructs and pointing paths within the research model.

14.6.4 Step 4: f^2

In the fourth step, the variation in the R^2 value when a specified exogenous construct is omitted from the model is assessed and is represented by f^2 values.

These results are reported in Table 14-16.

Table 14-16: f^2 values

	Ability	Behaviour	Motivation	Opportunity
Ability		0,003	0,280	
Behaviour				
Motivation		0,088		
Opportunity		0,022	0,429	

Considering the guidelines from theory, f^2 values above can be described as small, medium and large effects:

- "Ability" has no effect on "behaviour" and medium effect on "motivation";
- "Motivation" has small effect on "behaviour";
- "Opportunity" has small effect on "behaviour" and large effect on "motivation".

The results of f^2 values are consistent with previous analyses. In fact, "ability" and "opportunity" have higher effects on "motivation" than "behaviour", thus "motivation" is the construct with the higher effect on "behaviour".

14.6.5 Step 5: Q^2

In the fifth step, Stone-Geisser's Q^2 value was examined. Q^2 values are reported in Table 14-17.

Table 14-17: Q^2 values

	SSO	SSE	Q^2 (=1-SSE/SSO)
Ability	164,000	164,000	
Behaviour	41,000	33,918	**0,173**
Motivation	123,000	84,282	**0,315**
Opportunity	123,000	123,000	

As can be seen from Table 14-17, the Q^2 value of "behaviour" and "motivation" endogenous constructs are above zero value.

These results provide clear support for the model's **predictive relevance** regarding the endogenous latent variables.

14.6.6 Step 6: q^2

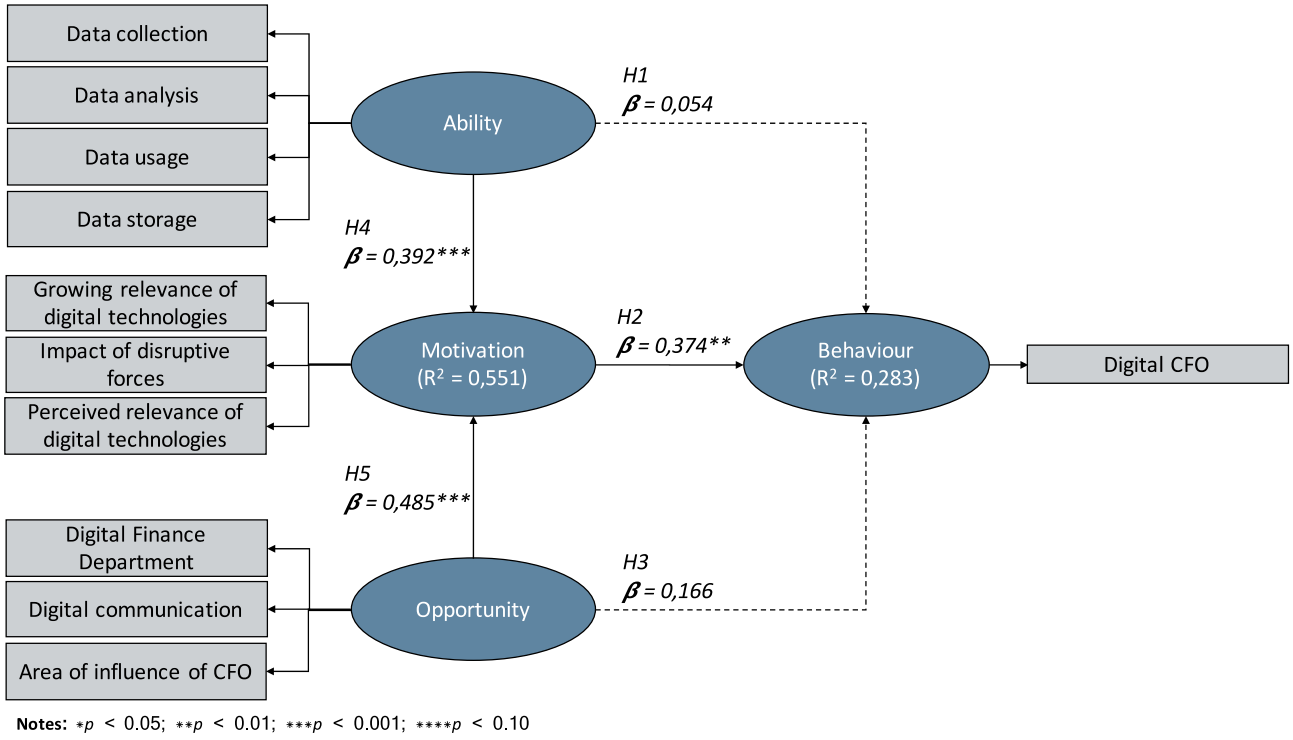
The sixth step of structural model evaluation is not developed within this research. This choice is explained by the same reasons provided in the previous chapter regarding the application of PLS methodology to JD–R research model.

14.7 Conclusions

The assessment of AMO research model is completed. The evaluation of the measurement model allowed to demonstrate the reliability and the validity of the model. Then, the evaluation of the structural model allowed to go further and analyse deeply the different variables and relationships within the model.

This following image provides comprehensive insights about the research model. In particular, in the image the main significant measures as path coefficients (β) and R^2 are displayed.

The dotted arrows between the constructs represent the not validated hypotheses. The number of asterisks close to the path coefficients reflect the p-values (Mura, Lettieri, Radaelli & Spiller, 2016).



Picture 14-9: Significant coefficients and R^2 values of AMO

Picture 14-9 allows to review and to provide final considerations about the hypotheses at the basis of the model, built from the literature in the previous chapters.

H1. Strong digital capabilities increase the digital behaviour of a CFO.

"Ability" has no statistically significant relationships with "behaviour". Therefore, this hypothesis was **not validated** within this research.

H2. A high motivation in introducing digital technologies increases the digital behaviour of the CFO.

Digital CFO "behaviour" is positively and significantly affected by "motivation". Therefore, this hypothesis was **validated** and **confirmed** within this research.

H3. The more the environment will present opportunities, the more the CFO might become digitalised.

"Opportunity" has no statistically significant relationships with "behaviour". Therefore, this hypothesis was **not validated** within this research.

H4. Strong digital capabilities increase motivation in introducing digital technologies.

"Motivation" is positively and significantly affected by digital "ability". Therefore, this hypothesis was **validated** and **confirmed** within this research.

H5. The more the environment will present opportunities, the more the CFO might be motivated in introducing digital technologies.

"Motivation" is positively and significantly affected by digital "opportunity". Therefore, this hypothesis was **validated** and **confirmed** within this research.

Overall, three out of five research hypotheses were validated and confirmed within the research model, by the application of PLS–SEM methodology.

From the results of PLS-SEM application, CFO's motivation has resulted the only construct having a direct impact on behaviour inclined to digitalization. Therefore, AMO research model has allowed to explain when and how CFO's motivation leads to such behaviour, depending on items like disruptive forces and perception of disruptive forces (application and growth of relevance).

Moreover, PLS-SEM results have demonstrated that CFO's motivation can be fostered by digital capabilities and opportunities from the environment. This further understanding of the model provides insights about correlations among behavioral determinants of the model.

15 DISCUSSION AND CONCLUSIONS

This research was born with the objective of analysing and exploring the on-going transformation occurring to CFOs caused by the introduction of a new digitalised environment. The relevance of this study is explained by the critical role managed by the CFO within the company, which requires the use of cutting-edge tools and methodologies to improve value creation in Finance Function. This alignment might be intensely shaken and no more assured due to the disruptive changing brought by digital technologies.

As discussed, digital technologies are going to strongly affect the way firms run their business, bringing along new business models, skills and professionals.

Within this new paradigm, CFO and Finance Function might play a central role in value creation. Indeed, digital technologies are providing a whole new relevance to data, which now is no more just focused on past information and control but also in prediction and explanation of complex environments. Finance as a highly data-driven function can take advantage of this new environment increasing its value creation capabilities.

However, it is arguable that how the professional role will evolve is still not clear and the use of digital technologies might lack in a standard approach. Moreover, the continuous evolution of CFO during its whole life brought the role to gain always wider tasks and responsibilities, undermining the psychological sustainability of the role itself. In this research study, the psychological wellness is assessed in order to assure not only the future state of CFO but also its long-term psychological sustainability in a fast-paced changing environment.

In order to accomplish these goals, the study has required several steps: **a structured literature review, the design of research frameworks, the empirical research and the test of research hypotheses.**

The first step was the design of a structured, pragmatic and holistic literature review. To do so, a funnel approach based on inclusion/exclusion criteria was settled and assured an effective and objective selection of the material to harvest the theoretical background.

At the end of the literature review, 108 papers were selected and divided among the main research topics of this study: **Chief Financial Officer, Industry 4.0, digital technologies, psychological wellbeing** and **behavioural determinants.** Therefore, papers selected allowed a deep and wide analysis of the CFO's background, an examination of the current digitalised environment and eventually the study of proper frameworks to assess psychological wellbeing and behavioural determinants.

The literature review related to CFO's background allowed to identify three different historical moments according to the specific role played within the company: **the accountant, the business partner, the value owner.**

Between 1930 and 1990, the business environment was considered as stable and CFOs acted mainly as controllers and "bean counters" accountable of the company's financial sustainability. The accountant value was created without a strong use of technology and based on simple financial metrics as ROI and RI (Howell, 2006).

Successively, the complexity of the environment started raising because of globalization, fluctuation of stock market, and introduction of ICT technologies. The adoption of more complex key indicators based not just on financial data, but also on operative information such as quality and flexibility started to spread. In this context, CFOs expanded their role toward CEO's business partner and adviser.

In fact, CFOs were expected to increase their support in strategic and operational decision making with a business partnering capacity. This came in addition to fulfilling traditional stewardship responsibilities relating to governance, compliance and control, and business ethics. Together with CFO, the Finance function evolved from a transactional and cost efficiency orientation to an increasingly value-adding strategic one, by participating in strategy development and validation, implementation, and evaluation. Thus, in its second historical moment, CFOs were expected to help drive the performance of the organization, no more by only delivering numbers, but providing insights into business and strategic performances and the factors affecting them (International Federation of Accountants, 2013).

The latest stage is occurring in the last decade, since Industry 4.0 is establishing as new industrial paradigm bringing several innovations. In this new paradigm, CFO covers the role of Value Owner.

According to a study developed by O'Keeffe (2017), the environment in which organizations are acting is increasingly complex and challenging. Not only the emerging new paradigm is pulling toward new and innovative business models triggering changing processes, but also concurrent forces such as: demographic shifts, globalization, rapid development of new digital technologies, increasing power of customers, introduction of automation and insights from business intelligence and big data analytics are disrupting the way firms run their businesses. Arguably, this impact is going to directly involve managers.

Indeed, it is demanded to CFOs ensuring financial stability of the company in a changing environment where it might not exist a resilient business model. Ambidexterity is a key capability of CFO to understand and cope the recent digital trend without remaining stuck in obsolete processes.

Luckily, as Industry 4.0 allows many opportunities to improve business models, it allows also several opportunities and tools to positively transform the Finance Function. **Artificial Intelligence** to support quantitatively and objectively complex decisions, **Big Data and Analytics** to extract insight from real time data, **Robotics Process Automation** to automate repetitive tasks, and **Cloud Computing** for knowledge sharing have been identified as the main relevant digital technologies enhancing CFOs and their departments in value creation.

Therefore, in this new digitalized environment the role of CFO results disrupted and deeply changed.

Firstly, new tasks are emerging in CFO's role. As argued in an Ernst & Young Study conducted by O'Keeffe (2017), in the future finance will cope with a wider stakeholders' base, communicating financial and non-financial information where the future is the main focus. Successively, the application of Industry 4.0 significantly improves the amount of information extracted from operations processes and transmitted in real-time toward monitoring and decision-making process. However, to do so, it is necessary to evolve IT systems making them more integrated, consistent and reliable.

