UNIVERSITÀ POLITECNICA DELLE MARCHE
FACOLTÀ DI ECONOMIA "GIORGIO FUÀ"

Corso di Laurea Magistrale in International Economics and Commerce

THE IMPACTS OF DIGITALIZATION ON MANAGEMENT ACCOUNTING: A FIELD STUDY

Relatore: Chiar.ma
Prof. Maria Serena Chiucchi
Correlatore: Chiar.mo
Prof. Marco Montemari

Tesi di Laurea di:
Angelica Sardini

Anno Accademico 2021 – 2022

TABLE OF CONTENTS

Introduction

During the last decades the surrounding environment is increasingly digital and this trend can only continue during the next years. The term “digitalization” is defined by the Oxford English Dictionary (OED) as “the adoption or increase in use of digital or computer technology by an organization, industry, country, etc.” (OED Online, 2016). Following this definition, we can refer to digitalization as a process of applying, implementing and understanding of the use of digital tools in order to improve various activities or techniques within different contexts. Social media, websites, Cloud services, connected devices and Artificial Intelligence are some of the new digital technologies that have led to a “datafication” of our society (Redden, 2018). In a landscape of increasing interconnection and the omnipresence of information technology also in everyday life, new technologies are playing a major role as a driving and changing force in several industries. In this regard, business organizations are trying to adopt new methods to increase efficiency and new value-producing opportunities (AlAnsari et al., 2022). Technological and digital improvements, especially the ability to automate tasks and processes, are demonstrating a large influence on many areas of the business environment. The introduction of these new digital technologies can change how companies create, organize, deliver and capture value, leading to transformations in their competitive strategy, operational methods and structure. Consequently,

this change on the economic and business landscape entails different informative demand, changing the information systems supporting decision making (AlAnsari et al., 2022). Therefore, the management accounting system as well as all business activities and processes supporting the whole organization can be strongly affected by these technological and digital changes (Mancini, 2016; Möller et al., 2020; Bhimani and Willcocks, 2014; Liu and Vasarhelyi, 2014). Following this perspective, digitalization can influence traditional management accounting approaches for identifying, analyzing, interpreting, and communicating information to the various levels of management (Manea, 2012). Despite research has already started to investigate the influence of digital technologies on management accounting, this stream of research requires, and deserves, additional attention (Rikhardsson and Yigitbasioglu, 2018). Thus, the purpose of the thesis is to explore the effects, the changes and the adaptations that digitization can generate on management accounting. In this study the focus of the impact of digital technologies on management accounting is distinguished with regard to management accounting tasks, techniques as well as the role and the skills of the management accountant in current business contexts. The goal is to analyse if and how the opportunities of digital technologies such as Big Data Analytics, Business Intelligence, Cloud, Internet of Things, Artificial Intelligence, social media and Blockchain are affecting management accounting. One of the reasons behind the thesis's focus on this particular topic lies on the relevance of management

accounting this function within companies. Management accounting provides tools, methods and approaches to support managers in planning, controlling and decision making (Garrison et al., 2018). Given the contribution of management accounting to the whole business organization as the ability to guide efficiently and effectively the management's actions towards its goals, the comprehension of how and whether management accounting methods and practises can change due to digital technologies appears crucial. In addition, the analysis of the potential effects of digitization that the present thesis aims to undertake seeks to define also what the future role of the management accountant might be in modern business contexts. In particular, this study can help to understand how to gain from successfully integrating digital technologies, how the position of management accountants can change within companies and how they can continue to add value to business organisations. The need to have more knowledge about the opportunities and the challenges of the implementation of digital technologies on management accounting is also related to the way approaches and techniques adapt to meet new decision-makers' demands. Therefore, an in-depth analysis in this regard can entail a more effective adoption of digital technologies which consequently can improve the overall managerial decision-making process. For these reasons, the implementation of digital technologies on management accounting practices represents an interest for researchers and the contingency theory is often used in the literature to explain the phenomenon. From this

perspective, management accounting is perceived effective when “fits” the changing environment and the strategy (Yigitbasioglu, 2017). Given that assumption, investigating how management accounting adapts itself to the transformations that digitalization entails results crucial. In order to achieve the abovementioned aim, a theoretical and an empirical analysis will be carried out. Hence, the work is composed of four chapters organized as follows. The first chapter introduces the main characteristics and the functions of management accounting, which are distinguished respectively in planning, controlling and decision-making activities. Moreover, in order to contextualize its relevance within business organization, an analysis is offered also on the evolution of the role of the management accountant over the years.

The second chapter, instead, aims to provide a detailed overview of the main new digital technologies, identifying the applications and the functionalities that can be used in business contexts. In particular, the chapter provides a better understanding of the uses of Business Intelligence, Big Data Analytics, Internet of Things, Artificial Intelligence, Cloud, Blockchain and social media within companies.

The third chapter includes a literature review in order to investigate the various effects that digital technologies can generate on management accounting. The structure of this chapter reflects the distinction of the impacts of digitalization in

terms of management accounting tasks, techniques, as well as the role and the skills of management accountant. The literature review allows to have an outline of the potential consequences that these technologies would be able to provide and therefore it helps to understand how management accounting can be affected by their implementation.

The aim of the fourth chapter is to explore the actual effects of digitalization on real business contexts, performing a qualitative research through the use of interviews. The sample of the interview research includes four management accountants and one Chief Financial Officer (CFO) operating in different business sectors. The interview research is grounded on the literature on the influence of digital technologies on management accounting, distinguishing the effects in relation to management accounting tasks, techniques and the management accountant role and skills.

Finally, the last section concludes the thesis by presenting its main contributions, its limitations and potential future avenues of research. In particular, this section allows a discussion between the opportunities described in the literature and the outcomes of the empirical research on business practices. The purpose of this section is to investigate the actual state of implementation of digital technologies in management accounting within business contexts, identifying confirmations or differences with respect to the current literature knowledge. Moreover, another

goal of this section is to contribute to a better understanding of this phenomenon, providing not only an overview of the potential implications that the digitalization can entail on management accounting but also new incentives and starting points for further studies about the topic.

CHAPTER 1

MANAGEMENT ACCOUNTING: CHARACTERISTICS AND FUNCTIONS

1.1. Introduction

In every business enterprise, the various transactions and actions which take place continuously, are arising out of the decisions and actions of management. Management can be defined as "the process of working with and through others to achieve organizational objective in a changing environment." (Kreitner and Cassidy, 2012, p. 5). Central to the process is the effective and efficient implementation of limited resources in order to generate and preserve value within business organizations. Management accounting, instead, can be perceived as a process of identification, measurement, collection, analysis, preparation, interpretation and communication of financial information used by management to plan, assess and control and to ensure the appropriate use of the resources of business organizations. Since value is strictly connected with the ability to generate profits and meet planned objectives, it is correct to argue that management accounting affects the managerial decisions and the optimal utilization of resources (Macintosh and Quattrone, 2010). Therefore, considering the importance of management accounting within organizations, the focus of this

chapter is completely directed toward a deep understanding of the management accounting function. The structure of the chapter includes firstly a summary of the definitions and main features of management accounting in order to grasp the main aspects and characteristics. The following part, instead, focuses on a more detailed comprehension of the functions of the management accounting in business organizations, highlighting the support to managers respectively to the planning, controlling and decision-making processes. The chapter concludes with a discussion about the role that management accountant plays within companies.

1.2. Management accounting: definitions and features

The Institute of Management Accountants (IMA) provided a definition stating the following: "Management accounting is a profession that involves partnering in management decision making, devising planning and performance management systems, and providing expertise in financial reporting and control to assist management in the formulation and implementation of an organization's strategy" (IMA, 2008, p. 1). The reference to the concept of a profession represents many purposes. For instance, it constitutes a basis for explaining the cognitive aspects of the topic and it allows to define the current and the future role of the profession, its boundaries, and its identity. Similarly, Schäffer et al. (2012) emphasize the managerial aspect and the objective-driven perspective, highlighting the fact that management accounting directs all decisions toward achieving the objectives

(Schäffer et al., 2012). As a consequence, the merely function of providing information is insufficient to define it, and planning and strategic practices, as well as monitoring and control, represent central importance. The management accounting's support within business organizations involves the full spectrum of a manager's responsibilities. Thus, the contribution of management accounting provides tools, activities and approaches in order to guarantee that managers can plan, control, and decision making in an efficient and effective way. Still in agreement with what has been said so far, management accounting has been properly designed to guide, efficiently and effectively the management's actions towards its goals" (Mancini et al. ,2016). The effectiveness that should lead the managerial actions refers to the relationship between planned objectives and actual outcomes. Therefore, managers within business organizations must be aware not only about the comparison between what they plan and what they achieve, but they should be aware also about the reasons that lie behind that potential discrepancy. The efficiency of managerial decisions, instead, regards the relation between the resources used and the output achieved, and management accounting's role in this context concerns the knowledge and the communication of such information in order to evaluate the conditions, understanding the motivations and take appropriate measures. The relevance that management accounting has acquired over the last few years in the business and management research entails the need to have a more accurate and broad definition of this

function. Within business enterprises, management accounting can be considered as a process that starts when the main business goals are set and that it terminates with the measurement of the degree of achievement of the results and eventually, with some corrective actions (Marchi et al., 2018). Precisely, the variety of information identified, presented by the management accounting function represents a crucial resource for management in order to conduct a multitude of activities such as planning, controlling, decision making, the optimization of the use of resources (Marchi et al., 2018). Several research surveys have investigated the importance of management accounting information in order to rank in relation to other sources of information for decision-making purposes. Generally speaking, the result of these studies reported that managers consider accounting information very highly relevant within organizations (Atrill and McLaney, 2009). Management accounting is based on four key principles that allow to determine its aims, models, logics, activities and competences. These are relevance, systemic approach, capability to influence and the ability to create trust (Dossi and Meloni, 2021). It is necessary to clarify that the relevance of management accounting depends also on the quality of the information provided. Therefore, in order to be useful to managers, management accounting information should possess specific key features. These can be summarized in relevance, reliability, comparability and understandability (Atrill and McLaney, 2009). Regarding the relevance, the information must have the ability to affect decisions and if this characteristic is

absent, there is really no point in producing the information itself. This consideration implies that the information should be targeted at the requirements of the specific recipient for whom it is being provided. Another important aspect concerns the timeliness because in order be able to have an effect on a decision, the information must be timely, i.e. it has to be available when the decision needs to be made. Due to technological improvements, the focus on timely accounting information has increased and contemporary integrated management information systems (e.g. enterprise systems and business intelligence) even include real-time information. (Chaudhuri et al., 2011; Davenport, 2000). Timeliness should be considered a multidimensional quality within management accounting information since the ways of enacting it are the affordable-speed, right-time and instantly-actionable. The concept of right-time does not match only with obtaining information "now", i.e. saving time, but also incorporates obtaining information at an appropriate moment. The instantly-actionable property is connected to the possibility for managers to be informed to the extent that they could take action on it (Gullberg,2016). Regarding the affordable-speed, this form of timeliness involves the ability of management accountants to achieve a balance between a complete and precise information and the speed with which it could be obtained. The reliability of management accounting information, instead, represents the absence of significant errors or bias. Nevertheless, the most common trouble occurs when reliability and relevance do not coexist: information that is highly

relevant is not very reliable, and vice versa. Moreover, the comparability represents a crucial characteristic since the information should be able to be compared over time and in relation to other similar businesses. This feature allows to assess the performance, the profitability and the efficiency of several different objects within business organizations. Comparability can also be improved through the clarity of the policies that have been adopted in measuring and presenting the information. Clearness and understandability represent other relevant features of management accounting reports because they must be understood by those managers or others entity at whom the information is aimed. As a result of these features, management accounting provides to the organizations the possibility to visualise, analyse and measure the current "health" of the business, questioning the operational and managerial strategies implemented and, if necessary, applying new paths of actions (Busco et al., 2006). Regarding the abovementioned systemic approach as a crucial characteristic of management accounting, we have to clarify that it refers to the ability to generate organised, fully integrated, and systemised information. The main aim is not simply supporting specific evaluations or decisions but it involves providing a set of information linked to each other in order to support achievement of business objectives as a whole and to guarantee that each individual assessment or decision is aligned with those objectives. Only an integrated information asset ensures a global vision of the business phenomenon through which it is possible to control

the process of generating value as a whole. The centrality of the management accounting within business organizations is guaranteed by the fact that it favours relations and dialogue. The role of the management accounting is not restricted to the production of information but embraces the comprehension of the knowledge developed and its actual use. Finally, management accounting must manage relationships and resources in a way that protects tangible and intangible assets, reputation and long-term business value. Trust is an essential element to achieve that goal. Management accountants should represent work ethics and respect for the organizational rules and the fundamental values of the organization. To sum up, management accounting is a set of knowledge whose understanding is essential for the success of managers and consequently of the organization (Gaidienë and Skyrius, 2006). This perspective highlights the importance of the business orientation of management accounting as it represents the will and the capability to provide more added value to the management of the organizations (Busco et al., 2007). In order to extremely summarize what has just been discussed about the contribution and functions of the management accounting, it can be stated that it aids management to perform three main activities: planning, controlling and decision making (Garrison et al., 2018).

1.3. Logic and relevance of management accounting on business organizations

As been discussed above, the main functions of management accounting relate to help managers to execute planning, controlling and decision-making activities (Garrison et al. 2018).

1.3.1. Planning

Planning as directional activity with tendentially cyclical character can be defined as the cognitive part of the business management that allows the prospective formulation of the management over time (Paolini et al., 2020). From this perspective, it can be stated that planning plays an essential role in the management of an organisation because it aids to identify the main issues, to evaluate their effects through the consideration of the organisational operations and to develop alternative measures and tactics able to ensure that the organization gains competitive advantage (Tarifi, 2021). The concept of planning should be understood as the process that involves defining the objectives and the lines of action in order to achieve the business goals (Marchi et al., 2018). It is necessary to distinct two different form of planning: strategic planning and operational planning. The former concerns a long-term perspective because it involves the establishment of global and long-term objectives and lines of actions.

Strategic planning can be interpreted as road map that defines long term strategic options, examining the future of the company and the finding of issues and trends that line up with the priorities of the organisation (Bagire and Namada, 2013). This path represents all the decisions needed to align with the changing organizational environment and since the related issues and problems vary in relation to the scope and contents, strategic planning is difficult to formalize. The attention should be directed to the concept of strategic planning as a process, understood as a directional activity that takes place continuously over time, linked to fixed deadlines and therefore not occasional. Consequently, the strategy development process includes several sequential steps such as environmental analysis, goals formulation, establishing the vision and mission, strategy implementation and control. The core phases of strategic planning concerns first of all the definition of the basic management objectives, then the formulation of the strategic choices to pursue the same objectives and finally the preparation of a formalized plan that will enable its implementation. Large part of the strategy literature agrees on the portrayal of the CEO as the key strategy maker that develops the strategic plan, and enforces its implementation on the rest of the organization. Hence, strategic planning seems to be a completely hierarchical process where top management alone delineates an overall strategic plan based on corporate goals and long-term objectives before general managers develop their functional goals and strategic business plans (Andersen 2000). Conversely, the

importance of the strategy sharing within all the structures of the organization should be highlighted, and as the research of Bagire and Namada (2013) suggests "the vision and mission are articulated by top management but should be known by all staff and integrate in the work system of the organization." (2013, p.484). Therefore, in order to achieve an effective strategy implementation, the integration, coordination and alignment of people, processes, structures, and resources are key essential elements. Strategic planning should be conceived as an organisational management instrument that guarantees the focus of both organisational stakeholders and employees on the achievement and the realization of the common goals of the organization. The criticality of this process lies on the ability to identify the priorities, the opportunities and the impediments which can limit or allow the carrying out of the mission. Furthermore, strategy planning involves the identification of internal strengths, weaknesses and the analysis of existing external opportunities and threats. Strengths and weaknesses of the whole organization and of the individual departments are evaluated to determine abilities and competences to compete and survive within the economic environment in which the company operates. Strengths usually refer to the features that add value to a product or service in order to generate a competitive advantage for the business organization. On the contrary, shortcomings and limitations in abilities, skills and resources represent the weaknesses that impede the effective performance of the organization. According to Odera (2014), the relevance of the

environment in the process of formulation of strategies is justified by the fact that it is the environment that drives the firm, and the latter that continuously responds to and adjusts to its changes (Tarifi, 2021). Following this perspective, external opportunities incorporate circumstances and conditions that can be exploited by the organization to increase performance and position of the company. Conversely, threats are explained as disadvantageous situations that limit the realization of some activities or goals with respect to which, organizations have very little or no control on. In this context, the support of management accounting in planning consists on providing to managers information and data which estimate the consequences of alternative actions related to the company's ability to achieve desired goals. As previously mentioned, the output of the strategic planning process is mainly led by a management orientation in the medium-long term. Once this perspective has been considered, the operational planning comes into play. It has mainly a short-term perspective and it is performed at a lower level, with the help of the different business functions. In order to achieve the objectives of strategic planning and to properly implement the related strategic solutions, it is necessary to adopt a process of translation of the aforementioned objectives and strategic actions to the short term. The operational planning leads to a breakdown of the medium and long-term objectives into objectives that refer to smaller time intervals. In addition, while at a strategic level, the focus is directed toward the organization as a whole, on an operational level the individual

business areas are considered, thus deciding concretely the initiatives that in each of them will have to be implemented in order to achieve the strategic objectives. In other words, through operational planning, the long-term strategic objectives are articulated in specific short-term objectives, the achievement of which is in charge of the individual business areas. In this context, a crucial aspect that must be investigated is the relationship between the short-term and long-term objectives. We can easily claim that there must be an instrumental link, which implies coordination among the strategic goals of the organization and deduced objectives of the operational planning. In order to achieve the strategic and long-term goals of the organization, the consistency between the operational objectives and the strategic ones represents a crucial and unavoidable condition. Therefore, it is needed a control process of the degree of consistency of the objectives to ensure the before mentioned instrumental relationship. This uniformity is not obvious, because it requires several analysis and controls. For instance, an accurate inspection of the means available and the evaluation of the availability of additional resources are essential activities to be able to carry out the operational objectives. Specifically, operational planning requires a series of analytical decisions and analysis which involves reflections on the feasibility of the strategic goals. As a matter of fact, operational planning identifies and determines how to procure the necessary resources for the achievement of the objectives. All the elements that embody planning such as the definition of objectives, the allocation

of resources and the implementation of operations should be measurable. Among the essential characteristics of strategic and operational objectives, measurability is the most important. Budgets are important instruments for short-term planning because they are accounting documents expressed in quantitative and monetary terms that support organizations in making decisions about alternative courses of action. The literature agrees on the three main function of budgeting which are evaluation, planning, and control (Henttu-Aho and Järvinen, 2013; Sivabalan et al., 2009). The development of plans represents the planning function of budget because it involves the coordination of resources across organizational units, formulation of action plans, identification of expected costs and promotion of innovative behavior (Sivabalan et al., 2009). Coordination of resources is a key reason for the adoption of budget in operational planning because budget can disclose, prior to period commencement, the funding constraints of departments and organizational units (Sivabalan et al., 2009). Moreover, budget represents also an instrument for the formulation of action plans since in many business organizations, it helps in determining the costs of the alternative courses of action (Merchant and Van der Stede, 2003). Another budget function related to the planning regards the management of production capacity in an upcoming period. Budgets, indeed, allow enterprises to evaluate their level of activity and the extent to which they use their operating capacity (Langfield-Smith et al., 2005). In this context management accounting reveals its connection with planning as an

information provider for decision-making and also because the entire budgeting process is developed around accounting-related reports.

1.3.2. Controlling

In the economic-business perspective, planning and controlling are considered in a systematic view and therefore conceived as a coordinated set of elements, characterized by a high degree of interaction, that support the company. The system is also viewed as an operative mechanism that allows to establish coordination and cooperation within the different structures of the organizations. This occurs because it is an instrument based on activities, principles and tools able to regulate in an integrated way the different areas within organizations in order to achieve common aims. In this specific context, the planning and controlling mechanism refers to the methods, principles and instruments used to select and set the objectives, identify lines of action to achieve these objectives, monitor the performance and compare the planned goals with the actual results. The control process includes collection, appraising, and responding to feedback to ensure that the planning meets the expectations. Moreover, it involves also the interpretation of the feedback in order to improve the effectiveness of the implementation of planning. The relevance of controlling lies on the possibility to know if a plan has been successful or not. The implementation of the plan requires the organization to put controlling in place, because the absence of such function

would put the company in a position in which it does not know the effectiveness of the performance. Hence, the main function of controlling consists in the comparison between the actual performance and the planned operational objectives. The reason that lies behind this verification is to identify the differences and deviations and to intervene on relevant and significant misalignments. Precisely, the aim of the control process is twofold: on one hand it is represented by the minimization of the divergences between actual results and objectives, on the other hand it involves the comprehension of the causes of the deviation. Regarding the latter, the goal would be to understand deeply the underlying reasons why performance does not match to what has been planned. It is through the controlling phase that the actual results of decisions made during the planning can be identified and measured. Managerial accounting plays a crucial role not only to determine and design control measures, but also to support management by providing reports that highlight the deviations between the planned performance and the actual one. The comparison of actual results against expected outcomes can refer to a product, a department, a division, and also at company levels. Control, understood as a "guide" was defined by Anthony (1965) as "the process by which managers ensure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives." Following this perspective, it can provide a means for guaranteeing cooperation among individuals or organizational units that may share only

partially common objectives, and directing the efforts toward a specified set of goals. In a perspective oriented to an effective formulation and management of objectives, control process develops through organizational and measurement activities which vary in relation to the content and the purposes assigned to the control function. The control process can be fragmented in several phases that involve perspectives analysis, forecasting and simulation models, dissemination of knowledge, negotiation of objectives, organisational and information integration, internal motivation, measurement of achieved results, analysis of deviations, definition and implementation of corrective actions. Furthermore, the controlling function should be conceived as a set of operational mechanisms that can be distinguished by feedback mechanism and feedforward mechanism. The difference between these two methods lies not only on the timing in which they are implemented but also and on type of information and instruments they use. The feedback mechanism is based on the measurement of the outcomes at the end of predefined time intervals, the comparison with the objectives, the analysis and the interpretation of the deviations to implement the necessary corrective actions. The advantages of this control mechanism are not only related to the accuracy of the information provided because it is based on the actual result achieved, but also on the provision of a complete picture of the management in relation to the planned objectives. On the opposite side, the not-action oriented perspective used in this type of mechanism represents the major disadvantage. The difficulty of

activating corrective actions in a timely manner since such information is only provided at the end of the period represents an important limit to this mechanism. A common solution for this problem of application of the feedback mechanism at the end of the annual budget reference period, is the monthly budgeting, which is an articulation of the annual objective into monthly objectives. Another method that can overcome this issue is represented by the feedforward mechanism, which means enhancing the information system for the measurement of intermediate results and the projection of such results at the end of the period on the basis of probabilistic and predictive models. The main aim of such control mechanism therefore is the forecasting of the probability of achieving the objective in order to be able to highlight possible deviations before their actual realization. The timing of this information allows the reactivation of the system in order to reach the objective when it is still achievable. In order to apply the feedforward mechanism and to facilitate a correct interpretation of forecasts and deviations, the users must be able to manage the mathematical-statistical relationships on the basis of which the predictive model is built. Moreover, the reliability of the data underpinning the predictive model must be ensured together with the usefulness of the model in terms of decision support. In this context, therefore, to provide even more forward-looking control, ante-action simulation models could also be effectively used. Despite all these utilities of the feedforward mechanism, it is necessary to clarify that compare to the feedforward mechanism, it is more expensive and more

time and labor intensive. As previously mentioned, within organizations budget is an important tool not only for planning but also for the control function (Anthony et al., 2007; Otley 1999). Budgets contain numerical objectives alongside the management outcomes that lead to a comparison between objectives and results. Since budget is one of the few formal financial controls that are provided to the board of directors, the control function implies the use of budget as a monitoring device. Moreover, the utilization of the budget in this function is extended also to the control of costs during the period. Variance analysis is an important management accounting tool to improve budgeting (Kloock and Schiller, 1997). It can be considered as a significant form of organizational feedback that discloses the difference between actual performance and some planned or targeted level of performance (Luckett and Eggleton, 1991). The need to verify the degree of consistency between the short-term objectives and the strategic objectives leads to a development of a constant check of the alignment of the results obtained through the business management and the planned objectives. Therefore, variance analysis plays an essential role in this context because it makes managers responsible and aware of the variances. The identification of mismatches in the control process represents a crucial source of discussion and interpretation aimed to understand the causes, and to decide eventual corrective actions which can provide the realignment or if it is not possible, a learning effect for the future (Chiucchi et al., 2018).

1.3.3. Decision Making

By definition, decisions influence future events and in the case of management of business organizations, they may affect only a single event or they may influence all events subsequent to that choice (Bruns, 1968). Management is achieved through a system of decisions of varying content and importance aimed at the pursuit of sustainable economic balance (Marasca and Pettinari, 2018). Such decisions, linked in space and time, imply the choice between alternative courses of action for future manifestation, which impact both internal and external circumstances. Within the business organization environment, decisions are originated from a joint evaluation of the quantitative and qualitative effects of the compared alternative courses of action. All managerial actions therefore should be inspired by the economic principles of effectiveness and efficiency. In order to make decision that allows the achievement of the planned objectives and an efficient utilization of the resources, relevant information and specific analysis are needed. Business decisions are generally divided into long-term decisions and short-term decisions. Through long-term decisions, the company has a given capacity and production structure for use over a long period of time. Short-term decisions are part of the framework of long-term decisions and involves the comparison of alternative courses of action concerning the optimal use of available capacity and production structure. Since short-term decisions refer to a short period of time, they present a higher degree of reversibility. The differences

between these two types of decisions are translated into the analysis carried out using information of a different quantitative-monetary nature. Long-term decisions thus require the use of financial measures. On the other hand, given the shorter reference horizon, short-term decisions can be assessed through economic variables, in particular costs and revenues, ignoring the financial value over time and the risk involved. The decision making should be conceived as a process that involves several consequential steps. The first activity needed to start this process for a given type of decision concerns the identification of the various alternatives and the criteria for choosing among them. A further step involves the gathering of the data necessary to evaluate the various alternatives. The analysis and the comparison of the quantitative and qualitative effects of each alternative represent the essence of the decision-making process because it leads to the actual selection of the best alternative. Despite this view of the decision making, it is crucial to clarify that this process does not follow a univocal and predefined path in all companies. On the contrary, the organizational structure and the environment of the business organization define and affect the decision-making process in relevant ways. For instance, in a strongly centralized organizations, lower-level managers have little freedom to make decisions because the decision-making authority is confined to a few top executives who are reluctant to delegate this power. On the other hand, the decisional authority is spread across all the business levels in a decentralized organization and consequently even the lowest-level

managers are allowed to make several decisions (Garrison et al., 2018). Decision-making is well known as one of the key rationales for management accounting (e.g. Simon et al., 1955). Hopper (1980) emphasizes the role of management accounting as a decision-making facilitator. The management accounting function in this context is to support the achievement of optimal decision outcomes through the aid in practice of economic and operational techniques. In order to assess the differences among alternative courses of action, management accounting exploit the usefulness of the differential analysis which is based on identifying the costs and benefits that differ between alternatives. The cornerstone of this analysis is based on the distinction between relevant and irrelevant costs and benefits in order to ignore the unrelated elements during the decision-making process. The reasons that lie behind this mechanism is to save time and effort for decision makers and to avoid making bad decisions by considering irrelevant elements in the assessment of alternatives. The mentioned method of the differential analysis is the differential approach, because it focuses solely on identifying the relevant costs and benefits (Garrison et al., 2018). Within businesses, an important application of this type of analysis regards the make or buy decision. This decision involves choosing whether to carry out one of the activities in the value chain internally or to buy externally from a supplier (Garrison et al., 2018). Despite the fact that Make or buy decisions in management accounting are usually resolved by identifying which decision will lead to lower costs and thus, higher

profits, the business organization has to take into account also the strategic perspective of the decision.