Furthermore, in order to improve communication, reporting system are required to be aligned and updated in a world 4.0 revolution. Indeed, when in 1970s the corporate reporting standards were established, manufacturing companies were 80% of

S&P market value, thus reporting systems mainly focused on evaluation of physical assets. Today, since the source of competitive advantage has moved toward intangible assets, the objective and correct evaluation of intangible assets (knowledge, IT and data) will represent a relevant issue for the upcoming years (O' Keffee, 2017). Thus, it is important to correctly record these assets and to foster their implementation to tackle the future challenges and opportunity in a way strategic goals are met. IT systems are increasingly measured on business metrics in terms of quality, responsiveness, business value, end customer's satisfaction, cost efficiency, time-to-market, strategic fit (Willcocks, Lacity & Craig, 2015).

Moreover, stakeholders and shareholders are more and more focused on strategy, sustainability and risk management issues. For this reason, CFO is increasing its importance in communication and investor relations role.

Eventually, it is necessary to consider the influence CFOs should have on Digital Business Strategy and ICT function. Indeed, analytical system might be affected by incompleteness and inconsistency in particular at the early stages of projects. This is often due to a misalignment between business aspects and the implementation of the analytical system (activities, algorithms, …) and when there is a lack between analytics and business strategies, the expectations of the projects might be not met (Nalchigar & Yu, 2017). CFO role might guarantee alignment and consistency of the digital systems implemented.

The emerging role is identified by the authors as the **Digital CFO (DCFO)**, defined in this research as "an innovative and technical-skilled professional figure able to understand, align, merge and optimize the traditional processes of Finance function (budgeting, risk analysis, reporting, cost analysis, …) through a harmonic and holistic exploitation of digital technologies such as Big Data, Cloud Computing, Artificial Intelligence and Robotics Process Automation. Digital Chief Financial Officer is proactively involved in company digital business strategy definition, enhancing firm's digitalization".

Once completed the analysis of the actual state of CFO's role, the focus of this research moved to the understanding of its psychological wellbeing and behavioural determinants assessment.

However, due to the gaps in the extent literature, two **research questions** have been defined. The first one wants to determine if the level of strain and motivation, caused by the introduction of digital technologies, lead to a reduced psychological well-being of the individual. The second one is concerning the definition of Digital CFO's determinants, thus understanding under which conditions and forces a "traditional" CFO is pushed toward a digital revolution.

Therefore, two research frameworks were chosen in order to accomplish the research questions of the study.

The **Job Demands-Resources (JD-R)** model was selected as the framework for psychological wellbeing assessment. Theory behind JD-R model assess that the creation of strain (energetic process) or motivation (motivational process), related to the working task, is due to the balance between the demands the job requires and the resources available to the employee. The original model has been integrated in this study with the relevance of digital technologies. The research framework was aimed at defining if the adoption of digital tools positively or negatively influenced CFO's turnover intentions within the firm.

Then, the choice of **Ability-Motivation-Opportunity (AMO)** model from literature was oriented to study the determinants pulling CFO toward digitalization. This model tries to explain individuals' behaviour starting from: Ability – skills and capabilities requisite to exploit opportunities; Motivation – the impetus toward a behavior; and Opportunity – contextual and situational constraints relevant to the performance of the Behavior. These constructs were measured through proxies identified respectively in: actual abilities in exploiting the digital technologies; perception of an imminent changing; level of digitalization of the organization.

The defined frameworks included research hypotheses which were tested through empirical research. The empirical research was characterized by the development of a **research questionnaire**, which involved Italian CFOs operating in medium-large companies. The survey consisted in the delivery of a 67-question questionnaire divided into three sections: Control variables; Digitalization of CFO; and Psychological well-being. The latter was composed of 27 readapted standard questions from OLBI, COPSOQ, QWI, UWES questionnaires.

Overall, **41 observations** of CFOs were collected from the survey. The observations were studied through a representativeness analysis considering the industries and firm's size distribution in comparison with the Mediobanca Ricerche e Studi list. The sample was considered as representative of the population and statistically assuring 12.9% of confidence Interval at 90% of confidence level.

Data collected were explored through a **descriptive analysis**, which allows to provide a comprehensive picture of Italian firms' digitalization degree, and through **PLS-SEM methodology** in order to test the two research frameworks.

The descriptive analysis, considering DCFO, Digital Finance Function and Digital firm, was made in order to extract insights from the assessment of the current state of digitalization in Finance in Italian business network. From this analysis, it emerged that Italian CFOs do not suffer of low tenure; indeed, a single regression model statistically confirmed the relationship between age and tenure (β= .578; R^2 = .231; p= .0019).

Moreover, a single regression model confirmed the correlation between involvement in Industry 4.0 projects and the perception of external turbulence. The more an organization perceive the external turbulence, the more it is driven to implement Industry 4.0 projects (β= .463; R^2 = .220; p= .049).

As regards the use of digital technologies, it was observed that Big Data Analytics and Cloud Computing are the tools primarily used in Finance department. These seems to have wider use across the main tasks assigned to CFOs and their use spread across the entire Information Management Process, from data collection to information storage.

The application of Robotics Process Automation presents seems to be linked to the efficient management of routinized activities. This is explained by the relevance in Information Management Process' stages and in activities such as auditing, forecasting, risk analysis and sensitivity analysis.

Artificial Intelligence appears to be the less used technology. Its applications focus on forecasting, risk analysis and sensitivity analysis. Contrary to RPA, AI application is devoted to the effectiveness of the analysis and in providing meaningful insights.

However, it seems to be not fully exploited and its application stay limited to few activities.

On average, the investments in these digital technologies is increasing if compared to the previous year's investments. According to the data, RPA peaked to a value of +9.4% while the Clouding, BDA, and AI touches respectively +6.9%, +6.5%, +5.1% increments in next year's investments.

As regards the data processed, customers and operations data strongly hold the first position in terms of relevance, followed by competitors and partners data. Other types of data, e.g. mass media, social media, and stock market are less used, probably because characterised by unstructured and non-financial information which might be difficult to process. However, the growing relevance of Artificial Intelligence and Big Data Analytics might turn upside-down this situation, providing huge volume of meaningful insights also from these data.

Then, JD-R and AMO were analysed using PLS-SEM analysis and supported by SmartPLS 3.0 software. PLS-SEM confirmed the reliability and the validation (both convergent and discriminant) of the research frameworks.

Finally, the results of research hypotheses testing provided several meaningful insights.

The JD-R model confirmed the presence of a motivational process led by the introduction of digital technologies to the professional role. This motivational process eventually brings to an improvement of tenure characterising CFOs. More in depth, the use of digital technology improves the job resources (β= .564; R^2= .318; p=0.00), job resources improve work engagement (β= .558; R^2= .312; p=0.00), and work engagement reduces CFO's turnover intention (β= .697; R^2= .784; p=0,00).

On the other hand, the energetic process triggered by the new responsibilities and learning process was not confirmed. This might be due to the absence of such process in this digitalization process or by the wrong selection of indicators measuring the job demands and burnout.

Therefore, JD-R research model testing allowed to answer to the first research question. The results showed that the introduction and the adoption of digital

technologies (e.g. Artificial Intelligence, Big Data & Analytics, Cloud Computing, Robotics Process Automation) trigger the motivational process, in favour of burnout reduction and work engagement enhancement. In the end, a decrease of CFO's turnover intentions is expected in an environment supported by the digital tools.

The AMO model confirmed the positive relationship between motivation and the attitudes of commitment toward digitalization (β= .374; R^2= .283; p= 0,06). On the other hand, opportunity and ability were rejected from being determinants in CFO's digitalization. Moreover, the research model investigated the correlations between the determinants. Motivation was demonstrated to be enhanced by ability (β= .392; R^2= .551; p= 0.00) and opportunity (β= .485; R^2= .551; p= 0.00).

These findings satisfied the second research question within this study. Therefore, the CFO's digital behaviour is pulled by his/her motivation, which is driven by the ability in digital technology adoption and by the opportunities available within the firm and the Finance department. Both training for development of analytical capabilities and a digitalised environment are required to set the basis for a digital CFO's attitude.

15.1 Insights for academics

In conclusion this study provided some relevant insights for academics and researchers. First of all, the systematic review of the literature highlighted the current state of knowledge about the CFO. Through this analysis, a lack in studying CFO's digital evolution and about the psychological wellbeing of this professional role were identified. This study wants to contribute in this sense and this objective seems to be achieved. Indeed, the professional role of CFO was thoroughly analyzed through its history identifying an original classification based on the role played within the company. Each step of the CFO was related to external contingency factors which pushed toward CFO's evolution. This might represent a relevant achievement because might explain future evolution through the study of past events. How supported by the

theoretical background of this research, every time complexity and evolution of tools occur, the role of CFO might evolve gaining importance.

Moreover, while many studies focused on understanding the importance of having a digitalised CFO, no one has actually taken care of the determinants causing digitalization or how the personal wellbeing might be affected by the changing process. This research achieved both these objectives. Motivation is proved to be a key determinant in fostering adoption of digital technologies. Furthermore, the introduction of digital technologies was proved to positively influence psychological wellbeing.

In addition, the use of these two models contributes to the literature in confirming the validity and the span of application of JD-R and AMO. More in depth, JD-R suffers of a strong flaw toward human-services working activities, the application to managerial function represents an innovative use of this model. As regard AMO, the literature about the application of this model seems to be limited, albeit the model provides wide flexibility and fields of application. The application of AMO model to understand the key determinants in CFO's digital evolution represents a key point in this study and contribute in improving the validity of AMO model.

Another important suggestion should be reported. This study focused on understanding causes, evolution and effects of introducing digitalization related to Chief Financial Officer because it is become the value owner in using data-driven analysis within the organization. However, the digitalization evolution will touch every executive in any organization. Thus, it might be possible to exploit the framework used in this study to conduct similar analysis targeted toward other C-level managers (i.e. CEO; COO; CIO). On the other hand, the focus might remain on CFO but exploring how the result of these analyses might change throughout different time period running longitudinal researches.

Additionally, the data gathered through this study are now available within literature to support successive empirical researches. For instance, it has not been possible to assess the actual existence of social desirability bias and non-response bias because of lack in precedent studies. Further studies might exploit the results achieved here to better interpret information thanks to benchmarking.

Furthermore, the literature about CFO is enriched of a new definition of the Digitalized CFO (DCFO) which merges the use of digital technologies with the responsibilities of the finance leading executive. Similarly, the Finance Function was redefined to embrace the new digital nature, evolving toward the Digital Finance Function.

Eventually, the application and described use of digital technologies within Finance might drive more aware researches aimed at understanding, developing and standardising the use of these new technologies. Artificial Intelligence seems to be the most ambiguous technologies where some efforts deserve to be spent.

15.2 Insights for practitioners

This research holds some meaningful insights for practitioners as well.

The literature review and the new definitions provided concerning digitalization in Finance might support and direct CFO's effort in introducing or enhancing the use of digital technologies within the organization. More in depth, skills, attitudes, responsibilities and use of the four digital technologies is analysed in this study and can help CFO in spotting inconsistency in their everyday work and getting up-to-date with the new digital paradigm.

This study enhances the relevance of deeply understanding the current digital shift and in being aware of the huge amount of value that it is possible to create with the use of the right tools within the Finance Function.

Moreover, it has been proved the importance of always questioning the business and the environment to identify criticalities which requires a changing process. For instance, the implementation of Industry 4.0 paradigm, which benefits has been deeply discussed, has been demonstrated to be linked to the perception of external turbulence. Therefore, companies not aware about external conditions might not notice the need for implementing a new business paradigm, thus losing competitive advantage.

The snapshot of Italian digitalization state might be used by CFO to self-assess its the level of digitalization understanding if it is aligned with the market. Indeed, the statistics provided are a powerful benchmarking tool to comprehend how to exploit data and digital technologies.

As regard the digitalization's determinants, AMO proved that motivation is the main determinant acting on CFO's digitalization. This motivation is triggered by the perception of relevance ad growth; thus, a conscious assessment of the environment might be enough to start the evolution process. According to AMO, external opportunities, such as the presence of digital within the company, and abilities, as the actual use of digital technologies, might not have a direct effect toward digital behavior enhancement. However, these last two indirectly foster digital attitude thanks to their impact toward motivation. Hence, designing training path and being plunged within a digitalized environment will eventually trigger a digital behavior.

Eventually, JD-R supports the hypothesis that CFO will improve their personal wellbeing through the introduction of digital technologies. Indeed, workload and cognitive demand, implied by job enlargement and learning process, have resulted not impacting on the energetic process. On the other hand, the motivational process surges thanks to the introduction of these technologies. Personal development and Autonomy foster work engagement and lower turnover intention. This research proved that, in addition to the positive direct improving of performance brought by digitalization, the adoption of digital technology increases CFO's wellness. Hence, it might be suggested to CFOs affected by strain the introduction of digital technologies in order to improve their working conditions. Indeed, as supported by Schaufeli (2017), increasing of job resources cause the best impact on personal wellbeing, reducing burnout while enhancing work engagement.

A virtuous cycle might be identified from the big picture provided by AMO and JD-R. Indeed, external conditions trigger adoption of digital technologies which improves the work engagement of CFO and motivation with it. At this point the inner motivation itself, obtained by a positive working experience, will drive the improvement of digital technology, which once again will increase the working conditions. This cycle

brings a win-win situation where the improvement of company's performance corresponds to a better working experience of CFO.

16 LIMITATIONS

Although this study provides several meaningful insights for academics and practitioners, it is also affected by some limitations due to constrains brought by literature and empirical research. In this section, the main limitations encountered are going to be listed and discussed.

The main limitation occurred is related to the **dimension of the sample** used to run the empirical research. Even though the sample has been considered as representative of the population selected and its size was sufficient to overcome the minimum bar imposed by PLS-SEM analysis, it is not deniable that a sample of 41 observation might bring along some bias.

Albeit several countermeasures were taken during the survey design to ensure a sufficient level of answers, due to the low response rate observed, the volume of answers settled on a level considered as barely acceptable.

Having a small sample size brought some problems during analyses. For instance, the JD-R's item used was affected by a low Cronbach's alpha, which might be improved if a bigger sample was available. The low Cronbach's alpha forced the removal of 7 standard questions out of 27 questions proposed.

Moreover, the low volume of observations assured a sample's confidence interval of 12.9%, worse than the 10% expected and, most important, very distant from the 5% usually expected in survey researches.

After that, having the low sample size might have compromised the descriptive analysis, which due to the low volume of data was characterised by a discrete behaviour instead of a continuous one which would have easily visualized peculiar trends and behaviours.

Another limitation faced was given by the **subjectivity** factor introduced by the questionnaire. Indeed, even if it has been tried to reduce subjectivity through questions aimed at describing the actual use of digital technologies and concrete factors, such as processes and forces, the absence of a common perspective in assessing the real use of

digital tool cannot be overlooked. However, obtaining that kind of observation would mean to visit every participants' workplace for a sufficient period of time to generalize the observations. As it is easy to comprehend, due to time and space constrains, it has not been possible to run these analyses.

Other limitations were given by the innovativeness of the research and the **few materials available** to compare the results obtained. For instance, not having a previous study about the level of CFO's psychological pressure, burnout and engagement, increased the difficulties in assessing the impact given by the adoption of digital technologies. To solve this issue, burnout and engagement have been measured through an incremental perspective, this led to the conceal of the absolute level of stress hold by the professional role. Another example given by the absence of previous researches consists of the lack in clues to analytically assess the presence of non-response bias and social desirability bias.

In addition, the disappointing values obtained from the PLS-SEM analysis of Job Demands in JD-R model, might suggest the selection of wrong indicators hiding a possible energetic process caused by the introduction of digital technologies.

Moreover, the little material available regarding AMO and CFO did not allow a strong hypotheses definition supported by the literature review. Hence, the predictors were generated by an innovative effort which, however, might not reflect the reality.

Another noteworthy limitation is given by the technologies considered in this research. Indeed, albeit the four technologies used are considered as the most relevant for future creation of value in Finance function, **it cannot be considered as a comprehensive list**. Simulation, Blockchain, Wearable devices, Platforms and applicative systems have been excluded from this analysis, even though it is fair to assume their growth in relevance in CFO's future.

Furthermore, in this study no relationships were found between the **DCFO and the firm's performances**. In other words, while it has been explored the determinants pulling CFO's digitalization and the personal benefits obtained in using digital technologies, the relationships between positive company's performance and having a digital CFO was not found. The main reason is because company's performance usually

is not related to the work of just one individual, but firm's operations are influenced also by the organizational and external factors. However, as discussed during the literature review, having a firm involved in Industry 4.0 projects and engaged with digital technologies might improve company's performance (Accenture, 2018; Fluchter, 2015; Iqbal, Doctor, More, Mahmud and Yousuf, 2017; O'Keeffe, 2017; Nalchigar & Yu, 2017; Wright, 2010), thus it is arguably that digital attitudes of leading roles will positively improve the organization's performance.

Eventually, this study is focused just on the companies running their operations, partially or exclusively, **in Italy**. Being the CFO a worldwide spread role, the focus on one specific country might not perfectly fit the digital transformation analysed during the literature review and a broader perspective in empirical research might highlight elements not observed in this research.

17 FUTURE RESEARCHES

Future researches might be directed toward the resolution of this study's limitation and improvement of the topic here treated.

Firstly, it is suggested to test the model and hypotheses here discussed using a bigger sample in order to achieve more reliable results.

After that, the models treated in this research resulted in variables which did not verify the hypotheses defined in the first place. This might imply that the wrong variables and determinants were selected, and no statistically valid correlations have been found. This is particularly true in AMO model, where just motivation was proved to have an impact on CFO's digitalization. However, this result might lack in consistency and other factors such as the one described by abilities and opportunities can pay a direct role in digitalization process. However, the significance of this constructs might be related to other variables not considered in this study. Hence, it is suggested to deepen the research in this direction also using other models such as Technology Adoption Model (TAM) (Davis, 1985) which is aimed at studying the determinants in accepting new information systems (Lee, Kozar, & Larsen, 2003).

JD-R might be also affected by wrong variables selection and it might worth to explore other variables in order to confirm or definitely exclude the presence of an energetic process in CFO's digital evolution.

It is also suggested to examine in depth the impact and use of other emerging technologies in order to fully describe the CFO's working environment in a digitalized world. These technologies might be: (1) simulations, (2) blockchain, (3) platforms, (4) mobile and wearable devices.

Moreover, it might be interesting to analyse the CFO's evolution in other countries in order to assess the macro-environmental factors influencing businesses. Indeed, even if globalization is creating an even environment across countries, it is also true that local phenomena are still characterising the different geographical locations.

Furthermore, this research might be repeated according to a longitudinal research, testing if the results obtained in psychological wellbeing still hold after some years of use of digital technology. Hence, when the excitement of innovation is smoothed by daily routine.

Eventually, it might worth to thoroughly study the relationships between the introduction of a digitalized CFO within the organization and study the effect on company's performances. In order to do that, it is suggested to develop a case study on a few companies identified as representative and objectively assess the level of digitalization of the CFO. After that, removing the effect of external environment and internal factors, it might be possible to understand if a digitalized CFO can generate an economic return to the shareholders.

18 REFERENCES

Accenture. (2018). From bottom line to front line. Retrieved from: https://www.accenture.com/t20180910T083815Z__w__/us-en/_acnmedia/PDF-85/Accenture-CFO-Research-Global.pdf

Agrawal, A., Goldie, J., & Huyett, B. (2013). Today's CFO: Which profile best suits your company. *McKinsey* Q, 1, 1-6.

Altukhova, N., Vasileva, E., & Yemelyanov, V. (2018). HOW TO ADD VALUE TO BUSINESS BY EMPLOYING DIGITAL TECHNOLOGIES AND TRANSFORMING MANAGEMENT APPROACHES. *Business Management / Biznes Upravlenie*, (1), 71-84.

Bakker, A. B., & Demerouti, E. (2007). The job demands-resources model: State of the art. *Journal of managerial psychology*, 22(3), 309-328.

Bakker, A. B., Demerouti, E. & Verbeke, W. (2004). Using the Job demands-Resoures model to predict burnout and performance. *Human Resource Management, 43 (1), 83-104.* doi: 10.1002/hrm

Bakker, A. B., Demerouti, E., & Euwema, M. C. (2005). Job resources buffer the impact of job demands on burnout. *Journal of occupational health psychology*, 10(2), 170.

Bakker, A.B., Demerouti, E., & Schaufeli, W. (2003). Dual processes at work in a call centre: An application of the job demands–resources model. *European Journal of work and organizational psychology*, 12(4), 393-417.

Barclay, D. W., Higgins, C. A., & Thompson, R. (1995). The partial least squares approach to causal modeling: Personal computer adoption and use as illustration. Technology Studies, 2, 285–309.

Bentler, P. M., & Huang, W. (2014). On components, latent variables, PLS and simple methods: Reactions to Rigdon's rethinking of PLS. Long Range Planning, 47, 136–145.

Berg, N. (2005). Non-response bias.

Boyes, H., Hallaq, B., Cunningham, J., & Watson, T. (2018). The industrial internet of things (IIoT): An analysis framework. *Computers in Industry*, 101, 1-12. doi: 10.1016/j.compind.2018.04.015

Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014). How virtualization, decentralization and network building change the manufacturing landscape: An Industry 4.0 Perspective. *International Journal of Mechanical, Industrial Science and Engineering*, 8(1), 37-44.

Calvaresi, D., Marinoni, M., Sturm, A., Schumacher, M., & Buttazzo, G. (2017, August). The challenge of real-time multi-agent systems for enabling IoT and CPS. *In Proceedings of the International Conference on Web Intelligence* (pp. 356-364). ACM.

Chang, V. and Wills, G. (2016). A model to compare cloud and non-cloud storage of big data. *Future Generation Computer Systems*, 57 (1), 56-76.

Chartered Global Management Accountant. (2016). A CFO's KEY COMPETENCIES FOR THEFUTURE. Retrieved from: https://www.cgma.org/content/dam/cgma/resources/reports/downloadabledocuments/cfo-competencies-report.pdf

Chen, C.F. and Chen, S.C. (2014). Investigating the effects of job demands and job resources on cabin crew safety behaviors. *Turism Management*, 41, 45-52. doi: 10.1016/j.tourman.2013.08.009

Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS quarterly*, 36(4).

Cohen, J. (1992). A power primer. Psychological Bulletin, 112, 155–159.

Collie, R. J., Granziera, H., & Martin, A. J. (2018). Teachers' perceived autonomy support and adaptability: An investigation employing the job demands-resources model as relevant to workplace exhaustion, disengagement, and commitment. *Teaching and Teacher Education*, 74, 125-136.

Cote, J. A., & Buckley, R. (1987). Estimating trait, method, and error variance: Generalizing across 70 construct validation studies. Journal of Marketing Research, 24, 315–318

References

Couto, V., & Neilson, G. (2004). The New CFO Role: It's in the DNA. *Financial Executive*, 20(5), 30-32

Crawford, E.R., LePine, J.A. and Rich, B.L. (2010). Linking job demands and Resources to employee Engagement and Burnout: A theoretical Extension and Meta-Analytic Test. *Journal of applied psychology*, 95 (5) , 834-848. doi: 10.1037/a0019364

Davis, F. D. (1985). A technology acceptance model for empirically testing new end-user information systems: Theory and results (Doctoral dissertation, Massachusetts Institute of Technology).