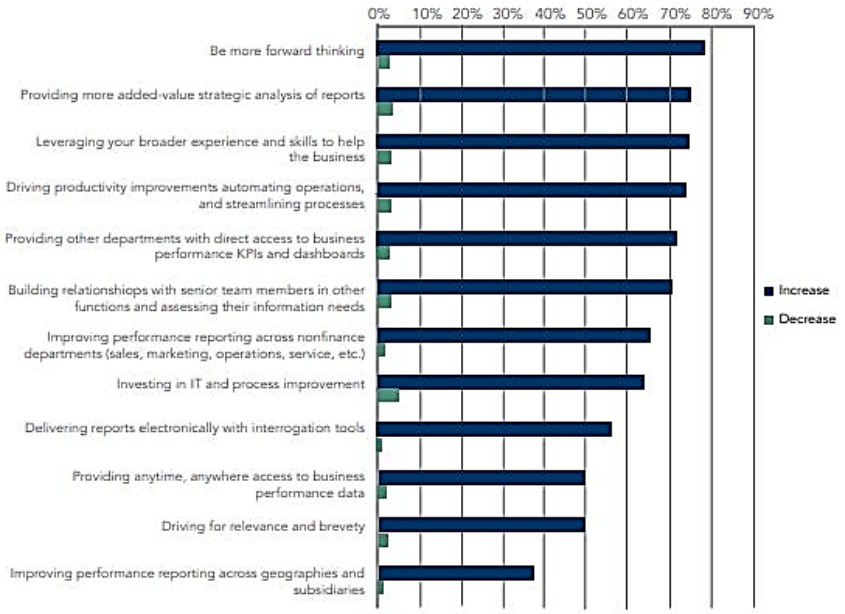
1.4. The role of the management accountant

During recent years an academic and professional debate on the role of management accountants has been flourished. The recent commentaries claim that management accountant is experiencing relevant role changes, involving a transition from a simple "scorekeeping" role to a proactive" business-consultancy" role (Hopper et al., 2007). The traditional role collocates the management accountants in the accounting department, isolated from the rest of the company where they are considered as experts in the preparation and interpretation of information to support decision-making and control. The day-to-day activities were mainly related to the "scorekeeping" tasks and techniques such as product costing, budgeting, capital appraisal methods and variance analysis. The traditional role of the management accountants has been expressed by Hopper (1980) as a professional figure that evaluates the financial performance of different business functions in objective and independent ways. Individual responsibility has been translated from the various organizational structures to responsibility centres and responsibility accounting systems. This implies that the passive traditional role of the management accountant includes the monitoring of the performance of each responsibility centre and the production of financial

reports. The traditional role of management accountants that we have described helps to understand that the current role is more directed to a “business-orientation”. The literature in this field of study has claimed the transition from the scorekeeper and watchdog (bean counter) function to the active advisor and an increasing participant role in decision-making (business partner). (Kaplan, 1995; Granlund and Lukka, 1997; Lukka, 1998; Malmi, 2001; Burns and Baldvinsdottir, 2005). The business orientation of management accountant can be conceived as the willingness and ability to provide more added value to the management of the companies (Järvenpää, 2007). Despite the fact that several and different factors have affected the change of the management accountant role, we can claim that the most relevant are globalization, technology, and corporate trends. The intuitive impact of the increasing globalization of business regards the fact that managers demand faster, though still relevant and focused information (i.e. real-time information for real time decision making) and broader access to the global information thanks to the current information technology (Hopper et al., 2007). The Internet and the World Wide Web, video-conferencing, e-mail, "virtual” and real-time reporting mechanisms, and e-business instruments are only few examples of technological tools that make the information extremely transferable, manageable, and transparent. Consequently, today management accountants are less involved in day-to-day accounting tasks but more focused in analysing and

interpreting information as internal consultants or business analysts (See Figure 1.1).

Figure 1.1 - *Controller Time change*



Source – Desroches D., Lawson R. (2013), *Evolving Role of the Controller*, Institute of Management Accountants, p. 9.

The stereotype of the management accountant cloistered in his department crunching numbers all day has been substituted by the physical presence in the other departments, with increasing face-to-face communications and more involvement in decision making. Today, management accountant participates in

cross-functional teams, collaborates with senior management, employees in other departments, external stakeholders such as regulators, other organizations in the industry, and supply-chain partners (Lawson, 2019). Nevertheless, we should highlight that the technical and professional expertise of management accountants remains crucially relevant within business organization. However, the changing role due to advances in information technology and the decentralization of accounting knowledge reduces the management accountants' time and effort in such traditional activities. Moreover, the management accountant's utilisation of information is more strategy-oriented, proactive, and mixed with non-financial performance measurement, and is projected to an improvement of business efficiencies and value creation (Russell et al., 1999). The transformation of the role involves the shift from the traditional objective monitor function of the financial performance of various centres of responsibility and a focus on cost control, to the integration of different sources of information and interconnections between non-financial performance measures and management accounting information (Hopper et al., 2007). In order to reach this step, the management accountant need to have a broader picture of the company that allows an understanding of the business and its operations as a whole. The management accountant has to integrate the narrow perspective of the business expressed by traditional accounting information with a wider view of the business articulated in various performance measures. The combination of financial and non-financial

performance measures and the ability to integrate them represent now a key competence for the management accountant, that requires expertise and knowledge in order to provide a comprehensive and coherent picture of the business (Scapens and Jazayeri, 2003). Thus, this new role provides several new tasks for management accountants. Scapens and Jazayeri (2003) provide a list of examples that includes strategy formulation, risk assessment, evaluation of the financial implications of operational decisions and customer relationship management. Järvenpää (2007) studied all these changes of the management accountant role by highlighting the organizational culture as a crucial factor in this evolution. According to the author, the changing role of the management accountant, summarized in an increasing business orientation, is woven into the organizational culture of the business. Following this perspective, the increasing business orientation of management accountants, is not just about the implementation of new accounting innovations, neither about being more managerially active, but it includes a whole set of different cultural change interventions such as structural interventions, official value statements, development of the effective accounting information systems, the role modelling performed by top management, human resources management and the directing of personal attention (Järvenpää 2007). The development of the role of management accountant from the "bean counter," to a supporter of management in its decision-making is described also as a process of hybridization (Burns and Baldvinsdottir,

2005). The fact the management accountants are now performing tasks that seem to be expanding and diversifying justifies the terms "hybrid accountants." Precisely, today management accountant needs a wide set of skills that involves not only the accounting ones but also soft skills, communication skills and teamwork ability (Paulsson,2012). Lambert and Sponem (2012) suggest four different styles of the management accounting function in relation to the degree of the management accountant authority and to type of client (local or headquarters): discrete, safeguarding, partner, and omnipotent. Similarly, the accountant, the analyst, the educator, and the coach represent the four different roles of management accountant proposed by Nilsson et al. (2011) based to the internal or external information that they use. Such classifications are useful to picture a broader perspective of the management accountant role that enables a plural understanding of his role expanding the spectrum of possibilities. The business partner role cannot be conceived as a universal concept. On the contrary, the development of the role of management accountant should be interpreted as a process of expansion rather than a radical transformation. The notion of “hybrid accountant” in fact, already includes the management accountant role as a flexible concept. Consequently, the appropriation and expropriation of tasks allow to attribute multiple and variable roles to management accountants in the sense that their role may not only expand and hybridize, but also contract and de-hybridize (Caicedo, et al. 2018).

CHAPTER 2

NEW DIGITAL TECHNOLOGIES: OVERVIEW AND POTENTIAL FOR MANAGEMENT ACCOUNTING

2.1. Introduction

The advent of digital technologies, such as big data, robotic processing systems, Blockchain, artificial intelligence (AI) has been conducting a shift within business organisations in competitive strategy, operational structure and production methods. Big data, robotics processing systems, AI and Blockchain have gained acceptance as part of the fourth industrial revolution (4IR) and Industry 4.0 (Moll and Yigitbasioglu, 2019). These advancements in technology are associated with the term "disruptive technologies", highlighting the ability to break through the usual technology capabilities and provide a revolutionary change in terms of processes or operations (Kostoff et al., 2004). The rise of these digital technology innovations is currently generating an upheaval in organizational reality (Horlach et al., 2016; Porter and Heppelmann, 2014a), including also the management accounting function (Knudsen, 2020). In this chapter, the most important digital technologies are analysed in detail in order to understand their impact in the economic landscape. The innovative technologies taken into consideration in the analysis include the Business Intelligence and the Big Data analytics, the Cloud

services, Internet of Things, Artificial Intelligence, social media and Blockchain technologies.

2.2. Business Intelligence and Big Data Analytics

Today, people, devices, platforms and sensors can constantly communicate exchanging data and generating new data that trace many of these exchanges (Santos et al., 2017). This vast volume of data generated implies that the collection, storage, integration, processing and analysis of them represent a key challenge for business organizations. In the IBM report, the CEOs interviewed claimed that in order to pursue operational agility and flexibility, technology plays a key role, considered as the top external force that will affect their businesses in the near term, above market factors and regulatory concerns (IBM, 2021). In particular, over the past two decades business intelligence and analytics (BI&A) has become an important area of study for both practitioners and researchers, reflecting the impact and the magnitude of Big Data in contemporary business organizations. The interest in this field referred to the techniques, technologies, systems, practices, methodologies, and applications of BI&A is due to the opportunities that help companies to better understand its business and to make timely decisions. However, first off it is necessary to understand and grasp the main features, applications and techniques of BI&A. The term intelligence was present in artificial intelligence research since the 1950s, while the term business

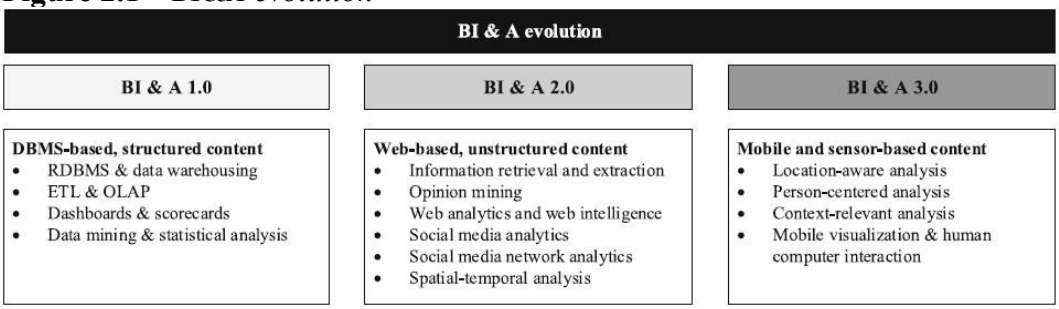
intelligence became widespread in the IT and business communities only in the 1990s (Eggert and Alberts, 2020; Sharda et al., 2015). BI includes structures, databases, tools and methodologies that inevitably involve different functionalities. For instance, Wixom and Watson (2010) highlight the ability of business intelligence to support decision making through the integration of company internal and external information. Chen et al. (2012) differentiate the type of data which can be analysed by BI methods. BI, therefore, is more than just the gathering and the representation of data. Conversely, BI's main aim is to increase knowledge and to support decision making activities through the data analysis (Eggert, 2019). In the late 2000s, business analytics started to be conceived as a key analytical component of business intelligence since it led to the emergence of tools that generate and capture a huge quantity of data and discern patterns in it more quickly than the unassisted human mind ever could (Davenport 2006; 2013). Big data analytics involves data sets that are so large and complex that they require advanced and specific data storage, analysis, and visualization technologies. The so called BI&A 1.0 includes a first step in gaining an objective, deep comprehension of relevant business phenomena and in giving managers the possibility to go beyond intuition with a fact-based decision making (Davenport, 2013). It was the first time that data about production processes, client interactions, sales, and other data were recorded, managed, aggregated, and analysed (Davenport, 2013). Since in the BI&A 1.0 era, data were mostly

structured, business organizations collected them through various legacy systems, and often stored in commercial Relational Database Management Systems (RDBMS) (Chen et al., 2012). BI&A 1.0 was characterized by company data warehouse and business intelligence software. The former was used to capture information whereas the BI software was used to examine and report it (Davenport, 2013). The reason of the denomination BI&A 1.0 lies on the characteristics of the data sets in that period. Indeed, the volume of the data sets and the velocity were small enough to be gathered in warehouses for analysis. Therefore, data management and warehousing are conceived as the pillars of BI&A 1.0. The RDBMS systems used analytical techniques based mainly in statistical methods developed in the 1970s and data mining techniques developed in the 1980s (Chen et al., 2012). Database query, reporting tools and online analytical processing (OLAP) are grounded mainly on intuitive and simple graphics exploited to investigate relevant data features (Chen et al., 2012). According to the report of Sallam et al. (2011), among the 13 capabilities that BI platforms deliver, the following eight are considered to belong to BI&A 1.0: reporting, dashboards, ad hoc query, search-based BI, OLAP, interactive visualization, scorecards, predictive modeling, and data mining (Sallam et al., 2011). In this period, thus, in order to be able to manage data, new competencies and skills were needed. Precisely, at first, the preparation of data sets to be included in an enterprise data warehouse was not so easy. Most of the time was

spent by analysts in readying data for analysis and relatively little time on the analysis itself (Chen et al., 2012). Moreover, the reporting activity in BI&A 1.0 involves only the analysis of what happened in the past, without explanations or predictions for the future (Davenport, 2013). Web search engines and e-commerce businesses as the main new items of Web 1.0 systems, provided the opportunity to companies to open their businesses online and directly communicate with their customers (Chen et al., 2012). In addition to these new advancements, companies started to exploit the huge advantage of detailed and IP-specific user search and interaction logs collected through cookies and server logs to understand better customers' needs and identifying new business opportunities. Web analytics, web intelligence, and the user-generated content collected through Web 2.0 have led to the era of BI&A 2.0 in the 2000s, which is mainly based on text and web analytics for unstructured web contents (Davenport, 2013). Vast amount of information gathered from the web entailed the use of web mining and text mining techniques for the visualization and analysis of the data (Davenport, 2013). For instance, the analysis of customer clickstream data logs, through web analytics tools such as Google Analytics can tell the company the user's online path and purchasing and browsing patterns (Chen et al., 2012). From this perspective, it can be stated that the vast amount of unstructured data, such as video, music, text files, led to the phenomenon of Big Data. The term describes the change of data in volume, velocity, variety, and veracity and it is related to the fact that data are not anymore

generated purely by an enterprise's internal transaction systems but they are externally sourced from the internet, websites, social media and sensors (Chen et al., 2012; Davenport, 2013). One of the most important features of Web 2.0 is the possibility for users to generate contents from social media, forums, websites, blogs and online groups. This aspect led to an advantage for companies that can gather a large volume of feedbacks and preferences also relevant from a marketing perspective (Sharda et al., 2015). Nevertheless, in order to exploit the benefits of these new opportunities, technological adjustments were necessary. In fact, unlike BI&A 1.0 technologies that are integrated into company IT systems, BI&A 2.0 systems need the integration of sophisticated and scalable techniques in text mining (e.g., information extraction, sentiment analysis, topic identification, question-answering), web mining, spatial-temporal analysis and social network analysis with existing BI&A 1.0 database management systems (Chen et al., 2012). The third wave of data analytics ushered new data sources, such as mobile devices and wireless connected sensors, which led to new and changing opportunities of collecting and analysing data. BI & A 3.0 therefore, is based on the analysis of unstructured data from mobile devices and sensor data (Eggert and Albert, 2020).

Figure 2.1 – *BI&A evolution*



Source – Eggert M., Alberts J. (2020), Frontiers of business intelligence and analytics 3.0: a taxonomy-based literature review and research agenda*, Business Research*, Vol. 13, p. 687.