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied psychology*, 86(3), 499.

Dijkstra, T. K. (2014). PLS' Janus face—response to Professor Rigdon's "Rethinking partial least squares modeling: In praise of simple methods." Long Range Planning, 47, 146–153.

Dijkstra, T. K., & Henseler, J. (2015a). Consistent and asymptotically normal PLS estimators for linear structural equations. Computational Statistics & Data Analysis, 81, 10–23.

Dijkstra, T. K., & Henseler, J. (2015b). Consistent partial least squares path modeling. MIS Quarterly, 39, 297–316.

EY. (2016a). Do you define your CFO role? Or does it define you? Retrieved from: https://www.ey.com/Publication/vwLUAssets/EY-do-you-define-your-cfo-role-or-does-it-define-you/$FILE/EY-do-you-define-your-cfo-role-or-does-it-define-you.pdf

EY. (2016b). Is the future of finance technology or new people? Retrieved from: https://www.ey.com/Publication/vwLUAssets/EY-is-the-future-of-finance-new-technology-or-new-people/$FILE/EY-the-DNA-of-the-CFO-part-2.pdf

EY. (2016c). Ready for the future economy? Retrieved from: https://www.ey.com/Publication/vwLUAssets/ey-ready-for-the-future-economy-the-CFO-perspective/$FILE/EY-ready-for-the-future-economy-the-CFO-perspective.pdf

EY. (2016d). The changing role of the CFO. Retrieved from: https://www.ey.com/Publication/vwLUAssets/EY-the-changing-role-of-the-cfo/$FILE/EY-the-changing-role-of-the-cfo.pdf

EY. (2017). As the CFO blurs, how can future finance leaders find focus? Retrieved from: https://www.ey.com/Publication/vwLUAssets/EY-DNA-of-the-CFO-Canadian-highlights-Part3/$FILE/EY-DNA-of-the-CFO-Canadian-highlights-Part3.pdf

Favaro, P. (2001). Beyond bean counting: the CFO's expanding role. *Strategy & Leadership*, 29(5), 4.

Favaro, P. (2001). The CFO's Evolving Roles. *Financial Executive*, 17(8), 32-38.

Fettermann, D. C., Cavalcante, C. G. S., Almeida, T. D. D., & Tortorella, G. L. (2018). How does Industry 4.0 contribute to operations management?. *Journal of Industrial and Production Engineering*, 35(4), 255-268.

Fisher, R. J. (1993). Social desirability bias and the validity of indirect questioning. Journal of consumer research, 20(2), 303-315.

Garson, G. D. (2016). Partial Least Squares: Regression and Structural Equation Models. Asheboro, NC: Statistical Associates Publishers.

Gliem, J. A., & Gliem, R. R. (2003). Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education.

Goretzki, L., Strauss, E., & Weber, J. (2013). An institutional perspective on the changes in management accountants' professional role. *Management Accounting Research*, 24(1), 41-63.

Graziano, C. M. (2002). TOP TECHNOLOGY ISSUES FOR CFOs. *Financial Executive*, 18(6), 68-70.

Green, R. (2007). How CFOs Should Tackle Information Management. *Financial Executive*, 23(10), 44-48.

Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). A primer on partial least squares structural equation modeling (PLS-SEM). Sage Publications.

Hiebl, M. R., Gärtner, B., & Duller, C. (2017). Chief financial officer (CFO) characteristics and ERP system adoption: an upper-echelons perspective. *Journal of Accounting & Organizational Change*, 13(1), 85-111.

Hockey, G. J. (1997). Compensatory control in the regulation of human performance under stress and high workload: a cognitive–energetical framework. *Biological Psychology*, 45, 73–93

Hoitash, R., Hoitash, U., & Kurt, A. C. (2016). Do accountants make better chief financial officers?. *Journal Of Accounting & Economics*, 61(2/3), 414-432. doi:10.1016/j.jacceco.2016.03.002

Howell, R. A. (2006). The CFO: From Controller to Global Strategic Partner. (cover story). *Financial Executive*, 22(3), 20-25

Hu, Q., Schaufeli, W. B., & Taris, T. W. (2011). The job demands–resources model: An analysis of additive and joint effects of demands and resources. *Journal of vocational behavior*, 79(1), 181-190.

IBM (NA). *The new value integrator*. Retrieved from: http://www-935.ibm.com/services/be/en/c-suite/insights/readings/media/smarter_leadership/the_new_value_integrator_insights_from_the_chief_financial_officer_study.pdf

International Federation of Accountants. (2013). *THE ROLE AND EXPECTATIONS OF A CFO.* Retrieved from: https://www.ifac.org/system/files/publications/files/Role%20of%20the%20CFO.pdf

Iqbal, R., Doctor, F., More, B., Mahmud, S., & Yousuf, U. (2017). Big Data analytics and Computational Intelligence for Cyber–Physical Systems: Recent trends and state of the art applications. *Future Generation Computer Systems*. doi: 10.1016/j.future.2017.10.021

Jarrahi, M.H. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. *Business Horizons*, 61(4), 577-586. doi: 10.1016/j.bushor.2018.03.007

Kagermann, H., Helbig, J., Hellinger, A., & Wahlster, W. (2013). Recommendations for implementing the strategic initiative INDUSTRIE 4.0.

Karasek, R.A. (1979). Job demands, job decision latitude, and mental strain: implications for job design. *Administrative Science Quarterly*, 24 (2), 285-308.

King, M. F., & Bruner, G. C. (2000). Social desirability bias: A neglected aspect of validity testing. Psychology & Marketing, 17(2), 79-103.

Kobusinska, A., Leung, C., Hsu, C.H., Raghavendra, S., & Chang, V. (2018). Emerging trends, issues and challenges in Internet of Things, Big Data and cloud computing. *Future Generation Computer Sytems*, 87 (1), 416-419. doi: 10.1016/j.future.2018.05.021

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. International Journal of e-Collaboration, 11(4), 1-10.

Kristensen, T. S., Hannerz, H., Høgh, A., & Borg, V. (2005). The Copenhagen Psychosocial Questionnaire-a tool for the assessment and improvement of the psychosocial work environment. *Scandinavian journal of work, environment & health*, 438-449.

Landt, J. (2005). The history of RFID. *IEEE potentials*, 24(4), 8-11. Retrieved 27 December 2017 from academia.edu https://s3.amazonaws.com/academia.edu.documents/28686813/008.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1514391203&Signature=Ilj6gEllLry5byc2R7IBsBkqgQo%3D&response-contentdisposition=inline%3B%20filename%3DThe_history_of_RFID.pdf

Lasi, H., Fettke, P., Kemper, H. G., Feld, T., & Hoffmann, M. (2014). Industry 4.0. *Business & Information Systems Engineering*, 6(4), 239-242.

Lee, J., Kao, H. A., & Yang, S. (2014). Service innovation and smart analytics for industry 4.0 and big data environment. *Procedia Cirp*, 16, 3-8.

Lee, Y., Kozar, K. A., & Larsen, K. R. (2003). The technology acceptance model: Past, present, and future. Communications of the Association for information systems, 12(1), 50.

Llorens, S., Bakker, B.A., Schaufeli, W., Salanova, M. (2006). Testing the Robustness of the Job Demands–Resources Model. *International Journal of Stress Management*, 13 (3), 378 - 391. doi: 10.1037/1072-5245.13.3.378

Lohmöller, J.-B. (1989). Latent variable path modeling with partial least squares. Heidelberg, Germany: Physica.

Maslach, C. (1982). *Understanding Burnout: Definitional issues in analysing a complex phenomenon*. Beverly Hills, CA: Sage

Maslach, C., & Leiter, M. P. (1997). *The truth about burnout: How organizations cause personal stress and what to do about it*. San Francisco, CA: Jossey-Bass

Maslach, C., Jackson, S. E., Leiter, M. P., Schaufeli, W. B., & Schwab, R. L. (1986). *Maslach burnout inventory* (Vol. 21, pp. 3463-3464). Palo Alto, CA: Consulting Psychologists Press.

McKinsey (2017). *Mckinsey special collection The role of the CFO*. Retreived on 03/05/2018 from: https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Strategy%20and%20Corporate%20Finance/Our%20Insights/Strategy%20and%20corporate%20finance%20special%20collection/Final%20PDFs/McKinsey-Special-Collections_RoleoftheCFO.ashx

Moeuf, A., Pellerin, R., Lamouri, S., Tamayo-Giraldo, S. & Barbaray, R. (2017). The industrial management of SMEs in the era of Industry 4.0. *International Journal Of Production Research* [serial online]. February 2018;56(3):1118-1136. Available from: Business Source Premier, Ipswich, MA. Accessed June 13, 2018.

Mura, M., Lettieri, E., Radaelli, G., & Spiller, N. (2016). Behavioural operations in healthcare: a knowledge sharing perspective. *International Journal of Operations & Production Management*, 36(10), 1222-1246.

Nalchigar, S. & Yu, E. (2017). Business-driven data analytics: A conceptual modelling framework. *Data & Knowledge Engineering*, 1-14. doi:10.1016/j.datak.2018.04.006

Ogiela, L. (2015). Intelligent techniques for secure financial management in cloud computing. *Electronic Commerce Research and Applications*, 14 (6), 456-464. doi: 10.1016/j.elerap.2015.07.001

O'Keeffe, F. (2017). *The role of the CFO and finance function in a 4.0 world*. Retrieved from: http://www.ey.com/Publication/vwLUAssets/ey-the-role-of-the-cfo-and-finance-function-in-a-4.0-world/$FILE/ey-the-role-of-the-cfo-and-finance-function-in-a-4.0-world.pdf

Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 885(879), 10-1037.

Porter, L. W., Steers, R. M., Mowday, R. T., & Boulian, P. V. (1974). Organizational commitment, job satisfaction, and turnover among psychiatric technicians. *Journal of Applied Psychology*, 59, 603–609.

Prasad, A., & Green, P. (2015). Organizational Competencies and Dynamic Accounting Information System Capability: Impact on AIS Processes and Firm Performance. *Journal Of Information Systems*, 29(3), 123-149. doi:10.2308/isys-51127

Radaelli, G., Lettieri, E., Mura, M., & Spiller, N. (2014). Knowledge sharing and innovative work behaviour in healthcare: A micro-level investigation of direct and indirect effects. *Creativity and Innovation Management*, 23(4), 400-414.

Richins, G., Stapleton, A., Stratopoulos, T. C., & Wong, C. (2017). Big Data Analytics: Opportunity or Threat for the Accounting Profession?. *Journal Of Information Systems*, 31(3), 63-79. doi:10.2308/isys-51805

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. (2015). Industry 4.0: The future of productivity and growth in manufacturing industries. *Boston Consulting Group*, 9.

Sauter, R., Bode, M., & Kittelberger, D. (2016). *How Industry 4.0 is changing how we manage value creation*. Retrieved from: https://www. horvath-partners. com/en/publications/featured-articles-interviews/detail/how-industry-40-is-changing-how-we-manage-value-creation.

Schaufeli, W. B. (2017). Applying the job demands-resources model. *Organizational Dynamics*, 2(46), 120-132.

Schaufeli, W. B., & Bakker, A. B. (2004a). Job demands, job resources, and their relationship with burnout and engagement: A multi-sample study. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, 25(3), 293-315.

Schaufeli, W. B., & Bakker, A. B. (2004b). Utrecht work engagement scale: Preliminary manual. *Occupational Health Psychology Unit, Utrecht University, Utrecht, 26.*

Schaufeli, W. B., & Taris, T. W. (2014). A critical review of the Job Demands-Resources Model: Implications for improving work and health. In *Bridging occupational, organizational and public health* (pp. 43-68). Springer, Dordrecht.

SCHMIDT, C. (2016). THE DIGITAL CFO. Cfo, *32*(2), 36-39.

Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *Journal of occupational health psychology*, 1(1), 27.

Spector, P. E., & Jex, S. M. (1998). Development of four self-report measures of job stressors and strain: interpersonal conflict at work scale, organizational constraints scale, quantitative workload inventory, and physical symptoms inventory. *Journal of occupational health psychology*, 3(4), 356.

Stergiou, C., Psannis, K.E., Kim, B.G. and Gupta, B. (2018). Secure integration of IoT and Cloud Computing. *Future Generation Computer Systems*, 78 (3) 964-975. doi:10.1016/j.future.2016.11.031

Subramanian, N., & Jeyaraj, A. (2018). Recent security challenges in cloud computing. *Computers & Electrical Engineering*, 71 (1) 28-42. doi: 10.1016/j.compeleceng.2018.06.006

Tsao, Y., Linh, V., & Lu, J. (2017). Closed-loop supply chain network designs considering RFID adoption. *Computers & Industrial Engineering*, 113716-726. doi:10.1016/j.cie.2016.09.016.

Van Decker, J. E., & Sinnett, W. M. (2013). The CFO's Top Technology Imperatives. Financial Executive, 29(5), 25-28.

Van den Broeck, A., Vander Elst, T., Baillien, E., Sercu, M., Schouteden, M., De Witte, H., & Godderis, L. (2017). Job demands, job resources, burnout, work engagement, and their relationships: an analysis across sectors. *Journal of occupational and environmental medicine*, 59(4), 369-376.

Viotti, S. and Converso, D. (2016). Buffering Effect of Job Resources in the Relationship between Job Demands and Work-to-Private-Life Interference: A Study among Health-Care Workers. *Safety and Health at Work*, 7(4) 354-362. doi:10.1016/j.shaw.2016.05.002

Weyer, S., Schmitt, M., Ohmer, M., & Gorecky, D. (2015). Towards Industry 4.0-Standardization as the crucial challenge for highly modular, multi-vendor production systems. *Ifac-Papersonline*, 48(3), 579-584.

Willcocks, L. P., Lacity, M., & Craig, A. (2015). *The IT function and robotic process automation*.

Wince, R. (2010). Role of the CFO in Quality Improvement. *Bank Accounting & Finance (08943958)*, 23(4), 29-32.

Wold, H. O. A. (1975). Path models with latent variables: The NIPALS approach. In H. M. Blalock, A. Aganbegian, F. M. Borodkin, R. Boudon, & V. Capecchi (Eds.), Quantitative sociology: International perspectives on mathematical and statistical modeling (pp. 307–357). New York: Academic Press.

Wold, H. O. A. (1982). Soft modeling: The basic design and some extensions. In K. G. Jöreskog & H. Wold (Eds.), Systems under indirect observations: Part II (pp. 1–54). Amsterdam: North-Holland.

Wortmann, F., & Flüchter, K. (2015). Internet of things. *Business & Information Systems Engineering*, 57(3), 221-224.

Xanthopoulou, D., Bakker, A. B., Demerouti, E., & Schaufeli, W. B. (2007). The role of personal resources in the job demands-resources model. *International journal of stress management*, 14(2), 121.

References

Xu, L. D., Xu, E. L., & Li, L. (2018). Industry 4.0: state of the art and future trends. *International Journal Of Production Research*, 56(8), 2941-2962. doi:10.1080/00207543.2018.1444806

Yeow, A., Soh, C., & Hansen, R. (2017). Aligning with new digital strategy: A dynamic capabilities approach. *The Journal of Strategic Information Systems,* 27(1), 53-58. doi:10.1016/j.jsis.2017.09.001

Zhong, R. Y., Xu, C., Chen, C., & Huang, G. Q. (2017). Big Data Analytics for Physical Internet-based intelligent manufacturing shop floors. *International Journal Of Production Research*, 55(9), 2610-2621. doi:10.1080/00207543.2015.1086037

Zorn, D. M. (2004). Here a chief, there a chief: The rise of the CFO in the American firm. *American Sociological Review*, *69*(3), 345-364.

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21 ANNEX

21.1 ANNEX 1: CLASSIFICATION OF THE REFERENCES

Year	Author 1	Author 2	Author 3	Author 4	Author 5	Author 6	Author 7	Title	Type of publisher	Journal of belonging	Aim of the publication	Topic	Perspective
2018	Jarrahi M.H.	-	-	-	-	-	-	Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making	Magazine	Business Horizons	Divulgation	Tools	Artificial Intelligence
2018	Kobusinka A.	Laung C.	Hsu C.H.	Raghavendra S.	Chang V.	-	-	Emerging trends, issues and challenges in Internet of Things, Big Data and cloud computing	Academic Journal	New Generation Computer Systems	Research	Tools	IoT, Big Data, Cloud computing
2018	Prendegast P.	Reilly A.	Robeznieks H.	Shannon A.	Nunes P.	-	-	From bottom line to front line	Company report	Accenture	Survey	Chief Financial Officer	Digitalization
2018	Fettermann C.D.	Gobbo Sá Cavalcante C.	Domingues de Almeida T.	Luz Tortorella G.	-	-	-	How does Industry 4.0 contribute to operations management?	Academic Journal	Journal of Industrial and Production Engineering	Research	Environment	Industrie 4.0
2018	Altukhova N.	Vasileva E.	Yemelyanov V.	-	-	-	-	How to add value to business by employing digital technologies and transforming management	Magazine	Business Management / Biznes Upravlenie	Divulgation	Tools	Digitalization
2018	Xu L. D.	Xu E. L.	Li L.	-	-	-	-	Industry 4.0: state of the art and future trends	Academic Journal	International Journal Of Production Research	Research	Environment	Industrie 4.0
2018	Subramanian N.	Jeyaraj A.	-	-	-	-	-	Recent security challenges in cloud computing	Academic Journal	Computers & Electrical Engineering	Research	Tools	Cloud Computing
2018	Stergiou C.	Psannis K.E.	Kim B.G.	Gupta B.	-	-	-	Secure integration of IoT and Cloud Computing	Academic Journal	Future Generation Computer Systems	Research	Tools	Internet of Things
2018	Collie R. J.	Granziera H.	Martin A. J.	-	-	-	-	Teachers' perceived autonomy support and adaptability: An investigation employing the job demands-resources model as relevant to workplace exhaustion, disengagement, and commitment	Academic Journal	Teaching and Teacher Education	Research	Psychological well-being	Examples
2018	Boyes H.	Cunningham J.	Watson T.	-	-	-	-	The industrial Internet of Things (IIoT): an analysis framework.	Academic Journal	Computer in Industry	Research	Tools	Industrie 4.0
2017	Zhong R. Y.	Xu C.	Chen C.	Huang G. Q.	-	-	-	Big Data Analytics for Physical Internet-based intelligent manufacturing shop floors	Academic Journal	International Journal of Production Research	Research	Tools	Big Data Analytics
2017	Yeow A.	Soh C.	Hansen A.	-	-	-	-	Aligning with new digital strategy: A dynamic capabilities approach	Academic Journal	The Journal of Strategic Information Systems	Research	Chief Financial Officer	Digitalization
2017	Huerta E.	Jensen S.	-	-	-	-	-	An Accounting Information Systems Perspective on Data Analytics and Big Data	Academic Journal	Journal of Information System	Research	Tools	Big Data Analytics
2017	Schaufeli W. B.	-	-	-	-	-	-	Applying the Job Demands-Resources model: A 'how to' guide to measuring and tackling work engagement and burnout	Academic Journal	Organizational dynamics	Research	Psychological well-being	JD-R model
2017	Candeias J.	-	-	-	-	-	-	As the CFO blurs, how can future finance leaders find focus?	Company report	EY	Survey	Chief Financial Officer	Digitalization
2017	Iqbal R.	Doctor F.	More B.	Mahmud S.	Yousuf U.	-	-	Big Data analytics and Computational Intelligence for Cyber–Physical Systems: Recent trends and state of the art applications	Academic Journal	Future Generation Computer Systems	Research	Tools	Big Data Analytics
2017	Richins G.	Stapleton A.	Stratopoulos T. C.	Wong C.	-	-	-	Big Data Analytics: Opportunity or Threat for the Accounting Profession?	Academic Journal	Journal of Information System	Research	Tools	Big Data Analytics