Mobile devices and sensor-based Internet-enabled devices equipped with RFID, barcodes, and radio tags are able to support "highly mobile, location-aware, person-centered, and context-relevant operations and transactions" (Chen et al., 2012, p.1168). This vast amount of data leads to analysis from cyber-physical systems, situation-aware data mining applications and position related data with location-based services. The common classification of analytics involves the distinctions between descriptive, predictive, and prescriptive analytics (Appelbaum et al., 2017). The former describes what has happened and constitutes continuous monitoring alert systems, where benchmarks and thresholds are used to evaluate transactions and trend analysis of historical data. Descriptive statistics, Key Performance Indicators (KPIs), dashboards, or other forms of visualizations represent the key elements of descriptive analytics, which is also considered the most widespread type of analytics in businesses (Dilla et al.,

2010). The key enablers of descriptive analytics involve data warehousing, decision dashboard/scorecards, business reporting and visual analytics (Sharda et al., 2015). On the contrary, predictive analytics answers the questions as to what is likely to happen in the future and includes probability models, forecasts, scoring model, statistical analysis and data mining (Appelbaum et al., 2017). The main aim of these models is to use historical data to make predictions of future events. The third category of analytics is known as prescriptive analytics. Considering the descriptive and predictive analytics results, prescriptive analytics tries to understand what should be done. It can be described as an optimization approach because it shows solutions with the related likely outcomes in order to make the best decision (Appelbaum et al., 2017). Although the predictive and prescriptive analytics' techniques may seem similar, their orientation is quite different because the prescriptive analytics take into account the purposes, the perspectives and the main critical questions of the analysis (Sharda et al., 2015). The importance of BI&A is highly represented by the several application areas involved. For instance, the success of Big Data and BI&A is usually connected primarily to the e-commerce and web communities. The customer-generated content on social media platforms, crowd-sourcing systems and blogs emerged in Web 2.0 offer the possibility for researchers and practitioners to grasp directly preferences, issues, trends and opportunities of the market looking it from different perspectives. Regarding social media, in fact, text analysis and sentiment analysis techniques

are widely adopted to have analytics of customer perceptions (Appelbaum et al., 2017). Another application area of BI&A regards politics and governments (Moll and Yigitbasioglu, 2019). Multimedia web platforms are frequently adopted by politicians to create discussions, campaign advertising, events promotion and donations (Chen et al., 2012). Moreover, also astrophysics, genomics and environmental research are actually exploiting the advantages of the BI&A of high-throughput sensors and instruments (Chen et al., 2012). Similar to the areas of applications presented, the health community is implementing these types of analytics thanks to the huge amount of healthcare-related content generated from numerous patient care points of contact, sophisticated medical instruments, and web-based health communities (Chen et al., 2012). The abovementioned application areas and the related opportunities demonstrate the relevant impact within the research community. In particular, we can distinct five technical areas in the analytics research: (big) data analytics, web analytics, text analytics, network analytics, and mobile analytics (Chen et al., 2012). The former regards the BI&A technologies mainly based on data mining and statistical analysis. Regarding web analytics, it is necessary to highlight the importance of this field within BI&A research because it leads to specific analytical challenges and opportunities. Web search engines, HTTP/HTML-based hyperlinked web sites, and directory systems for locating web content have facilitated the development of technologies for crawling, updating, ranking of web sites and search log

analysis (Chen et al., 2012). Text analytics involve the analysis of the unstructured content in textual format, from e-mails, social media, corporate documents and web reviews (Hu and Liu, 2012). Network analysis, which is based in bibliometric analysis, involves models for analyse online community and social network in order to discover scientific impact and knowledge diffusion (Zhang et al., 2021). Moreover, Mobile BI has the capability to potentially transform the BI environment because the possibility to collect highly detailed, personalized, context-aware, and location-specific content through smart devices opens several new innovative BI&A opportunities (Djatna and Munichputranto, 2015).

2.3. The contribution of Cloud services

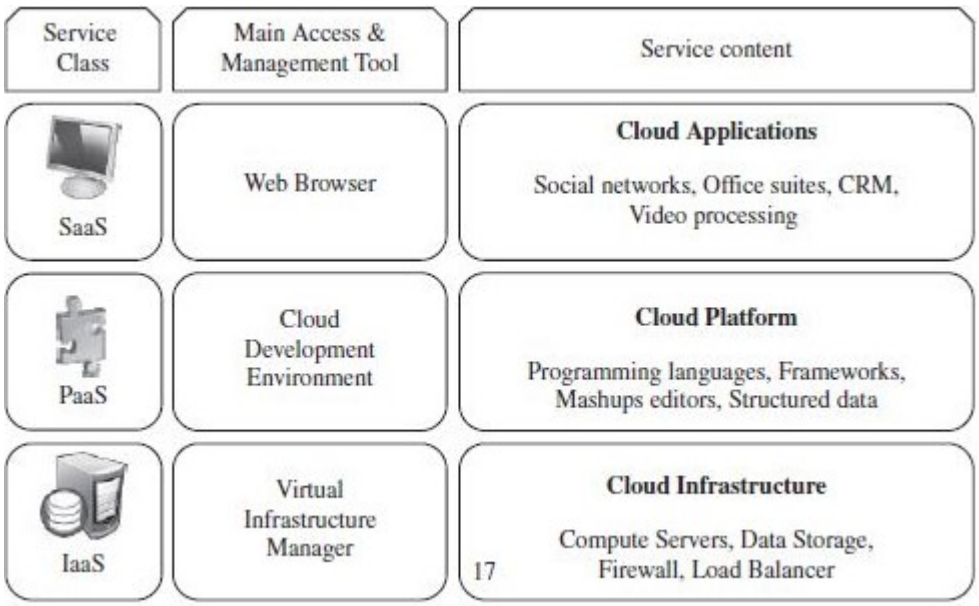
In 2020 the revenues of Cloud computing reached the $219 billion and industry analysts predict a value of $791 billion by 2028 (Fortune Business Insights, 2021). The Cloud computing phenomenon represents a crucial change in the way information technology services are generated, developed, distributed, updated, scaled and paid for (Marston et al., 2011). The popularity gained is due to its capability to improve flexibility at lower cost of deployment (Moll and Yigitbasioglu, 2019). In order to give an explanation of the meaning in simple terms, cloud computing can be conceived as a utility that make computing resources available on demand, anytime, anywhere, at a relatively low cost

(Strauss et al., 2015). The definition of Marston et al. (2011) describes Cloud computing as" an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location." (Marston et al., 2015, p. 177). Essentially, through these types of services it is possible to access applications and data on-demand at any time and everywhere (Buyya et al., 2011). The National Institute of Standards and Technology (NIST, 2011) highlights the following five fundamental characteristics of Cloud computing: on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service. Although the functionalities of some characteristics seem intuitive, the meanings of some of them should be clarified. For instance, the resource pooling refers to a multi-tenant model used to reach several consumers with different physical and virtual resources dynamically assigned in relation to the consumer demand (NIST, 2011). The measured service, instead, regards the ability of cloud services of monitoring and optimizing the resources usage through a measurement system that guarantee transparency for the consumer (NIST, 2011). From the abovementioned features, it can be stated that Cloud services imply a convergence of IT efficiency and business agility (Marston et al., 2011). Regarding the concept of IT efficiency, it also involves the idea of green computing, based on the fact that computers are physically located in cheaper electricity geographical areas (Marston et al., 2011). The business agility refers

not only to the low-cost computing but also to the ability of the companies to use instruments that can be deployed and scaled rapidly, avoiding the necessity of massive investments (Marston et al., 2011). The major benefits of Cloud computing in scalability, cost savings and resiliency compared with the traditional costly on-premises hardware situated in centralized data centers justify its wide diffusion in business organizations. In this context, it is necessary to distinct the public cloud configuration and the private cloud configuration. The former involves cloud computing services offered over a public network, such as those offered by Google, whereas the private cloud is operated by the company itself (Strauss et al., 2015). However, the incorporation of all the company's data on a single cloud provider's platform represents actually a difficult task to perform. As a consequence, large organizations have started to implement a hybrid multicloud approach which is represented by a mixture of public cloud, private cloud and on-premises resources from different suppliers (Forbes, 2019). This approach allows companies to choose the best solution for the tasks at hand, avoiding being tied to any single vendor. The feasibility of the hybrid multicloud approach has become particularly evident since the public cloud services within hybrid environments demonstrated to support the data protection and the security and conformity requirements that organizations request (Marston et al., 2011). Today, the "dominant architecture" for cloud service delivery is based on multicloud, hybrid cloud and multiprovider (Boville et al., 2021). In the IBM Research Insight the

percentage of the use of a single public cloud as primary archetype decreased from 16% in 2019 to 2%, only in 2021 (IBM, 2021). Hybrid cloud represents a new phase of innovation in cloud-driven business transformation: today analysts see hybrid cloud as a $1.2 trillion market opportunity, and nearly 80% of IT decision makers consider it in their future (Forbes, 2019). Although Cloud-based platforms are able to generate new opportunities and innovations, they also entail new risks and threats. For instance, McCurdy et al. (2021) disclose that 7 in 10 organizations are not able to protect data deployed across multiple cloud and on-premises environments and in 2020 the 90% of cyber-related incidents occurred in cloud environments. Cloud platforms and solutions adopted by organizations to integrate supply chains, enable remote work, and optimize customer experiences must be integrated to a cybersecurity approach (McCurdy et al., 2021). Companies should be able to support the implementation of these technologies in a more open environment with appropriate safety practices. “Zero trust” is an example of a preventative approach that uses the authentication and verification requirements for each exchange of value (IBM, 2021).

Figure 2.2 – *Cloud computing classes*



Source – Buyya R., Broberg J., Goscinski A. (2011). *Cloud computing: Principles and paradigms*, John Wiley & Sons, Inc., Hoboken, New Jersey, p. 14.

According to the abstraction level and the service model of providers, Cloud computing services are generally divided into three classes: Infrastructure as a Service, Platform as a Service, and Software as a Service (Mell and Grance, 2011). Infrastructure as a Service (IaaS) (as the Figure 2.2 depicts), regards providing virtualized resources on demand such as storage, computation and communication (Sotomayor et al., 2019). A Cloud infrastructure allows on-demand offering of servers running multiple choices of operating systems and a customized software stack (Buyya et al., 2011). Amazon Web Services mainly offers IaaS with a software stack that can be customized in a similar way of an

ordinary physical server. Starting and stopping the server, customizing it with the software packages' installation, attaching virtual disks to it, and configuring access permissions are all examples of the activities that the users are free to perform with the server. Moving to a higher level of abstraction, Platform as a Service (PaaS) is another class of Cloud computing, representing an approach to make a cloud easily programmable. In Cloud platforms, multiple programming models and data access, authentication, and payment services are offered as building blocks to new applications (Buyya et al., 2011). Software as a Service Applications is positioned on the top of the cloud stack. The access of the services of this layer is open to end users through Web portal. Therefore, SaaS defines the shift from locally installed computer programs to on-line software services, while eliminating the software maintenance for customers and simplifying development and testing for providers (Youseff et al., 2008; Hayes, 2008; Buyya et al., 2011).

Since the Cloud accounting services revolutionize the way information technology services are utilized also within organizations, it is necessary to take into account some aspects before the actual adoption. Each business organization is unique and thus, must carefully assess specific features and needs in order to choose the most appropriate cloud computing solution (Dimitriua and Matei, 2014). Firstly, companies that want to adopt these new systems should evaluate the best service that meet the organization's objectives. Through the analysis of the business's features, the company choose the most suitable Cloud solution

because it should enhance the adaptability to the market and improve its competitiveness. Among the different aspects to take into account before the Cloud computing adoption, the most important may be the data quality and storage, specific information demands, the complexity of their financial reporting needs and the best timing for the transfer (Dimitriua and Matei, 2014).

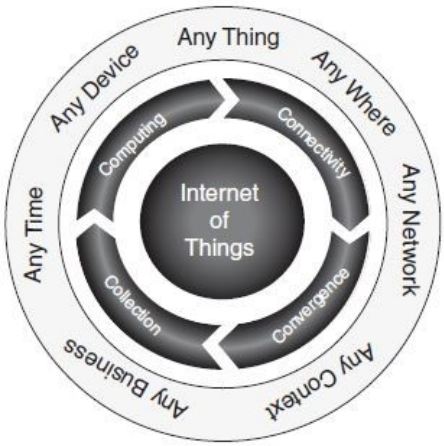
2.4. Internet of Things

Over the past decade, the diffusion of wireless communication systems and the electronics and technological advancements, have deployed a key role of mobile devices and ubiquitous services. They are not only used to connect users anytime-anywhere to the Internet but they represent an opportunity to interlink the physical world with the cyber world (Conti et al., 2012), leading to the emergence of Cyber-Physical Systems (CPS) (Poovendran, 2010; Park et al., 2012). CPS can be defined as new ICT systems in which computation and networking are integrated with physical processes in order to increase their efficiency, adaptability, and security (Lee and Sokolsky, 2010). The way information is distributed is changing due to the interactions of CPS with ICT devices because they access to the virtual world, modifying the cyber infrastructure. Among the "disruptive technologies" that have a huge impact in many economic, business and social dimensions, the Internet of Things (IoT) stands out as the CPS paradigm with the highest economic impact with an estimated value of 36 trillion of dollars (McKinsey

Global Institute, 2013). The origin of IoT has been attributed to Kevin Ashton, a British scientist that in the late 1990s studied options to strengthen operational efficiency by connecting radio frequency identification (RFID) information technology (IT) to the Internet at the Massachusetts Institute of Technology's Auto-ID center (de Vass et al., 2020). The innovative idea was based on finding information about a tagged object through an Internet address or a database entry corresponding to a specific RFID (Borgia, 2014). Over time, the technology developments have extended this logic from RFID to any possible object: a "thing" can be a physical object such as a sensor, an actuator, a smart item, a device or a digital entity (Borgia, 2014). These items have in common the fact that they are easily readable, uniquely recognizable, locatable, addressable and/or controllable via Internet (Borgia, 2014). Moreover, the crucial aspect involves the fact that these "things" are interconnected in such a manner that they can interact and communicate with each other and with the surrounding environment (Iqbal et al., 2020). Consequently, providing a ubiquitous seamless connection among things and human beings represents the essential concept behind IoT.

Figure 2.3 represents graphically the notion of Internet of Things, emphasizing the dimension of ubiquity (i.e. any device, anywhere, any business, anytime, any network, etc.) and the fundamental features of IoT such as connectivity, convergence, collection and computing (Iqbal et al., 2020).

Figure 2.3 – *IoT representation*



Source – Iqbal M.A., Hussain S., Xing H., Imran M. (2020), Internet of Things (IoT) Fundamentals, in Iqbal M.A., Hussain S., Xing H., Imran M., *Enabling the Internet of Things: Fundamentals, Design, and Applications*, first edition, John Wiley & Sons, Hoboken, NJ, p. 2.

Although there is no universally recognized definition of IoT, Patel et al. (2016) defines it as a "concept and a paradigm that considers pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications/services and reach common goals." (Patel et al. 2016, p. 6122). From this definition, it can be stated that IoT has completely revolutionized the way data is collected since it involves sensors, embedded systems, communication technologies, Internet protocols, networks, that allow to easily exchange information between different objects and users. In order to understand the complex and dynamic system of IoT,

it is necessary to define its requirements. Sensor data acquisition, storage, filtering and analysis represent the foundation of IoT solutions as the multitude of distributed sensors gather observations from physical environment or digital entity and transmit them to applications to storage and analyse (Iqbal et al., 2020). Heterogeneity and scalability in IoT technologies represent additional elements to consider in order to be able to manage the variety in terms of services, devices, environments, resources and data (Borgia, 2014). Furthermore, also the optimization of the operational costs such as installation, development, maintenance costs and energy-efficient solutions constitute an important IoT requirement to take into account for the implementation of these technologies. Since the human contribution and intervention in IoT solutions is usually scarce, if not completely absent, self-capabilities of objects gain higher relevance. Among these abilities, the most important regard the autonomy in terms of configuration, adaptation to various scenarios, reaction to stimuli and events and processing of Big Data (Borgia, 2014). In addition, it is necessary to emphasize the importance of the security dimension of IoT technologies, because they are predisposed to several cyber-attacks and threats (Farooq et al., 2020). For this reason, IoT architectures should guarantee a secure environment in terms of communication, integrity of data, privacy, and trustworthiness (Borgia, 2014). Unfortunately, it can happen that manufacturers leave security aside in order to accelerate their product development (Emami-Naeini et al., 2021). However, since security is

considered as the most important concern in IoT applications (Ahlmeyer and Chircu, 2016), it is necessary to guarantee that the IoT ecosystem is successfully secured. One of the most important security needs of an IoT system is the confidentiality as confidential data stored in IoT devices should not be disclosed by illegal and unauthorized persons (Tariq et al., 2019). Authorization embodies another crucial security requirement in IoT technologies because allows the access to information that a sensor gathers only to the legal users who are authorized objects and service requester (Abbas et al., 2019). In light of the fact that security represents a crucial requirement in IoT applications, appropriate security measures should be adopted. The current protective measures, such as authentication mechanisms, encryption techniques, network protection, access control lists and application safety are often a discouraging task for systems with several linked devices also for the massive usage of many resources (Farooq et al., 2022). Hence, the definition of security measures should also consider the resource limitations of IoT devices (Farooq et al., 2022). Additionally, IoT security solutions can be provided also through Machine Learning. Machine learning is an intellectual method that studies how to simulate human learning activities with self-improvement approaches in order to acquire new knowledge and new skills, to recognize existing knowledge, and to continuously enhance the performance and achievement (Wang et al., 2009). ML-based security solutions in IoT devices are used for security, privacy, malware analysis, and attack recognition (Hossain

et al., 2019). Despite the high accuracy that they provide, their usage in IoT devices requires more storage, energy resources and computation, which can represent a complex challenge in IoT infrastructures (Farooq et al., 2022).

2.5. Artificial Intelligence

During the last decade, the adoption of artificial intelligence in the economy has speeded up (Brynjolfsson et al., 2021; Furman and Seamans, 2019). As a general-purpose technology and as the heart of a new industrial revolution, AI has, directly and indirectly, a strong impact in many sectors of the economy and social life (Taddy, 2019; Milana and Ashta, 2021). The importance of AI derives from its contribution to the global economy equal to US$ 15.7 trillion and from the fact that the advancement and adoption of AI is expected to increase the global GDP by 14% in 2030 (Surender and Geetu, 2021). A common definition of artificial intelligence usually expresses a relation with human intelligence, describing it as a technology that educates machines so that they are able of doing tasks that traditionally required the human mind (Ghosh et al., 2018). AI-based systems and the related machines are rapidly evolving and becoming capable of taking on less-routine activities. Precisely, AI applications can perform repetitive tasks, reducing human efforts and in comparatively lower time (Ghosh et al., 2018). Despite the relevance of this essential contribution of AI, it is needed a more deeply understanding of its features. Kaplan and Haenlein (2019) define AI as “system’s

ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation" (Kaplan and Haenlein, 2019, p. 15). From this more accurate definition, it can be stated that AI uses information from IoT platforms or other big data sources as an input in order to identify the underlying rules and patterns. Therefore, since AI systems are able to use huge amount of data to understand and learn from the past, they rely heavily on data science techniques (Yu et al., 2019; Ghosh et al., 2018). Today, the AI applications actually implemented are related to the so called "artificial narrow intelligence (ANI)" which uses artificial intelligence only for specific tasks (Meske et al., 2022; Kaplan and Haenlein, 2019). Some example of these applications regards the Facebook face recognition in images, voice understanding of Siri and Tesla's self-driving cars (Kaplan and Haenlein, 2019). On the contrary, although today is not already reached, "strong AI" refers to the ability to perform all imaginable human jobs, including all physical and all mental ones (Butz, 2021). Artificial Intelligence is represented by a combination of three innovative technologies: machine learning, cognitive computing, and natural language processing. As we mentioned above, Machine learning is a technique used to improve the presentation criteria of information or experience through learning (Farooq et al., 2022). Precisely, ML is based on algorithms and statistical models that computer systems use to perform a specific task without being explicitly programmed (Mahesh, 2019; Yu et al., 2019). Through ML techniques,

machines are able to handle and work on massive data efficiently (Mahesh, 2019). Modelling, data visualization, and pattern recognition are some of the statistical methods used in ML to implement self-learning activities and understand data trends and patterns (Rout et al., 2018; Yu et al.,2016). ML techniques includes three types of learning mechanism: supervised, unsupervised and reinforcement (Ghosh et al., 2011). The difference between the first two types of learning lies on the fact that the supervised learning maps a set of inputs to a set of labeled outputs whereas in the unsupervised learning the outputs are not labeled (Kaplan and Haenlein, 2019). The reinforcement learning, instead, provides a system in which an output variable needs to be maximized and multiple decisions can be taken to influence the output (Kaplan and Haenlein, 2019). Despite all the potential advantages of AI in different context, the use of AI systems generates several risks. One of the main issues concerns the "automation bias", which means that in particular circumstances, humans tend to over-rely on automated decision-making with the potential risk to don't recognize errors in the system (Goddard et al., 2012). Therefore, there is the possibility that AI-based automation prevails over human autonomy (Strauß, 2021). Despite the utilities and the advantages that automation can provide, the excessive reliance on it can represent a significant problem (Gianfrancesco et al., 2018). Gianfrancesco et al. (2018) argue that the solution of this issue lies on measures capable to improve the understanding of the purpose behind the design of AI systems "including choosing appropriate

questions and settings for machine learning use, interpreting findings, and conducting follow-up studies" (Gianfrancesco et al., 2018, p.5). In addition, this type of bias can boost the process of "deskilling" due to lack of skill development or the decline of existing skills (Sutton et al., 2018). Furthermore, the growth of data analytics and AI for economic and business use creates another downside of artificial intelligence because it entails a significant power imbalance and authority of private businesses (Zuboff, 2015).

2.6. Social media

The ubiquitous adoption of Internet technologies in both fixed and especially mobile forms has led to the diffusion of social media (Debreceny, 2015). Social media are new information and communication technologies where their users are able to connect and share experiences, content, opinions, and perspectives on the Internet (Kaplan and Haenlein, 2010). The growth of these dynamic internet platforms has entailed a transformation of people's lives in general, leading to fast and deep changes of all aspects of human life and to the emergence of a different strategic environment (Tourani, 2021). The fact that these technologies altered both personal and professional lives means that they also have an impact on business organizations. However, social media should not be considered as simply one more tool that companies can exploit. On the contrary, social media have changed the industries' structure and competition, introducing new business

models and new methods for business development (Tourani, 2021). The success of social media provides a huge potential for businesses not only in term of marketing (Alalwan et al., 2017) and customer relationship management (Baird & Parasnis, 2011), but also in strategy (Li et al., 2021). This radical transformation generated by social media, therefore, entails a re-examination of business strategy development within business organizations (Bianchi & Andrews, 2015). Since social media has various features that reflect multiple aspects of business operation, they can be integrated into business development strategy (Tourani, 2021). The study of Tourani (2021) show that social media support strategies of the Iranian mid-size enterprises in food industry. Specifically, they found out that in organizations using the "analyzer strategy" (Miles and Snow's, 1978) social media have a relevant role even in business improvement and success in providing products and services in the long-run (Tourani, 2021). The social media phenomenon thus, has the potential to radically transform organisational practices and relationships (Obermayer et al., 2022). Arnaboldi et al. (2017a) emphasize the twofold use of social media (Arnaboldi et al., 2017a). First, they represent a channel used to create virtual communities, which implies that they must achieve several different aims such as issues of reputation and risk management, marketing and sales, communication, research and innovation (Bruhn et al., 2012; Field and Chelliah, 2012; Boyd and Gessner, 2013; Rust and Huang, 2014; Trainor et al., 2014). In addition, the fact that social media data are being

produced continuously, and are available in real time (Kaplan and Haenlein, 2010; Kietzmann et al., 2011; Gruber et al., 2015) entails a higher rate of generation of data than in past. From this perspective, it can be stated that social media represents also a source of information, capable of understanding about competitors, peoples' individual characteristics, opinions, preferences and relationships (Haefliger et al., 2011; Gamboa and Goncalves, 2014; Jeacle and Carter, 2014). This function is usually known as social media monitoring (Constantinides, 2014). However, despite the fact that social media have access to billions of accounts and their related data, in order to use them, several steps are first needed to gather, clean, validate and then analyse the data. Through large scale network analysis, sentiment and text analysis to interpret text, images, videos and memes of social media, there is the possibility to grasp a lot of specific and important information, especially from a business perspective. Companies through social media information and the related data mining techniques can perform a multitude of organizational tasks related to recruitment, marketing, customer relationship management, and employee communications (Schaupp and Be´langer, 2014). In both large and small enterprises, the uses of social media are usually most widely recognized usually within marketing and advertising tasks (Askool and Nakata, 2011). Indeed, the business landscape is experiencing a relevant increase of the areas of digital marketing and digital communication because they now are needed to address new challenges such as the management

of the new type of media, real-time communication and customer engagement (Tench and Jones, 2015; Valos et al., 2016; Constantinides, 2014). Furthermore, social media lead to the emergence of new roles such as the chief digital officer, the data scientist and the data designer (Dumeresque, 2014; Constantinides, 2014). Social media are also considered as useful channels for online collaboration with customers, suppliers and partners (Obermayer et al., 2022). The opportunities generated by social media involve the ability to cooperate directly and in real-time. Specifically, social media can be used to find new ideas to develop services and products, to engage customer with advertising and personalized contents, to co-create new product designs with customers and to be constantly in touch with customers and partners (Nair, 2011). In addition, if we consider social media as a resource used for interaction between B2B network actors like a market platform or communication tool, they are able to improve a company's information search, business networking, and crowdfunding functions (Drummond et al., 2022; Olanrewaju et al.,2020). Empirical studies demonstrate the central role of social media to the development and upkeeping of B2B relationships (Drummond et al., 2022), in terms of key account management (Lacoste, 2016), in opportunity creation by network activities (Drummond et al., 2018), and for networking in the internationalisation process (Fraccastoro et al., 2021). Furthermore, current organization and management studies claim that social media provide evaluative representations of companies and that, in the

absence of alternatives in the public domain, they can affect collective judgements. Following this perspective, organizational reputation is going to be closely aligned to media reputation (Etter et al., 2019), Giving superior credibility to social media, they currently play a crucial role for the formation of organizational reputation that business must take into account.

2.7. Blockchain

Blockchain technology is receiving more attention with every passing day, as it has revolutionized the traditional trade due to its distributed ledger characteristics and to the rules of cryptography (Gad et al., 2022). The term was first used in 2008 by Satoshi Nakamoto when he introduced Bitcoin, a cryptocurrency with a purely peer-to-peer network (Nakamoto, 2008). Despite being born as the distributed ledger behind Bitcoin transactions, its areas of application have largely expanded (Sheldon, 2021; Wörner et al., 2016). Within the information technology perspective, Blockchain allows technology to be the driving force of the next vital revolution (Gad et al., 2022). Today, the applications of Blockchain technology are extensively used in various industries, ranging from finance (Fanning and Centers, 2016) and Internet of Things (Panarello et al., 2018) to supply chain management (Kshetri, 2018), health-care (Esposito et al., 2018), and reputation systems (Dennis and Owen, 2015). Blockchain can be defined as a decentralized, distributed and digitalized ledger that can record transactions

between two parties to create permanent and unalterable records in a verifiable and efficient way (Iansiti and Lakhani, 2017; Clohessy et al., 2020). Transactions are recorded into blocks created by nodes in which each block has a header, the relevant data to be protected, and ancillary security metadata (Minoli and Occhiogrosso, 2019). The integrity of the blocks is verified through a private key cryptography-based digital signature employed at a node (Gietzmann and Grossetti, 2021; Gad et al., 2022). The main elements of a blockchain system regard the distributed nature of the network, the consensus mechanism, the permissionless access and the cryptographic algorithms (Gietzmann and Grossetti, 2021). Since the Blockchain technology is a distributed network, the agreement between parties, defined as the consensus, is a major challenge. Due to the impossible verification of the distributed nodes by a central node for their identical ledgers, the nodes' consistency should be ensured by a protocol. The ability of Blockchain technology to process data over a distributed and integrated node network represents a peculiarity compared to conventional centralized solutions. More specifically, the main difference with a conventional centralized system, indeed, lies on the fact that in the latter there is a central trusted agency used to validate each transaction, whereas in a decentralized system any two peers can conduct a transaction without the authentication by the trusted agency. Therefore, in the Blockchain network trust represents the main issue and the various consensus procedures are used to reduce the concern about it (Gad et al.,

2022). In order to grasp the opportunities of this technology is crucial to understand how the Blockchain mechanism works. The transaction, which can involve the transfer of physical or digital assets, or the completion of a task, is broadcast on a P2P (Peer to Peer) network of nodes which uses techniques to authenticate the transaction and user's status. Once the transaction is validated, the next step consists of a creation of a new block of data for the ledger by linking that transaction to other transactions. Then, the transaction is considered valid because the new block is permanently unalterably attached to the existing Blockchain (Gad et al., 2022; Casino et al., 2019). Typically, Blockchain technologies are divided into three main categories: public, private and federated (Zheng et al., 2017). Public blockchains (such as Bitcoin and Ethereum) allows anyone to join as new user and permits everyone in the network to verify the transaction (Casino et al., 2019). In addition, all participants in this type of Blockchain can perform operations such as transactions or contracts and also the process of getting consensus is public. Conversely, in private blockchains, only a list of allowed users can participate and they have restricted authority management to access the data (Gad et al., 2022). A federated/ consortium blockchain is a hybrid combination of public and private blockchains which entails that an authorized node can be selected in advance (Gad et al., 2022). The abovementioned features of this technology allow to understand that Blockchain could greatly reduce the cost of transactions, becoming ''the system of record for

all transactions" (Iansiti and Lakhani, 2017). Therefore, the way businesses process digital transactions can be radically transformed due to how Blockchain sends, receives, and stores information (Stern and Reinstein, 2021). The fact that Blockchain can be used for the establishment of a limitless number of different ledgers implies that any entity which needs a distributed ledger for storage, verification and secured access of several types of information would be interested in this technology (Fuller and Markelevich, 2019). Specifically, Kokina et al., (2017) claim that Blockchain technology is ready to modify invoicing, contracts, payment processing, and documentation with relevant implications for management accountants, finance professionals, and regulators. The influence and the opportunities of Blockchain have reached industries such as financial services, supply chain management, governmental record-keeping, and healthcare (Stern and Reinstein, 2021). Following this logic, it seems that the adoption of Blockchain technology would lead to a world where every agreement, every process and every task has a digital record and signature that can be identified, validated, stored, and shared and each digital or physical entity (individuals, companies, algorithms and machines) would freely interact with one another (Iansiti and Lakhani, 2017). Despite the hype that this picture can generate, these transformations require a lot of years. The process of adoption in order to spread Blockchain in our economic and social infrastructure will be indeed gradual and steady (Iansiti and Lakhani, 2017).