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Year	Author 1	Author 2	Author 3	Author 4	Author 5	Author 6	Author 7	Title	Type of publisher	Journal of belonging	Aim of the publication	Topic	Perspective
2017	Nalchigar S.	Yu E.	-	-	-	-	-	Business-driven data analytics: A conceptual modelling	Academic Journal	Data & Knowledge Engineering	Research	Tools	Big Data Analytics
2017	Hiebl M. R.	Gärtner B.	Duller C.	-	-	-	-	Chief financial officer (CFO) characteristics and ERP system	Academic Journal	Journal of Accounting &	Research	Tools	ERP
2017	Tsao Y.	Linh V.	Lu J.	-	-	-	-	Closed-loop supply chain network designs considering RFID adoption	Academic Journal	Computers & Industrial Engineering	Research	Tools	Cloud Computing
2017	Wiengarten F.	Ahmed M. U.	Longoni, A.	Pagell M.	Fynes B	-	-	Complexity and the triple bottom line: an information-processing perspective	Academic Journal	International Journal of Operations & Production Management	Research	Tools	Triple Bottom Line
2017	Van den Broek A.	Elst T. V.	Bailien E.	Sercu M.	Schouteden M.	De Witte H.	Godderis L.	Job Demands, Job Resources, Burnout, Work Engagement, and Their Relationships: An Analysis Across Sectors	Academic Journal	Journal of occupational and environmental medicine	Research	Psychological well-being	Cognitive demand
2017	Agrawal A.	MonierJ.-H.	Bibbs E.	Davies R.	Huey D.	-	-	Mckinsey special collection: The role of the CFO	Company report	McKinsey	Divulgation	Chief Financial Officer	Digitalization
2017	Calvarsi D.	Marinoni M.	Sturm A.	Schumacher M.	Buttazzo G.	-	-	The challenge of real-time multi-agent systems for enabling IoT and CPS.	Conference	In Proceedings of the International Conference on Web Intalligence	Divulgation	Tools	Internet of Things
2017	Moeuf A.	Pellerin R.	Lamouri S.	Tamayo-Giraldo S.	Barbaray R.	-	-	The industrial management of SMEs in the era of Industry 4.0	Academic Journal	International Journal Of Production Research	Review	Environment	Industrie 4.0
2017	O'Keeffe F.	-	-	-	-	-	-	The role of the CFO and finance function in a 4.0 world	Company report	Ernest and Young	Divulgation	Chief Financial Officer	Industrie 4.0
2016	Sauter R.	Bode M.	Kittelberger D.	-	-	-	-	How Industry 4.0 is changing how we manage value creation	Company report	Horváth & Partners Management consulting	Research	Environment	Industrie 4.0
2016	CGMA	-	-	-	-	-	-	A CFO's key competences for the future	Association	Chartered Global Management Accountant	Divulgation	Chief Financial Officer	Digitalization
2016	Chang V.	Willis G.	-	-	-	-	-	A model to compare cloud and non-cloud storage of big data.	Academic Journal	Future Generation Computer Systems	Research	Tools	Cloud Computing
2016	Viotti S.	Converso D.	-	-	-	-	-	Buffering Effect of Job Resources in the Relationship between	Academic Journal	Safety and Health at Work	Research	Psychological well-being	JD-R model
2016	Hoitash R	Hoitash U.	Kurt A. C.	-	-	-	-	Do accountants make better chief financial officers?	Academic Journal	Journal Of Accounting & Economics	Research	Chief Financial Officer	Education
2016	Kraus L.	-	-	-	-	-	-	Do you define your CFO role? Or does it define you?	Company report	EY	Survey	Chief Financial Officer	Digitalization
2016	Bendoly, E.	-	-	-	-	-	-	Fit, Bias, and Enacted Sensemaking in Data Visualization:	Academic Journal	Journal Of Business Logistics	Research	Tools	Visual management
2016	EY	-	-	-	-	-	-	Is the futureof finance technology or new people?	Company report	EY	Survey	Chief Financial Officer	Digitalization
2016	Pekkola S.	Saunila M.	Rantanen H.	-	-	-	-	Performance measurement system implementation in a	Academic Journal	International Journal of Productivity	Research	Tools	Performance
2016	EY	-	-	-	-	-	-	Ready for the future economy?	Company report	EY	Survey	Chief Financial Officer	Digitalization
2016	Agrawal A.	Seth I.	Uhlaner R.	-	-	-	-	Role of the CFO: selected readings for finance leaders	Company report	McKinsey	Divulgation	Chief Financial Officer	Role
2016	Sidorova Y.	Arnaboldi M.	Radaelli J.	-	-	-	-	Social media and performance measurement systems:	Academic Journal	International Journal of Productivity	Research	Tools	Social media
2016	Singh D.	-	-	-	-	-	-	The changing role of the CFO	Company report	EY	Survey	Chief Financial Officer	Digitalization
2016	Schmidt C.	-	-	-	-	-	-	The Digital CFO	Magazine	CFO	Survey	Chief Financial Officer	Digitalization
2016	Burchard R.	-	-	-	-	-	-	What Are The Challenges Your CFO Might Be Facing?	Company report	Burchard & associates, Inc.	Divulgation	Chief Financial Officer	Workload
2015	Rüßmann M.	Lorenz M.	Gerbert P.	Waldner M.	Justus J.	Harnisch M:	Engel P.	Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries	Company report	Boston Consulting Group	Divulgation	Environment	Industrie 4.0
2015	Ogiela L.	-	-	-	-	-	-	Intelligent techniques for secure financial management in cloud computing	Academic Journal	Electronic Commerce Research and Applications	Research	Tools	Cloud Computing
2015	Wortmann F.	Flüchter K.	-	-	-	-	-	Internet of things	Academic Journal	Business & Information Systems	Divulgation	Tools	Internet of Things
2015	Prasad A.	Green P.	-	-	-	-	-	Organizational Competencies and Dynamic Accounting Information System Capability: Impact on AIS Processes and Firm Performance	Academic Journal	Journal of Information System	Research	Tools	Accounting Information System
2015	Willcocks L. P.	Lacity M.	Craig A.	-	-	-	-	The IT function and robotic process automation	Magazine	The Outsourcing Unit Working Research	Divulgation	Tools	Robotic Process Automation
2015	Weyer S.	Schmitt M.	Ohmer M.	Gorecky D.	-	-	-	Towards Industry 4.0-Standardization as the crucial challenge for highly modular, multi-vendor production systems	Academic Journal	Ifac-Papersonline	Research	Tools	RFID
2014	Schaufeli W. B.	Taris T. W.	-	-	-	-	-	A Critical Review of the Job Demands-Resources Model: Implications for Improving Work and Health	Academic Journal	Bridging occupational, organizational and public health	Research	Psychological well-being	JD-R model
2014	Brettel M.	Friederichsen N.	Keller M.	Rosenberg M.	-	-	-	How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape: An Industry 4.0 Perspective	Academic Journal	International Journal of Mechanical, Industrial Science and Engineering	Research	Environment	Industrie 4.0
2014	Lasi H.	Kemper H.-G.	Fettke P.	Feld T.	Hoffmann M.	-	-	Industry 4.0	Academic Journal	Business & Information Systems Engineering	Divulgation	Environment	Industrie 4.0
2014	Chen C.F.	Chen S.C.	-	-	-	-	-	Investigating the effects of job demands and job resources on cabin	Academic Journal	Turism Management	Research	Psychological well-being	JD-R model
2014	Lee J.	Kao H.A.	Yang S.	-	-	-	-	Service innovation and smart analytics for industry 4.0 and big data environment	Academic Journal	Procedia Cirp	Research	Tools	Big Data Analytics
2013	Goretzki L.	Strauss E.	Weber J.	-	-	-	-	An institutional perspective on the changes in management accountants' professional role	Academic Journal	Management Accounting Research	Research	Chief Financial Officer	Evolution
2013	Kagermann H.	Helbig J.	Hellinger A.	Wahlster W.	-	-	-	Recommendations for implementing the strategic initiative INDUSTRIE 4.0	Report	National Academy for Science and Engineering	Divulgation	Tools	Industrie 4.0
2013	Sweeney P.	-	-	-	-	-	-	The cfo's expanding communication role	Magazine	Financial Executives	Divulgation	Chief Financial Officer	Communication

Annex

Year	Author 1	Author 2	Author 3	Author 4	Author 5	Author 6	Author 7	Title	Type of publisher	Journal of belonging	Aim of the publication	Topic	Perspective
2013	Van Decker J. E.	Sinnett W. M.	-	-	-	-	-	The CFO's Top Technology Imperatives	Magazine	Financial Executives	Divulgation	Chief Financial Officer	Technology
2013	IFAC	-	-	-	-	-	-	The role and expectations of a CFO	Association	International Federation of Accountants	Survey	Chief Financial Officer	Digitalization
2013	Agrawal A.	Goldie J.	Huyett B.	-	-	-	-	Today's CFO: Which profile best suits your company?	Company report	McKinsey	Research	Chief Financial Officer	Strategic fit
2013	Barsky N. P.	Catanach Jr. A. H.	-	-	-	-	-	What Makes a CFO "the Best"?	Magazine	Strategic Finance	Divulgation	Chief Financial Officer	Role
2012	Chen H.	Chiang R. H..	Storey V. C.	-	-	-	-	Business intelligence and analytics: from big data to big impact	Academic Journal	MIS quarterly	Divulgation	Tools	Big Data Analytics
2011	Maltby D.	-	-	-	-	-	-	Big data analytics	Conference	In 74th Annual Meeting of the Association for Information Science and Technology (ASIST)	Divulgation	Tools	Big Data Analytics
2011	Russom P.	-	-	-	-	-	-	Big data analytics	Company report	TDWI, Best practice report, fourth quarter	Research	Tools	Big Data Analytics
2010	Sharma R	Jones S.	-	-	-	-	-	CFO of the Future: Strategic Contributor or Value Adder?	Academic Journal	Journal of Applied Management Accounting Research	Research	Chief Financial Officer	Evolution
2010	Crawford E.R.	LePine J.A.	Rich B.L.	-	-	-	-	Linking job demands and Resources to employee Engagement and Burnout: A theoretical Extension and Meta-Analytic Test	Academic Journal	Journal of applied psychology	Research	Psychological well-being	JD-R model
2010	Wright T.	-	-	-	-	-	-	Technology Trends CFOs Must Know.	Magazine	Financial Executives	Divulgation	Chief Financial Officer	Forces
2010	Hu Q.	Schaufeli W. B.	Taris T. W.	-	-	-	-	The Job Demands–Resources model: An analysis of additive and joint effects of demands and resources	Academic Journal	Journal of vocational behaviour	Research	Psychological well-being	JD-R model
2010	-	-	-	-	-	-	-	The new value integrator	Company report	IBM	Survey	Chief Financial Officer	Evolution
2010	Wince R.	-	-	-	-	-	-	The role of CFO in quality improvement	Academic Journal	Bank accounting and finance	Research	Chief Financial Officer	Role
2007	Green R.	-	-	-	-	-	-	How CFOs Should Tackle Information Management	Magazine	Financial Executives	Divulgation	Chief Financial Officer	Role
2007	Ehrenhalt S.	Ryan D.	-	-	-	-	-	Mastering the CFO's four key roles	Magazine	Financial Executives	Divulgation	Chief Financial Officer	Role
2007	Bakker A. B.	Demerouti E.	-	-	-	-	-	The job demands-resources model: State of the art	Academic Journal	Journal of managerial psychology	Review	Psychological well-being	JD-R model
2007	Xanthopoulou D.	Bakker A. B.	Demerouti E.	Schaufeli W. B.	-	-	-	The Role of Personal Resources in the Job Demands-Resources Model	Academic Journal	International Journal of Stress Management	Research	Psychological well-being	JD-R model
2006	Llorens S.	Bakker A. B.	Shaufeli W. B.	Salanova M.	-	-	-	Testing the Robustness of the Job Demands–Resources Model	Academic Journal	International Journal of Stress Management	Research	Psychological well-being	JD-R model
2006	Howell R. A.	-	-	-	-	-	-	The CFO: From Controller to Global Strategic Partner	Magazine	Financial Executives	Divulgation	Chief Financial Officer	Evolution
2005	Bakker A. B.	Demerouti E.	Euwema M. C.	-	-	-	-	Job Resources Buffer the Impact of Job Demands on Burnout	Academic Journal	Journal of occupational health psychology	Research	Psychological well-being	JD-R model
2005	Kristensen T. S.	Hannerz H.	Høgh A.	Borg V.	-	-	-	The Copenhagen Psychosocial Questionnaire-a tool for the assessment and improvement of the psychosocial work environment	Academic Journal	Scandinavian journal of work, environment & health	Research	Psychological well-being	Questionnaire
2005	Landt J.	-	-	-	-	-	-	The history of RFID.	Magazine	IEEE potentials	Divulgation	Tools	RFID
2004	Norman W.	MacDonald C.	-	-	-	-	-	Getting to the bottom of "triple bottom line"	Academic Journal	Business Ethics quarterly	Research	Tools	Triple Bottom Line
2004	Zorn M.	-	-	-	-	-	-	Here a Chief, There a Chief: The Rise of the CFO in the American Firm	Academic Journal	American sociological review	Research	Chief Financial Officer	Evolution
2004	Schaufeli W. B.	Bakker A. B.	-	-	-	-	-	Job demands, job resources, and their relationship with burnout and engagement: a multi-sample study	Academic Journal	Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior	Research	Psychological well-being	Turnover intention
2004	Couto V.	Neilson G.	-	-	-	-	-	The new CFO role: it's in the DNA	Magazine	Financial Executives	Divulgation	Chief Financial Officer	Role
2004	Bakker A. B.	Demerouti E.	Verbeke W.	-	-	-	-	Using the Job Demands-resources model to predict burnout and performance	Academic Journal	Human Resource management	Research	Psychological well-being	JD-R model
2004	Schaufeli W.	Bakker A. B.	-	-	-	-	-	Utrecht Work Engagement Scale. Preliminary Manual.	Academic Journal	Occupational Health Psychology Unit, Utrecht University, Utrecht	Review	Psychological well-being	Questionnaire
2003	Bakker A. B.	Demerouti E.	Schaufeli W. B.	-	-	-	-	Dual processes at work in a call centre: An application of the job demands – resources model	Academic Journal	European Journal of work and organizational	Research	Psychological well-being	JD-R model
2002	Graziano C. M.	-	-	-	-	-	-	Top technology issues for CFOs	Magazine	Financial Executives	Divulgation	Chief Financial Officer	Technology
2001	Demerouti E.	Bakker A. B.	Nachreiner F.	Schaufeli W. B.	-	-	-	The job demands-resources model of burnout	Academic Journal	Journal of Applied psychology	Research	Psychological well-being	JD-R model
2001	Favaro P.	-	-	-	-	-	-	Beyond bean counting: the CFO's expanding role	Academic Journal	Strategy & Leadership	Divulgation	Chief Financial Officer	Evolution
2001	Favaro P.	-	-	-	-	-	-	The CFO's evolving roles	Magazine	Financial Executives	Divulgation	Chief Financial Officer	Evolution
1998	Spector P. E.	Jex S. M.	-	-	-	-	-	Development of four self-report measures of job stressors and strain: interpersonal conflict at work scale, organizational constraints scale, quantitative workload inventory, and physical symptoms inventory	Academic Journal	Scandinavian journal of work, environment & health	Review	Psychological well-being	Questionnaire
1997	Hockey G.J.	-	-	-	-	-	-	Compensatory control in the regulation of human performance under stress and high workload: a cognitive–energetical framework	Academic Journal	Biological Psychology	Research	Psychological well-being	Workload
1997	Maslach C.	Leiter M.P.	-	-	-	-	-	The truth about burnout: How organizations cause personal stress and what to do about it	Book	-	Book	Psychological well-being	Burnout
1996	Siegrist J.	-	-	-	-	-	-	Adverse health effects of high-effort/low-reward conditions	Academic Journal	Journal of occupational health psychology	Research	Psychological well-being	Reward