CHAPTER 3

THE IMPACT OF DIGITALIZATION ON MANAGEMENT ACCOUNTING

3.1. Introduction

Digitalization with the integration of technologies, such as artificial intelligence (AI), sensor networks, Blockchain, internet of things and others is transforming every aspect of society, environment and economic landscape (Craglia et al., 2020). Digital technologies shape the business and they are transforming business models, information systems supporting organizational decision making, and new value-producing opportunities (AlAnsari et al., 2022). These changes have significantly influenced all kinds of business processes including also the redesign of support functions, such as the management accounting (Möller et al., 2020; Bhimani and Willcocks, 2014; Liu and Vasarhelyi, 2014). The availability of new technological applications able not only to process faster in comparison with traditional ways, but also to use both internal and external data, has changed the traditional management accounting approaches for identifying, analyzing, interpreting, and communicating information to the various levels of management (Manea, 2012). An evident example of how digital technologies impact the management accounting function can be found through Business Intelligence and

Analytics (BI&A hereafter). Considering that the aim of BI&A is to use the data analysis to increase knowledge and to support decision making activities and the main function of management accounting is to provide information to support managers in decision making, BI&A inevitably have a direct impact on management accounting (Eggert, 2019; Geddes, 2020). Moreover, Miller and Skinner (2015) have emphasized how social media change the ways in which business information is produced, distributed and processed. Therefore, the impact of social media on the management accounting is described by the changes on reporting, performance measurements and dissemination procedures (Miller and Skinner, 2015). In addition, also Blockchain technology affects the management accounting function, thanks to its ability to improve information's reliability and security with the creation of multiple copies of a document and the use of cryptography (Fuller and Markelevich, 2019). In order to have a more detailed overview of the effects and transformations that digital technologies generate on management accounting, this chapter is structured as follows: the first part provides the analysis of the consequences of digital technologies on management accounting techniques, the following part involves the effects of digitalization on the tasks of management accounting and, in conclusion, it is examined the impact of digital advancements on the role of management accountants.

3.2. The impacts of digitalization on management accounting techniques

The world is becoming increasingly instrumented, intelligent and interconnected and business organizations should be able to adapt to the new digital and economic environment with fluidity and ease in order to create added value (Geddes, 2020; Boisot and Child, 1999; Nielsen, 2018). This process of adaptation of businesses highlights the need for management accounting to change over time to maintain its fit (Yigitbasioglu, 2016). As the Contingency theory suggests, management accounting practices should adapt and evolve with the changing circumstances (Brignall, 1997). In this case, advancements in digital technologies necessitate new management accounting practices or a refinement of traditional practices, in order to meet manager's new information requirements (Baines and Langfield-Smith, 2003; Chenhall and Langfield-Smith, 1998; Gul, 1991; Perera et al.,1997). Despite the current effects of digital technologies on management accounting, digitalization should not be considered as a sudden paradigm shift (Knudsen, 2020). On the contrary, it is a gradual process composed by three phases. The first wave of digitalization, usually associated to the period between the 1960s and 1970s, is related to the advent of computerized information systems which facilitated management accountants recording activities with much more details and more accurate analyses (Granlund and Mouritsen, 2003; Porter and Heppelmann, 2014b). In the late 1990s, the World Wide Web and Internet Information Services (IIS) have introduced the second

phase of digitalization where IIS and enterprise resource planning (ERP) systems significantly transform the corporate use of information technology (Porter and Heppelmann, 2014b; Davenport, 1998). The third phase of digital advancements is currently on going since today, the emergence of new and integrated technologies has relevant impact on how organizations work and consequently on management accounting techniques. Yigitbasioglu (2016) defines the MAA (management accounting adaptability) as the ability to change management accounting practices to maintain fit with the organizational environment. This term was used to emphasize the fit in terms of adaptation for new technological and information requirements. A lack of adaptability in light of such changes, may lead in management accounting systems no longer able to provide relevant information for decision-making and control. Hence, the Yigitbasioglu's study (2016) identifies the relationships between MAA, IS flexibility and MAE (management accounting effectiveness). The results claim that information system flexibility is positively related to MAA, which in turn is positively correlated with MAE. To sum up, an adaptable management accounting system with flexible information systems is likely to be more effective than a relatively static system (Yigitbasioglu, 2016). The need for higher flexibility in management accounting landscape entails the adaptation of management accounting techniques such as activity-based costing and budgeting (Granlund and Malmi, 2002; Seal et al., 2014; Armitage et al., 2016). Bhimani and Willcocks (2014) claimed that in

general, the new opportunities for decision supports and for collection and analysis of the data are likely to change management accounting practices. Big Data and the possibility to analyse this vast amount of information rather than samples has generated transformations in the use of many management accounting techniques (Rikhardsson and Yigitbasioglu, 2018). Consequently, as Big Data analytics provides improved alternatives, methods for current inventory, asset valuation, depreciation and valuation of intangibles will prove inadequate and obsolete or will have to change in the future (Vasarhelyi et al., 2015). These new technologies for Big Data analysis are not only improving the accuracy of the results, but they are also expanding the scope of the analysis, including both structured data and unstructured data (e.g., textual information) (Liu and Vasarhelyi 2014). This expansion of scope should lead to a widening of management accounting monitoring techniques in order to include also unstructured data (Geddes, 2020). The incorporation of new information sources provides to decision makers a more comprehensive overview of the organization's financial situation (Moffitt and Vasarhelyi, 2013). However, Big data is not self-explanatory and mathematical models, data analytics, and statistical techniques by themselves do not constitute knowledge. Therefore, the following step includes the transformation of information into knowledge (Nielsen, 2018; Muller et al., 2016). Consistent with this theory, Pickard and Cokins (2015) stated that management accountant is in the best position to provide purpose and hence

relevance to the data and to drive data analytics in order to have relevant information for effective business decisions. Hence, management accounting should include all types of data and should use new analytics techniques and tools since the use of data analytics by management accounting guarantees organisations' long-term viability through new perspectives, by improving productivity, profitability managing customers and innovation (Bose et al., 2022). In order to understand the implications of Big Data for management accounting techniques, a first major challenge regards the difficulty for management accountants to consider Big Data as a resource (Arnaboldi et al., 2017b). The pressing deadlines linked to the financial close process and the plethora of data they already have to manage could represent some of the reasons of this disinclination (Janvrin and Mascha, 2014). Hence, management accountants consider the fluidity of Big Data as a burden rather than an opportunity (Arnaboldi et al., 2017b). The fact that the sources of Big Data are external to the organization like from the internet and physical devices (e.g. cameras, sensors, social media contents) involves relevant implications for management accounting. A first difference regards the purpose of the information as, in contrast to traditional data used in management accounting, Big Data information are not generated specifically for business uses (Constantiou and Kallinikos, 2015). In addition, the external origin of Big Data, implies also a lack of total ownership or control over data for management accountants which leads to reputation, privacy,

stability and scalability issues (Arnaboldi et al., 2017b). However, the inroads of Big Data, social media and data analytics has led to a growing interest in performance measurement within business organizations (Knudsen, 2020; Begkos and Antonopoulou, 2020). Moreover, the growth of the use of Big Data, social media, analytics and other digital technologies defines the basis for the emergence of new key performance indicators (KPIs) based on new types of information (Knudsen, 2020). As a consequence, several researches try to understand the effects of social media and Big Data on the development of performance indicators (Agostino and Sidorova, 2017). Since the main aim of these new KPIs is to help make sense of economic performance, also management accounting techniques should adapt to these new performance measurements in order to provide managers new decision-relevant information. Davila (2019) suggests that profitability analysis and cost behaviour should now rely on qualitative sources of data like customer feedback, social media, or internal reports. Since traditionally the focus has been mainly directed toward quantitative information, the inclusion of new types of sources in the analysis poses a challenge in management accounting techniques (Davila, 2019). For instance, Tang (2017) and Arnaboldi et al. (2017b) emphasize the shift from forecasting to "nowcasting" thanks to technological developments. The term nowcasting refers to technique based on real-time web-search data to predict the present or the near future (Arnaboldi et al., 2017b). An example of the use of this technique in management accounting

could regard the prediction of customer's sentiments regarding the launch of a new product or service (Knudsen, 2020). The increasingly wider selection of KPIs based on social media data and Big Data which involves marketing, communication, customer care and even innovation entails a challenge for management accounting techniques because they have to ensure that the insights are governed and protected appropriately to be shared with managers and stakeholders (Arnaboldi et al., 2017b). In addition, management accounting should take into account also the form of these new performance measures and how to communicate the related information (Arnaboldi et al., 2017b). These new performance indicators based on social media and Big Data are the expression of how digitalization is shaping management accounting because the exploration of different sources of information and the connected innovative technologies stimulates further adaptations and innovations (Knudsen, 2020). Following this perspective, it can be stated a potential convergence between Big Data and management accounting techniques, especially with budgeting and activity-based analysis (Ibrahim et al., 2021). Activity-Based Costing (ABC), Activity-Based Management (ABM), and Activity-Based Budgeting (ABB) as components of Activity analysis rely heavily on data since they have to gather an abundance of data on the relevant activities of the organization (Ibrahim et al., 2021). Regarding ABC, it is based on the allocation of overhead costs to products through several cost drivers using cause-and-effect rationale (Blocher et al., 2010). Despite its

usefulness, organizations suffer from applying ABC, because of the costs of data-collecting, storing, and processing. Therefore, in addition to several measurement errors of time-driven ABC, the data is still a critical factor of these management accounting techniques (Cardinaels and Labro, 2008). Furthermore, today the more complex business environment with less labour, more mixed production lines, and a large volume of overhead costs increases the data problem for costing systems (Ibrahim et al., 2021). In this regards, Big Data and the related advanced techniques can represent the solutions of the majority of ABC's obstacles. The integration of activity analysis techniques with Big Data and analytics could significantly improve these techniques. For instance, Big Data volume can overcome the shortage of data, the velocity can allow real-time data, and veracity can avoid error and trustworthiness issues (Ibrahim et al., 2021). Moreover, Big Data and analytics can also help the selection of the best cost driver: the vast amount of data on different cost drivers, and analytics allow to determine which ones have the highest significant correlations, thereby managers can choose in real-time the best one, avoiding any distortions in cost estimations (Cardinaels and Labro, 2008; Cavalieri et al., 2004; Homburg, 2001; Kim and Han, 2003; Ibrahim et al., 2021). As previously mentioned, also the budgeting represents an element of convergence with Big Data. Budgeting usually has been considered as the traditional core of management accounting, but since several years has been criticised for being time consuming, disconnected from corporate strategy and

inflexible to changing environments (e.g., Hansen et al., 2003; Libby and Lindsay, 2010). In addition, the economic context surrounded by digital products, platform strategies, and network economies, may entail traditional budgeting to be inappropriate, leading to the promotion of beyond budgeting, rolling budgets or activity-based budgeting (Bogsnes, 2016; Hansen, 2011). Since the budgeting process is a planning function based on forecasting, involves several challenges. The majority regards the inaccuracy of the future forecasts, the unavailability of accurate data on time, and also the different nature of data such as financial and non-financial, internal and external, quantitative and qualitative (Ibrahim et al., 2021). The common element between all these budgeting challenges is data because it represents the most important and critical factor in the budgeting process. Big Data and its analytics may overcome all these challenges (Ibrahim et al., 2021). ICAEW (2014) claims that management accountants can implement Big Data predictive models using statistical modelling and data mining to improve budgeting and forecasting activities. Cokins (2014) argues that the traditional cost-center budgeting and cost variance control can also change through the integration of predictive analytics and Big Data in business operations. Firstly, the massive amount of data and the related predictive analytics can improve the budgeting process in forecasting methods, since Big Data incorporate larger inputs that increase the accuracy of estimates (Duan and Xiong, 2015). The other Big Data dimension, "Velocity," through real-time data processing can provide

the continuous monitoring of the budget implementation process, reducing implementation errors (Ibrahim et al., 2021). Social media data can improve targeting, understanding customer experiences and preference therefore, leading to more accurate budgeted sales. The budget slack, due to over-estimation of the budgeted costs or under-estimating the budgeted revenues, generates a bias in budgets and reduces firm profits (Baerdemaeker and Bruggeman, 2015; Fisher et al., 2002). Automated big data systems can resolve this budgeting problem because prediction analytics and the vast amount of available real-time data can guarantee more accurate targets free from any bias or manipulation (Ibrahim et al., 2021) Overall, incorporating Big Data into the budgeting process could improve performance management, resources allocation and the strategic goals implementation (Ibrahim et al., 2021). Furthermore, also the use of BI systems can affect the budgeting process thanks to the IT support. This contribution does not refer only to provide IT tools, but instead, it involves applications for preparing, managing, and monitoring budgets. Although the underlying logics of the budgeting process seem not to change, BI systems required the implementation of a workflow which makes the process more structured, more rationally organized, and faster (Nespeca and Chiucchi, 2018). Nevertheless, within a BA environment, to supplement a traditional budgeting process with forecasts and predictions, an in-depth knowledge of different advanced statistical techniques and limitations is necessary (Nielsen, 2018). Additionally, the fact that

the organizations have access to more data than they have ever had before, raises the issue about poor quality data as possible compromising factor of the effectiveness of the budgeting process (KPMG and ACCA,2015). Therefore, data quality represents the most relevant impediment of an efficient budgeting process because if organisations do not use the most relevant data and the internal and external data are not effectively integrated, Big Data would be an obstacle rather than an opportunity (KPMG and ACCA, 2015).

3.3. The effects of digital technologies on management accounting tasks

Since BI&A technologies, Internet of Things, AI, and blockchain facilitate data collection, analysis and information delivery, they are able to support decision-making. Given that the main activities of management accounting regard providing information to support decision making, there is an obvious link between new digital technologies and management accounting (Cokins, 2017; Maisel and Cokins, 2014). Therefore, management accounting has much to exploit from the successful integration of digitalization into management accounting tasks (Rikhardsson and Yigitbasioglu, 2018). Although the overall tasks can vary in relation to the business environment, the main ones include planning, control, performance measurement, transaction processing, reporting and decision support (Atkinson et al., 2011; Rom and Rohde, 2007; Booth et al., 2000). As previously mentioned from the study of Yigitbasioglu (2017) about the

relevance of management accounting adaptability (MAA) to any change of circumstances, IS flexibility can be considered as a driver of MAA. In an increasingly digitalised and interconnected world, this aspect has necessarily implications for IS design and implementation in business organisations (Yigitbasioglu, 2017). Traditionally, flexibility has been considered costly due to high investments, significant implementation and maintenance efforts (Soh et al., 2003). Actually, traditional accounting applications are often complex because they need storage capacity, Internet bandwidth, and a specialized IT staff to configure, install and update the accounting software (Mihalache, 2011). Conversely, today the needs for management accounting include ease of access and use, flexibility, velocity, understandability, collaboration, and the current technological developments, especially the Cloud accounting, allow to meet these requirements. The term Cloud accounting includes the same functions as an accounting software installed on the customer's computer, but which actually runs on the CSP's servers (Cloud Solution Provider) (Dimitriua and Matei, 2014). In simple terms, it offers accounting services through the use of Cloud computing solutions. The main characteristic that also distinct from traditional accounting applications is the fact that it is provided as a service without the necessity to install any software or make costly investments. Excluding the abovementioned cost advantage of these types of solutions, other several benefits of Cloud accounting in management accounting tasks need to be considered. For instance,

the automatic data backup eliminates the manual action and the possibility of forgetting to do it, and reduces the probability of human errors (Khanom, 2017). With this option, the risk of losing accounting information is significantly lower. Moreover, the fact that the data are available through an access by all authorized users at all times, makes collaboration easier and faster within the whole organization. The real-time information updating represents a further advantage of Cloud accounting because in traditional accounting systems the change of one figure implies necessarily the manual change in each form, ledger or other document where the figure was present. On the contrary, Cloud computing allows to save time and money since entered data are available in each location. In this regard, the real-time updating of the information, that Cloud services provide, highlights the relevance of real-time reporting. According to Ashcroft (2005), real-time reporting in management accounting has multiple advantages compared to conventional periodic reporting. Fast-paced business environment and high competition requires more updated information in order to guarantee that managers make rapidly needed decisions and adapt quickly to opportunities and problems (Trigo et al., 2014; Geddes, 2020). The main benefit of real-time reporting in management accounting regards the availability of complete and instantaneous information about key dimensions of the organization (Trigo et al., 2014). This capability has a positive impact on the decision-making process, allowing management to make better decisions and actions at the right time.

Moreover, professional investors claim that real-time reporting allows also companies to be more confident on corporate governance, which boosts the likelihood to attract more investment (ACCA, 2013). Today, in addition to Cloud computing, there are other technologies available to implement real-time reporting. Among these real-time reporting technologies, the most relevant are the business intelligence and Blockchain. The latter allows a real-time updating of information because the blockchain-based book keeping is able to make each transaction in the ledger instantaneously available (Byström, 2019). BI, instead, enables the creation and spread of focused and relevant data, allowing long-term planning and optimization of the daily business processes (Trigo et al., 2014). Since the latest most important trend in management accounting regards the shift from traditional perspective to strategic management guidance and support through easier access to more data, Business Intelligence can facilitate this change, incorporating this additional data with techniques (such as data mining, statistical analysis, process mining, descriptive, predictive and prescriptive analytics) and answering the questions of what has happened, what could happen, and what is the best decision moving forward (Appelbaum et al., 2017). Moreover, the BI's aid in providing real-time reporting involves the use of advanced dashboards (Trigo et al., 2014). BI dashboards allow management accountants to interactively and autonomously generate reports, choosing what information they want to put in the reports, performing analysis and scenario

creation (Trigo et al., 2014). From these considerations, it can be stated that digital technologies have changed reporting (Knudsen, 2020). Regarding internal reporting, Agostino and Sidorova (2017) claim that the information of social-media performance (e.g., followers, critical comments, likes) become an important internal report within business organizations. In terms of corporate reporting, instead, digital technologies may enable faster and more comprehensive delivery of financial information to stakeholders (Bellucci and Manetti, 2017). Therefore, real-time data and new forms of reporting, the easier access to population data rather than sample data, the use of analytical tools entail changes in the visualization methods because managers search for new patterns, relations and correlations in data (Rikhardsson and Yigitbasioglu, 2018). Today, considering visualization as the process of representing data as visual images, the challenge regards the presentation of large amounts of data on a single screen (Negash and Gray,2008; Trigo et al., 2014). Accounting research has emphasized the role of visualisation in making visible the relationships between intangible resources and value of the organization (Cuganesan and Dumay, 2009). Specifically, within businesses, visualization is used to help to understand data through data storytelling, which is a necessary factor in helping to make sense of the analysis (CIMA, 2016; Davenport and Kim, 2013). Big data, business intelligence and analytics have promoted the development of new visualisation solutions which allow higher levels of flexibility, easier dynamic control of data

presentation by end-users and the fit between the format and the task (Rikhardsson and Yigitbasioglu, 2018). This latter aspect represents a crucial benefit for management accounting because traditionally, the fit between the presentation format, the task, and the end-user has relied on the designer (management accountant) of the system and if absent, can lead to suboptimal decisions (Peng et al., 2007). The large amount of data available from social media, sensors, internet of things has highlighted the importance of management accounting tasks not only in relation to the data preparation in DA (data analytics), but also in the presentation and communication of the outcomes of DA (Spraakman et al., 2021). In this regard, DA improves the information delivery process through the use of visualization methodologies such as graphics, building maps and dashboards and it provides a faster, more comprehensive and more effective data analysis by supporting inference (through drill down, regression, trend analysis) and by including different types of data (Spraakman et al., 2021). In addition, also BI technology incorporates tools that can help management accountants to create graphical data presentations, dashboards and charts (Khedr et al., 2015). These BI visualizations increase the flexibility of the information delivery for management accounting tasks, allowing users to present information in formats that suit their specific purposes (Cardinaels and Van Veen-Dirks, 2010; Rikhardsson and Yigitbasioglu, 2018). The easy visual way through which business metrics and KPIs are shown in BI dashboards and performance

scorecards represents the utility of these tools because they enable decision makers to quickly understand the organization's performance. In addition, digital advancements have introduced intelligence feedbacks in visualization which use artificial intelligence not only for the display of information with the help of visual analysis and interpretation of the data, but also for the selection of the adequate visualization that fits the user and the task (Rikhardsson and Yigitbasioglu, 2018). Nevertheless, in order to ensure that management accounting exploits these opportunities, the effectiveness in communicating results through these visualization tools and in providing quantitative evidence or numerical insights to support decision making is a crucial element (Spraakman et al., 2021). The ability to communicate results effectively refers to the presentation of the information in a clear and readily understandable way. The study of Spraakman et al., (2021) emphasizes the importance of the effective presentation and communication of results, claiming that this capability is one of the success factors in adding value to decision-making through DA. Therefore, the relevance of management accounting tasks is not related just to the presentation of the data, but regards the ability to identify and communicate the options available to decision makers through the analysis of different datasets and scenarios (Nielsen, 2018). Appelbaum et al., (2017) highlights the use of data analytics in corporate performance measurement. For instance, predictive analytics allows to make predictions about the future financial performance through supervised algorithms

such as bagging and boosting models, support vector machines (SVM) and artificial neural networks (ANN) (Appelbaum et al., 2017). Prescriptive business analytics, instead, can be used to compare the results of predictive analytics and to recommend the optimal solutions (Appelbaum et al., 2017). Elkmash et al. (2021) have discusses the several benefits of using big data analytics in customers' performance measurement, such as lower cost of customers' unstructured data analysis and higher capability to manage customers' problems quickly. In addition, the extraction of unstructured data from social media through text mining and the use of predictive analytics, can provide estimates of all aspects of the customer's perspective, enabling management accountants to perform analysis on-the-fly and to support management with an appropriate customer perspective related strategy (Appelbaum et al., 2017). Moreover, management accounting can use process mining to have a better overview and understanding of the flows of the internal process. For instance, in order to have a comprehensive view of the work processes that are taking place within the company, process mining can extract workflow processes from the event logs provided by ERP systems and integrate them with visualization techniques (Van der Aalst et al., 2004). Regarding innovation and learning for future benefits, predictive algorithms such as SVM, ANN, probability theory and time series regression models can be used by management accountants to predict the possible outcome of current investments in innovation and employee training (Appelbaum et al., 2017).

Despite the advantages of these new technologies, new insights and better decisions are not automatically given. No analytical tool can improve or substitute what is a cognitive or social process and, furthermore, generating insight is an intrinsically human trait (CIMA, 2016). The reason behind this attention to the optimal use of the new visualization techniques thus lies on the fact that management accounting plays an essential role in helping the organization to translate new data insights into company value. Management accounting's overview across the organisation allows it to be in the best position to help on gaining insight from data, providing an objective 'big picture' perspective (CIMA, 2016). In addition to the advancements in reporting activities, new technologies enable the transformation of other management accounting tasks. In this specific regard, time-consuming tasks such as the data registration, will be surely affected by the impact of BI&A. Big data represents a disruptive force in this context because allows real-time registration of internal and external data (Rikhardsson and Yigitbasioglu, 2018). The novelty refers to the fact that, in addition to regular transaction data that are usually collected, Big Data includes also data from RFID chips, sensors and clickstreams from corporate webpages (Bhimani and Willcocks, 2014). Several papers disclose that BI&A is able to support other specific accounting tasks, such as profitability analysis, planning and sustainability accounting (Petrini and Pozzebon, 2009; Kowalczyk and Buxmann, 2015; Bronzo et al., 2013; Marx et al., 2012). Specifically, Marx et al. (2010)

propose an integrated maturity model to support an aligned development of planning and business intelligence (BI). The model distinguishes five maturity levels according to corporate strategy, organizational structure, and the planning system, and it assigns the BI applications to each maturity level. Regarding the customer profitability analysis, business intelligence tools such as DEA (Data Envelopment Analysis), Self-Organizing Map (SOM) neural network and C4.5 are used in a survey-based profitable customers segmentation system that performs the customer satisfaction survey and executes the mining of the survey, the socio-demographic and the accounting database (Lee and Park, 2005). In addition, routine and non-routine decisions regarding for example product pricing or the choice of product mix can also use BI&A (Kowalczyk and Buxmann, 2015). Moreover, low-value work in management accounting, especially in terms of digital tasks that are repetitive, labor intensive, high volume and rules based, using multiple systems and structured data, is increasingly being standardized through automation (Kokina and Blanchette, 2019). These tasks have the potential for the application of RPA (Robotic Process Automation). RPA refers to software robots that allow the automation of processes "mimicking human actions and automating repetitive tasks across multiple business applications without altering existing infrastructure and systems" (Diepeveen et al.,2016, p. 2). Therefore, RPA is a technology that enables the reduction of human manual intervention, improving efficiency, data security and effectiveness of rules-based business

processes and tasks. Robotic process automation uses software bots that can be conceived as “digital workers” that can, autonomously or with multiple systems, execute routine tasks consisting of binary decisions (Kokina and Blanchette, 2019). More sophisticated RPA are also able to collect unstructured data and integrate with AI-based systems for its analysis, thus evolving into intelligent automation (IA) capable of performing non-routine tasks through judgment processes (Kokina and Blanchette, 2019; Gupta et al., 2022). Since management accounting involves tasks with high level of transaction processing, interaction with several systems and decisions to be made, they represent potential candidates for RPA (Le Clair, 2017). The Big Four accounting firms have indeed recently launched their own robots capable to automatically recognize data, record invoices, and create reports, thus increasing the likelihood of replacing basic accounting clerks (Zhang et al., 2020; Bullock, 2017). Furthermore, automation could also entail cost and time savings in data generation, analysis and verification, thus improving capabilities for reporting and decision-making (Gärtner and Hiebl, 2018). However, automated management accounting tasks entail high risks if not used properly, because when some of these accounting activities that once required human intelligence, are replaced by technologies, it creates a false sense of security as if everything is under control (Quattrone, 2016). It can be stated that it is a necessary not only an aware distinction between human and computer intelligence, but also an in-depth understanding of the

automized tasks in order to have cooperation and task division between the management accountant and the new technologies (Korhonen et al., 2021). In this regard, in order to understand the possibilities of management accounting task' automation, the study of Korhonen (2021) emphasizes the importance of the definition of the actual tasks that automation is to replace or supplement, because while many tasks can be easily automated, for other tasks it is still too challenging without the mediation of a human actor. Therefore, management accountants should understand whether a task is programmed or nonprogrammed and whether the information system at hand actually allows the automation of those processes (Emmanuel et al., 1990). The result of the Korhonen's (2021) research reveals that automation does not necessarily increase the efficiency in processes, especially for those that require very complex accounting-related expertise, which need relevant support of information technology (IT) infrastructures. Therefore, practitioners need to carefully evaluate the processes they want to automate, because without adequate support and maintenance, the automated tasks might not answer information changing demands and thus fail to give useful information for decision making (Korhonen et al., 2021). In addition to the aspects to take into account before implementing automation procedures, management accounting should also consider concerns about privacy and data security issues that the applications of Big Data technology are raising (Warren et al., 2015). Security risks in management accounting's information, data collection and transmission

refer not only to data loss during the transmission process, but also to intentional attacks (Jia, 2019). Therefore, in the digital era, the security of management accounting work needs to be taken into account since by definition, management accountants possess a thorough and complete understanding of the whole business organization (Appelbaum et al., 2017). Regarding the concerns of data privacy and security, Big Data entails a relevant challenge for management accountants because allows the acquisition, integration and sharing of several types of data from different sources. For instance, the disclosure of personal or sensitive information could be compromised even with data security and privacy measures (Appelbaum et al., 2017). In order to overcome the issue of privacy maintenance, data access restriction and data anonymization are two typical solutions that should be enforced system-wide (Cormode and Srivastava, 2009). Data security, instead, involves management accounting tasks because while the IT department define controls and procedures, the management accountant needs to ensure and control that the practises are followed (Appelbaum et al., 2017). Despite the fact that the introduction of Big Data technology is still in its infancy in some business contexts, management accounting tasks should be adapted to guarantee the functioning of a safe and effective accounting data security system.