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Year	Author 1	Author 2	Author 3	Author 4	Author 5	Author 6	Author 7	Title	Type of publisher	Journal of belonging	Aim of the publication	Topic	Perspective
1986	Maslach C.	Jackson S.E.	Leiter M.P.	Schaufeli W. B.	Schwab R.L.	-	-	Maslach burnout inventory	Book	-	Book	Psychological well-being	Questionnaire
1982	Maslach C.	-	-	-	-	-	-	Understanding Burnout: Definitional issues in analysing a complex phenomenon	Book	-	Book	Psychological well-being	Burnout
1979	Karasek R.A.	-	-	-	-	-	-	Job demands, job decision latitude, and mental strain: implications for job design.	Academic Journal	Administrative Science Quarterly	Research	Psychological well-being	JD-R model
1974	Porter L.W.	Steers R.M.	Mowday R.T.	Boulian P.V.	-	-	-	Organizational commitment, job satisfaction, and turnover among psychiatric technicians	Academic Journal	Journal of Applied Psychology	Research	Psychological well-being	Turnover intention
2008	Siemsen E.	Roth A. V.	Balasubramanian S.	-	-	-	-	How motivation, opportunity, and ability drive knowledge sharing: The constraining-factor model	Academic Journal	Journal of Operations Management	Research	Behavioural determinants	MOA model
2007	Hughes J.	-	-	-	-	-	-	The ability-motivation-opportunity framework for behavior research in IS	Conference	Proceedings of the 40th Hawaii International Conference on System Sciences	Review	Behavioural determinants	MOA model
1979	Bettman J.R.	-	-	-	-	-	-	An Information Processing Theory of Consumer Choice	Academic Journal	Journal of Marketing	Review	Behavioural determinants	MOA model
2007	Egmond, C.	Bruel, R.	-	-	-	-	-	Nothing is as practical as a good theory. Analysis of theories and a tool for developing interventions to influence energy-related behaviour	Report	-	Research	Behavioural determinants	MOA model
2013	Jepson A.	Clarke A.	Ragsdell G.	-	-	-	-	Applying the motivation-opportunity-ability (MOA) model to reveal factors that influence inclusive engagement within local community festivals: The case of UtcaZene 2012	Academic Journal	International Journal of Event and Festival Management	Research	Behavioural determinants	MOA model
2017	Tay L. C.	Tan F. Y.	Yahya K. K.	-	-	-	-	The power of ability-motivation-opportunity enhancing human resource management practices on organizational ethical climate	Academic Journal	International Journal of Business and Society	Research	Behavioural determinants	MOA model
1995	Ölander F.	Thøgersen J.	-	-	-	-	-	Understanding of consumer behaviour as a prerequisite for environmental protection	Academic Journal	Journal of Consumer Policy	Research	Behavioural determinants	MOA model
2014	Ou-Yang H. Y.	Ariphongphokin R.	Trung H. N.	-	-	-	-	Adopting the motivation-opportunity-ability model to evaluate the intentions of Thai students to study abroad	Academic Journal	International J. Soc. Sci. & Education	Research	Behavioural determinants	MOA model
1989	Jaworski B. J.	MacInnis D. J.		-	-	-	-	Marketing jobs and management controls: toward a framework	Academic Journal	Journal of Marketing Research	Research	Behavioural determinants	MOA model
2016	Trošt J. K.	Škerlavaj M.	Anzengruber J.	-	-	-	-	The ability-motivation-opportunity framework for team innovation: efficacy beliefs, proactive personalities, supportive supervision and team innovation	Academic Journal	Economic & Business Review	Research	Behavioural determinants	MOA model
2007	Binney W.	Hall J.	Oppenheim P.	-	-	-	-	The MOA framework and behavioural response	Conference	ANZMAC 2007: 3Rs, reputation responsibility relevance: Proceedings of the 2007 Australian and New Zealand Marketing Academy conference	Research	Behavioural determinants	MOA model
2014	Radaelli G.	Lettieri E.	Mura M.	Spiller N.	-	-	-	Knowledge sharing and innovative work behaviour in healthcare: A micro-level investigation of direct and indirect effects	Academic Journal	Creativity and Innovation Management	Research	Behavioural determinants	MOA model

21.2 ANNEX 2: QUESTIONNAIRE (IN ITALIAN)

THE DIGITAL EVOLUTION OF THE CFO - QUESTIONNAIRE

SECTION	#	QUESTIONS	SUB-QUESTIONS	RESPONSE
CONTROL VARIABLES	D1	Gentile Direttore, La ringraziamo per il tempo che sta per dedicarci.Il questionario dovrebbe impegnarLa per un massimo di 15 minuti.La invitiamo gentilmente a completare tutte le sezioni del questionario al fine di rendere la sua testimonianza usufruibile alle successive analisi statistiche. La informiamo che i dati da Lei forniti verranno trattati in maniera anonima e conforme alla normativa europea GDPR (UE 2016/679) per il Trattamento dei Dati Personali. I dati ricavati dal questionario verranno utilizzati in maniera anonima ed aggregata, senza la possibilità di ricondursi ai relativi rispondenti. La invitiamo a confermare la sua volontà nel partecipare al sondaggio e al suo libero e pieno consenso nel trattamento dei dati da Lei forniti.		YES
	D2	Inserisca la sua età		Open-Ended Response
	D3	Inserisca il suo genere		Nominal scale
	D4	Selezioni l'ultimo titolo di studio che ha conseguito		Nominal scale
	D5	Inserisca l'area accademica dell'ultimo titolo di studio conseguito		Nominal scale
	D6	Inserisca il numero di anni in cui ha ricoperto il ruolo di Direttore Finanziario (CFO) nel corso della sua vita professionale		Open-Ended Response
	D7	Inserisca il fatturato medio della sua azienda negli ultimi tre anni		Open-Ended Response
	D8	Inserisca la percentuale di fatturato dell'azienda derivante da attività internazionali		Open-Ended Response
	D9	Specifichi il settore principale in cui opera l'azienda		Open-Ended Response
	D10	Il settore in cui opera la sua azienda, può essere considerato come turbolento per la destabilizzazione dovuta alle tecnologie digitali?		Likert scale (1-7)
	D11	La sua azienda sta svolgendo progetti relativi ad Industry 4.0?		Likert scale (1-7)
	D12	La Funzione "Sistemi Informativi" risponde direttamente alla Funzione "Amministrazione, Finanza e Controllo"?		YES/NO

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SECTION	#	QUESTIONS	SUB-QUESTIONS	RESPONSE
DIGITALIZATION OF THE CFO	D13	Quanto si rispecchia nella seguente definizione di Digital CFO?"Il Digital CFO è una figura professionale innovativa e tecnicamente competente capace di capire, allineare, unire e ottimizzare le attività tradizionali della Funzione "Amministrazione, Finanza e Controllo" (budgeting, analisi di rischio, reporting, analisi dei costi, ...) attraverso un impiego armonizzato e olistico delle tecnologie digitali quali Big Data, Cloud Computing, Artificial Intelligence, Robotics Process Automation. Il Digital CFO è impegnato proattivemente nella definizione della Digital Business Strategy dell'azienda promuovendo iniziative finalizzate alla digitalizzazione"		Likert scale (1-7)
	D14	Quanto la seguente definizione di Digital Finance Department rispecchia la Funzione "Amministrazione, Finanza e Controllo" della sua azienda: "Il Digital Finance Department è l'evoluzione della tradizionale Funzione "Amministrazione, Finanza e Controllo" la quale, guidata da un Digital CFO, è pervasa da conoscenze digitali e ottimizza i processi applicando le tecnologie digitali al fine di svolgere in modo efficiente ed efficace le attività quotidiane, supportare le diverse Funzioni aziendali e raggiungere gli obiettivi strategici"?		Likert scale (1-7)
	D15	Quanto le tecnologie digitali stanno cambiando il ruolo di Direttore Finanziario (CFO)?		Likert scale (1-7)
	D16	Secondo la sua opinione, (in una scala da 1-Per niente a 7-Completamente) quanto le seguenti forze stanno influenzando/accelerando la trasformazione digitale del Direttore Finanziario (CFO)?	Richiesta di informazioni in tempi sempre più ristretti	Likert scale (1-7)
			Presenza di un ambiente turbolento e complesso	Likert scale (1-7)
			Crescita del volume e della eterogeneità dei dati	Likert scale (1-7)
			Supporto per decisioni sempre più complesse	Likert scale (1-7)
			Necessità di forti collaborazioni con elementi esterni ed interni all'azienda	Likert scale (1-7)
			Creazione di vantaggio competitivo con aziende rivali	Likert scale (1-7)
			Aspettative per performance sempre migliori	Likert scale (1-7)
	D17	Ritiene che ci siano altre forze impattanti non considerate nella lista precedente? Potrebbe specificarle nello spazio sottostante?		Open-Ended Response
	D18	Secondo la sua opinione, quanto le tecnologie digitali hanno aumentato l'area di influenza del Direttore Finanziario (CFO) nelle seguenti attività?	Definizione della strategia corporate aziendale	Likert scale (1-7)
			Gestione delle attività operative	Likert scale (1-7)
			Investimenti in ICT	Likert scale (1-7)
			Comunicazione con shareholders e stakeholders	Likert scale (1-7)
	D19	Ritiene che avere delle competenze tecniche relative all'IT possa essere rilevante per un Direttore Finanziario (CFO)?		Likert scale (1-7)
	D20	Le sue capacità e conoscenze sono sufficienti per gestire il cambiamento digitale del Direttore Finanziario (CFO)?		Likert scale (1-7)
	D21	Sarebbe disposto a seguire corsi di formazione per affrontare al meglio la digitalizzazione del Direttore Finanziario (CFO)?		Likert scale (1-7)
	D22	Ritiene che l'importanza dell'utilizzo di tecnologie digitali nella funzione "Amministrazione, Finanza e Controllo" crescerà nei prossimi anni?		Likert scale (1-7)
	D23	Le tecnologie digitali quanto hanno migliorato la comunicazione e condivisione delle informazioni con le altre funzioni presenti in azienda?		Likert scale (1-7)

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SECTION	#	QUESTIONS	SUB-QUESTIONS	RESPONSE
DIGITALIZATION OF THE CFO	D24	Quanto sono rilevanti le seguenti tecnologie digitali nel suo lavoro?	Cloud Computing	Likert scale (1-7)
			Big Data and Analytics	Likert scale (1-7)
			Artificial Intelligence	Likert scale (1-7)
			Robotics Process Automation	Likert scale (1-7)
	D25	Apporterebbe qualche modifica alla precedente lista (Cloud Computing, Big Data and Analytics, Robotics Process Automation?		Open-Ended Response
	D26	Secondo la sua opinione, qual è la rilevanza (in una scala da 1-Per niente a 7-Indispensabile) del Cloud Computing nel supportare le seguenti attività?	Budgeting	Likert scale (1-7)
			Analisi dei costi	Likert scale (1-7)
			Analisi dei rischi	Likert scale (1-7)
			Auditing	Likert scale (1-7)
			Comunicazione	Likert scale (1-7)
			Controllo di gestione	Likert scale (1-7)
			Supporto decisionale	Likert scale (1-7)
			Analisi di sensitività	Likert scale (1-7)
			Analisi di previsione	Likert scale (1-7)
	D27	Quanto aumenterà (in percentuale) circa il budget del prossimo anno in investimenti relativi a Cloud Computing rispetto all'anno precedente?		Open-Ended Response
	D28	Secondo la sua opinione, qual è la rilevanza (in una scala da 1-Per niente a 7-Indispensabile) dei Big Data and Analytics nel supportare le seguenti attività?	Budgeting	Likert scale (1-7)
			Analisi dei costi	Likert scale (1-7)
			Analisi dei rischi	Likert scale (1-7)
			Auditing	Likert scale (1-7)
			Comunicazione	Likert scale (1-7)
			Controllo di gestione	Likert scale (1-7)
			Supporto decisionale	Likert scale (1-7)
			Analisi di sensitività	Likert scale (1-7)
			Analisi di previsione	Likert scale (1-7)
	D29	Quanto aumenterà (in percentuale) circa il budget del prossimo anno in investimenti relativi ai Big Data and Analytics rispetto all'anno precedente?		Open-Ended Response
	D30	Secondo la sua opinione, qual è la rilevanza (in una scala da 1-Per niente a 7-Indispensabile) dell' Artificial Intelligence nel supportare le seguenti attività?	Budgeting	Likert scale (1-7)
			Analisi dei costi	Likert scale (1-7)
			Analisi dei rischi	Likert scale (1-7)
			Auditing	Likert scale (1-7)
			Comunicazione	Likert scale (1-7)
			Controllo di gestione	Likert scale (1-7)
			Supporto decisionale	Likert scale (1-7)
			Analisi di sensitività	Likert scale (1-7)
			Analisi di previsione	Likert scale (1-7)
	D31	Quanto aumenterà (in percentuale) circa il budget del prossimo anno in investimenti relativi all' Artificial Intelligence rispetto all'anno precedente?		Open-Ended Response
	D32	Secondo la sua opinione, qual è la rilevanza (in una scala da 1-Per niente a 7-Indispensabile) del Robotics Process Automation nel supportare le seguenti attività?	Budgeting	Likert scale (1-7)
			Analisi dei costi	Likert scale (1-7)
			Analisi dei rischi	Likert scale (1-7)
			Auditing	Likert scale (1-7)
			Comunicazione	Likert scale (1-7)
			Controllo di gestione	Likert scale (1-7)
			Supporto decisionale	Likert scale (1-7)
			Analisi di sensitività	Likert scale (1-7)
			Analisi di previsione	Likert scale (1-7)

SECTION	#	QUESTIONS	SUB-QUESTIONS	RESPONSE
DIGITALIZATION OF THE CFO	D33	Quanto aumenterà (in percentuale) circa il budget del prossimo anno in investimenti relativi al Robotics Process Automation rispetto all'anno precedente?		Open-Ended Response
	D34	Le informazioni provenienti dai social media sono rilevanti per il suo lavoro?		Likert scale (1-7)
	D35	Secondo la sua opinione, qual è la rilevanza (in una scala da 1-Per niente a 7-Indispensabile) dell'utilizzo di informazioni provenienti dai social media nel supportare le seguenti attività?	Budgeting	Likert scale (1-7)
			Analisi dei costi	Likert scale (1-7)
			Analisi dei rischi	Likert scale (1-7)
			Auditing	Likert scale (1-7)
			Comunicazione	Likert scale (1-7)
			Controllo di gestione	Likert scale (1-7)
			Supporto decisionale	Likert scale (1-7)
			Analisi di sensitività	Likert scale (1-7)
			Analisi di previsione	Likert scale (1-7)
	D36	Secondo la sua opinione, quali tipi di dati vengono/dovrebbero essere processati con le seguenti tecnologie?	Cloud Computing - Dati dei clienti	YES/NO
			Cloud Computing - Dati di aziende concorrenti	YES/NO
			Cloud Computing - Dati di fornitori e stakeholders	YES/NO
			Cloud Computing - Dati provenienti dalla divisione Operations	YES/NO
			Cloud Computing - Dati dai Social Media	YES/NO
			Cloud Computing - Notizie dai mass media	YES/NO
			Cloud Computing - Dati dalle borse finanziarie	YES/NO
			Big Data and Analytics - Dati dei clienti	YES/NO
			Big Data and Analytics - Dati di aziende concorrenti	YES/NO
			Big Data and Analytics - Dati di fornitori e stakeholders	YES/NO
			Big Data and Analytics - Dati provenienti dalla divisione Operations	YES/NO
			Big Data and Analytics - Dati dai Social Media	YES/NO
			Big Data and Analytics - Notizie dai mass media	YES/NO
			Big Data and Analytics - Dati dalle borse finanziarie	YES/NO
			Artificial Intelligence - Dati dei clienti	YES/NO
			Artificial Intelligence - Dati di aziende concorrenti	YES/NO
			Artificial Intelligence - Dati di fornitori e stakeholders	YES/NO
			Artificial Intelligence - Dati provenienti dalla divisione Operations	YES/NO
			Artificial Intelligence - Dati dai Social Media	YES/NO
			Artificial Intelligence - Notizie dai mass media	YES/NO
			Artificial Intelligence - Dati dalle borse finanziarie	YES/NO
			Robotics Process Automation - Dati dei clienti	YES/NO
			Robotics Process Automation - Dati di aziende concorrenti	YES/NO
			Robotics Process Automation - Dati di fornitori e stakeholders	YES/NO
			Robotics Process Automation - Dati provenienti dalla divisione Operations	YES/NO
			Robotics Process Automation - Dati dai Social Media	YES/NO
			Robotics Process Automation - Notizie dai mass media	YES/NO
			Robotics Process Automation - Dati dalle borse finanziarie	YES/NO
	D37	Secondo la sua opinione, qual è la rilevanza (in una scala da 1-Per niente a 7-Indispensabili) di ciascuna tecnologia digitale nel supportare la raccolta dei dati?	Cloud Computing	Likert scale (1-7)
			Big Data and Analytics	Likert scale (1-7)
			Artificial Intelligence	Likert scale (1-7)
			Robotics Process Automation	Likert scale (1-7)

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SECTION	#	QUESTIONS	SUB-QUESTIONS	RESPONSE
DIGITALIZATION OF THE CFO	D38	Secondo la sua opinione, qual è la rilevanza (in una scala da 1-Per niente a 7-Indispensabili) di ciascuna tecnologia digitale nel supportare l'analisi dei dati grezzi (es. elaborazione KPI)?	Cloud Computing	Likert scale (1-7)
			Big Data and Analytics	Likert scale (1-7)
			Artificial Intelligence	Likert scale (1-7)
			Robotics Process Automation	Likert scale (1-7)
	D39	Secondo la sua opinione, qual è la rilevanza (in una scala da 1-Per niente a 7-Indispensabili) di ciascuna tecnologia digitale nel supportare l'utilizzo dei dati elaborati (es. controllo, analisi dei rischi)?	Cloud Computing	Likert scale (1-7)
			Big Data and Analytics	Likert scale (1-7)
			Artificial Intelligence	Likert scale (1-7)
			Robotics Process Automation	Likert scale (1-7)
	D40	Secondo la sua opinione, qual è la rilevanza (in una scala da 1-Per niente a 7-Indispensabili) di ciascuna tecnologia digitale nel supportare l' archiviazione dei dati (es. scrittura del bilancio)?	Cloud Computing	Likert scale (1-7)
			Big Data and Analytics	Likert scale (1-7)
			Artificial Intelligence	Likert scale (1-7)
			Robotics Process Automation	Likert scale (1-7)

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SECTION	#	QUESTIONS	SUB-QUESTIONS	RESPONSE
PSYCHOLOGICAL WELLBEING	D41	WORKLOAD	Da quando sono state introdotte le tecnologie digitali, il mio lavoro di Direttore Finanziario (CFO) è più pesante	Likert scale (1-7)
	D42		Da quando sono state introdotte le tecnologie digitali, il lavoro di Direttore Finanziario (CFO) mi occupa più tempo	Likert scale (1-7)
	D43		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) mi è richiesto un carico di lavoro maggiore rispetto a quello che riesco a svolgere in modo adeguato	Likert scale (1-7)
	D44	COGNITIVE DEMAND	Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) devo prestare attenzione ad una quantità maggiore di informazioni mentre lavoro	Likert scale (1-7)
	D45		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) devo memorizzare una quantità maggiore di informazioni	Likert scale (1-7)
	D46		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) devo prendere decisioni più difficili	Likert scale (1-7)
	D47	AUTONOMY	Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) ho una maggiore autonomia nello svolgere il mio lavoro	Likert scale (1-7)
	D48		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) ho ricevuto considerevoli opportunità per una maggiore libertà e indipendenza nello svolgere il mio lavoro	Likert scale (1-7)
	D49		L'introduzione delle tecnologie digitali mi ha concesso maggiori libertà nel decidere come svolgere il lavoro di Direttore Finanziario (CFO)	Likert scale (1-7)
	D50	PROFESSIONAL DEVELOPMENT	Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) mi è richiesto di prendere più iniziative	Likert scale (1-7)
	D51		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) ho avuto più opportunità di imparare cose nuove durante il lavoro	Likert scale (1-7)
	D52		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) ho più opportunità nello sviluppare le mie competenze	Likert scale (1-7)
	D53	EXHAUSTION	Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) impiego più tempo per rilassarmi dopo il lavoro	Likert scale (1-7)
	D54*		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) riesco a reggere meglio la pressione del mio lavoro	Likert scale (1-7)
	D55*		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) riesco a gestire meglio il mio lavoro	Likert scale (1-7)

Annex

SECTION	#	QUESTIONS	SUB-QUESTIONS	RESPONSE
PSYCHOLOGICAL WELLBEING	D56*	DISENGAGEMENT	Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) ho scoperto nuovi e interessanti aspetti del mio lavoro	Likert scale (1-7)
	D57		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) parlo negativamente del mio lavoro più frequentemente	Likert scale (1-7)
	D58*		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) mi sento sempre più coinvolto nel mio lavoro	Likert scale (1-7)
	D59	VIGOUR	Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) quando mi sveglio ho più voglia di andare a lavoro	Likert scale (1-7)
	D60		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) riesco a lavorare per periodi di tempo più lunghi	Likert scale (1-7)
	D61		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) a lavoro sono più perseverante anche quando le cose non vanno bene	Likert scale (1-7)
	D62	DEDICATION	Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) do più significato e valore al mio lavoro	Likert scale (1-7)
	D63		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) sono più entusiasta del mio lavoro	Likert scale (1-7)
	D64		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) il mio lavoro mi ispira maggiormente	Likert scale (1-7)
	D65	TURNOVER INTENTION	Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) considero più spesso di andare a lavorare da un'altra parte	Likert scale (1-7)
	D66*		Da quando sono state introdotte le tecnologie digitali, raccomanderei maggiormente ad un buon amico di cercare lavoro come Direttore Finanziario (CFO)	Likert scale (1-7)
	D67*		Da quando sono state introdotte le tecnologie digitali, come Direttore Finanziario (CFO) mi piace di più parlare con gli altri a proposito del mio lavoro	Likert scale (1-7)

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