3.4. The implications of digital transformation on the role and skills of management accountants

The advent of digital technologies is creating entirely novel professions across industries, such as Big Data analysis, app development or software design, and is expected to transform work practices in a wide range of jobs, generating several challenges also for the management accounting profession (Bhimani and Willcocks, 2014; Oesterreich and Teuteberg, 2019). Agostino and Sidorova (2017) state that the emergent technologies and practices "are shaping accounting and accountability, by reconfiguring new organizational roles and positioning, experts and expertise, and accountability-type relationships" (Agostino and Sidorova, 2017, p. 780). The profound transformation of roles, expertise, and accountability relationships raises relevant questions about the role of management accountants in a digital world (Knudsen, 2020). The connection between management accounting and digital technologies affects not only tasks and techniques but also the position of a management accountant within a business organization (AlAnsari et al., 2022). The reason behind this transformation lies on the leading role that management accountant is expected to take within the digital transformation process by acting as a change agent (Oesterreich et al., 2019). Moreover, the ability of ERP systems and business analytic tools to interpret and analyse various types of data entails the need for management accountants to adjust their responsibility and to change their roles in

order to provide better support for decision making, performance management and gaining competitive advantage (Nielsen, 2015). AlAnsari et al. (2022) claim that in order to succeed in the digital era, all management accountants will require an acquisition of high level of mastery and skills. According to this perspective, they should be able to explore new methods to analyse, manage, and extract value from data and to apply analytical and critical thinking skills to provide support for decision makers (Lawson, 2019). In order to achieve that condition, management accountants need to shape their professional identity and acquire the necessary skills for this type of activities (Nielsen, 2018). Specifically, Big Data represents a fundamental factor that potentially affects the skill sets of management accountants (Rikhardsson and Yigitbasioglu, 2018). Although some researchers such as Bhimani and Willcocks (2014) claim that management accountants merely need to understand the potential of Big Data and do not need to acquire specialist technical competences, others disagree by considering Big Data as a crucial paradigm shift (Payne, 2014; Rikhardsson and Yigitbasioglu, 2018). The expression "data is the new oil" should be connected to the emerging need of Big Data to be cleaned, processed and analysed in order to generate meaningful information (Al-Htaybat and von Alberti-Alhtaybat, 2017). According to Al-Htaybat and von Alberti-Alhtaybat (2017), in order to exploit data analytics' opportunities for internal decision making and to make useful contributions in practice, management accountants need additional skills. Some examples of these

skills regard machine learning, artificial intelligence, data science and data structure, data governance, information system analytics and automized systems (AlAnsari et al., 2022). Several publications emphasize the importance for management accountants of implementing data scientist's tasks in order to preserve and strengthen the business partner role (Oesterreich et al., 2019). Since the role of data scientist may seem apparently similar, for some aspects, to that of the management accountant, the possible replacement of management accountant with data scientists or how it will be the coexistence of these two roles represent a relevant issue (Lawson, 2019). According to Lawson (2019), the difference between these two roles lies on the fact that while the data scientist's job includes "designing a data strategy that's relevant and manageable and the extraction of information from large quantities of data", the management accountant role should be considered as an "analytic scientist translators" (Lawson, 2019, p. 9). It can be stated that both data scientists and management accountants "tell stories", but their parameters, approaches and data-telling process differ (Al-Htaybat, K. and von Alberti-Alhtaybat, 2017). Data scientists, for example, tend to rely heavily on external sources, such as sentiment analysis of social media, whereas the more conservative perspective of management accountants tends to be more adverse to such sources (Al-Htaybat, K. and von Alberti-Alhtaybat, 2017).This phenomenon entails a potential conflict between the accounting values of reliability and timeliness of information and the primary aim of data scientists

which is based on gathering as much information as possible from Big Data analysis, even though some of them are more speculative and predictive than reliable (Al-Htaybat, K. and von Alberti-Alhtaybat, 2017).Therefore, it is important to understand that, in order to exploit the advantages of both roles, management accountants should be able to utilize methods of analysis, interpretation and presentation of data and they should communicate and cooperate with data scientists to translate data into business insights (Phillips, 2013; Lawson, 2019). In addition, the direct access to data by end-users and sophisticated user-friendly BI&A tools that generate decision-relevant information, highlight the need for management accountants to carve out new roles (Rikhardsson and Yigitbasioglu, 2018). For instance, since management accountants will no longer be designers of management reporting systems, it is likely that they would play a consultative role towards end users, helping them in the selection and interpretation of decision-relevant data and would adopt a more active role in assisting IT personnel to choose the best match between the features of the BI&A system and the requirements of the users (Rikhardsson and Yigitbasioglu, 2018). Specifically, Cavélius et al. (2020) analyse the unsolved struggle for management accountant between being a technician and a business partner by comparing different types of company. In companies where digitization is not yet visible, although management accountants sometimes still struggle with data collection and verification, they act as business partners because their clients

are mainly local. On the contrary, the study of Cavélius et al. (2020) reveals that in organizations that begin their digitization process, the tasks related to ensuring data-reliability create tensions on the role of management accountant as they have less time available for business partnering. The business partner role is instead strongly evident in the companies with advanced digital processes because successful data-reliability projects are already in place and consequently they don't need to spend a lot of their time for data-collection and reliability tasks (Cavélius et al., 2020). This study allows to evaluate how management accountant role maintain its relevance within business organizations despite all the digital advancements. Following this perspective, it can be stated that digitalization by itself cannot drive change and, moreover, cannot entirely replace the management accountant because when human labor can be automated in some ways, practices will adapt and change (Quattrone, 2016; Korhonen et al., 2021). The increasing need for management accountants to develop new skills in technology and analytics should not decrease the importance of business acumen, analytical thinking, and other traditional management accounting competencies (Möller et al., 2020). On the contrary, an emergent role for management accountants would be to combine their strategic and leadership skills and their expertise in areas such as cost structures, profitability analysis, revenue streams and management control with the application of new technologies (Rikhardsson and Yigitbasioglu, 2018). Linking knowledge of digital technologies with expertise in business and

accounting would be beneficial for business organizations because on one hand, an accounting background would help to fully understand the final objectives and, on the other hand, the latest technological tools would be used to achieve these goals in a more efficient, optimized, and timely way (AlAnsari et al., 2022). This new role leads to a condition in which management accountant is expected to combine the abilities of a strategic-thinking business partner with selected functions of a data scientist (Oesterreich et al., 2019). In particular, the study of Al-Htaybat and von Alberti Alhtaybat (2017) claims that management accountants' tacit knowledge, considered not only as the "feel for the numbers", but also as values and principles, is a crucial element that cannot be replaced by relying entirely on data analytics. Despite the attention of the current literature toward this role, the research of Oesterreich et al. (2019) demonstrates that today the existence of such role cannot be confirmed by job advertisements and member profiles. The fact that in many business organisations digital transformation process has not yet proceeded as expected could represent a possible explanation of this lack (Oesterreich et al., 2019). Therefore, regarding the choice of the companies of whether upskilling management accountants or hiring specialists such as data scientists, the results of the study of Oesterreich and Teuteberg (2019) demonstrate that as the size of the company increases, the supply of business analytics competences and IT skills in management accountant profiles, tends to decrease. Furthermore, thanks to digital technologies, the faster and more

easily accessible information within business organizations allows decision makers to evaluate alternatives and actions on the fly. Such changes in the decision-making process represent an additional disruptive force capable of changing management accountants' role in organizations (Rikhardsson and Yigitbasioglu, 2018). Therefore, a consequence of these transformations for management accountants will be to increasingly have to share responsibility for management accounting analysis with other functions (Rikhardsson and Yigitbasioglu, 2018). Regarding the relationships between management accountant and other functions within organizations, it can be stated that in order to be able to identify impacts from areas such as supply-chain, human resources and marketing, it is necessary a high level of interaction between MA and these other functions (Nielsen, 2018). New digital technologies, especially those that involves analytics, in order to guarantee that analytical insights actually generate value for the company, require an alignment between behaviours, values, outcomes and decision-making norms from all the departments within the organization (Nielsen, 2018). Therefore, given the management accountants' "big picture" perspective of the overall organization, their focus should be directed not only to numerical and financial information, but also to customers, employees and incentives, innovation, organizational processes and cultural environment, involving necessarily other business functions (CIMA, 2016; Dahal, 2019). Following this perspective, the attention toward organizational and behavioral

aspects assumes relevance for the role of management accountants. Among the individual skills and knowledge that IFAC (2002) classified as critical to the success of a MA, there are also soft' skills, such as communication, team leadership and interpersonal skills. For instance, when working as part of a cross-functional team, these skills are crucial because management accountant should gain a greater awareness and a deep understanding of strategic and operational issues in order to be able to exploit digital technologies to better support decision making (Atrill and McLaney, 2009). Moreover, Internet of Things and Industry 4.0 allow data capturing firms' manufacturing and business processes to be continuously communicated within an organization and with external parties along the value chain and create a large and complex network of suppliers, producers and customers (Drath and Horch, 2014). To manage this network, decision makers will need a broad overview of the overall performance, and since management accountants should be able to provide it through the ability of recognizing and evaluating how various performance measures reflect actual operations, their role should be extremely interconnected with all the functions involved (Richins et al., 2017). In conclusion, it can be stated that the increasingly advanced digital developments change the role of management accountants, but a successful implementation of the role of MA requires dynamicity, competences, flexibility and adaptation in order to lead over changes in market environment (Dahal, 2019).

CHAPTER 4

DIGITALIZATION AND MANAGEMENT ACCOUNTING: AN EMPIRICAL ANALYSIS

4.1. Introduction

The aim of the previous chapters is to provide a framework of the impact of digitalization on management accounting. The structure of the chapters allows to guarantee a clear picture of the topic, defining a functional roadmap in order to understand the effects of digital technologies on management accounting. The characteristics and the functions of management accounting described in the first chapter are crucial to the purpose of the study given that they are the items on which digitalization might have an impact. The second chapter provides a detailed overview of the main new digital technologies and identifies the opportunities and the functionalities that can be used in management accounting. The literature review of the third chapter allows to define an outline of the multiple effects of digital technologies on management accounting. The distinction of the impact of digitalization on tasks, techniques, skills and the role of management accountant guarantees a clearer configuration of the different consequences of the implementation of digital technologies. The use of these technologies and the potential changes that they entail are analysed in the literature and they are

summarized in this study, highlighting not only how the main techniques and tasks of management accounting could be affected by the implementation of digital technologies, but also how the role and the skills of the management accountants could change due to digitalization. The purpose of this chapter is to carry out a qualitative research through semi-structured interviews in order to investigate the actual effects of digitalization on management accounting in real business contexts. To fulfil this aim, this chapter is structured as follows: the first section provides a description of the research methodology, the following section describes the findings of the research in relation to the three main aspects identified in the previous chapters (tasks, techniques and role) and the final section concludes the chapter by discussing the outcomes of the research and highlighting the main contribution of the study.

4.2. Research Methodology

As previously stated, the current study involves a qualitative research. The most common element for the distinction between qualitative research and quantitative research is based on the type of instruments and concepts used. The former uses instruments of logical type, able to evaluate a phenomenon through words, images and descriptions, whereas most of the quantitative research relies chiefly on numbers, using tools and concepts from statistics (Al-Htaybat and Alberti-Alhtaybat, 2017; Berg and Lune, 2012). Although the difference between these

two methods implies also two different ways of understanding social reality, the choice of the method is the consequence not only of the way of perceiving the reality, but also of the purposes of the research and the role that the researcher can play (Corbetta, 2003). According to Berg and Lune (2012) qualitative research is able to investigate and examine "various social settings and how inhabitants of these settings make sense of their surroundings through symbols, rituals, social structures, social roles and so forth." (Berg and Lune, 2012, p. 8). Therefore, qualitative procedures seek patterns among cases, allowing the researchers to understand how others perceive and give meaning to the topics which are the objects of the research. This study employs a qualitative method because, for the aim of this research, it is necessary to understand the perceptions of the "actors" (i.e. those who act) in relation to the impact of digitalization on management accounting, i.e. a complex phenomenon which needs to be studied in its real-life context.

4.2.1. Data collection and data analysis

The data collection technique chosen uses the interviews as an instrument to investigate in a deep and direct way how the participants perceive the effects of the use of digital technologies in management accounting contexts. The reason for this choice lies on the fact that the qualitative research interview's focus is to understand the object of the study from the point of view of the subjects and to

explain the meaning of their experiences, trying to provide an explanation of their perceptions or to provide a potential for further research (Kvale and Brinkmann, 2009). An interview can be defined as a conversation with a specific structure and purpose that goes beyond the simple exchange of views (Qu and Dumay, 2011). The interview involves a careful questioning and listening approach with the aim to obtain detailed tested knowledge (Kvale and Brinkmann, 2009). However, in addition to the choice of the research method, it is necessary to define in a clear and precise way the objectives of the research in order to structure the interview accordingly. This first step is crucial for the effectiveness of the overall research, since the definition of the goals of the study provides a starting point for the composition of the interview structure. Moreover, the structure of the interview is strictly linked to the type of research implemented. Considering the distinction based on the degree of rigidity among the standardized, the unstandardized, and the semistandardized interview, the type of interview used for this study reflects the main features of a semistandardized interview. Unlike the standardized interview in which the questions are asked in the exact same sequence and wording, the semistandardized interview presents a higher degree of flexibility and adaptability (Qu and Dumay, 2011). For instance, if a topic of interest, which was not initially planned, emerges spontaneously during the interview, the researcher can explore it (Chiucchi, 2012). Therefore, this technique allows to analyse the phenomenon more in-depth and detail. In order to exploit the

advantages of using an interview as an instrument for data collection, it was necessary to define an interview guide as a framework to follow during the meetings with interviewees. The interview guide represents a tool which helps the data collection process and, at the same time, the point of departure of data analysis. The abovementioned literature review represents the basis for the definition of the interview guide because it provides not only an overview of the current knowledge about the topic, but it also helps to define the main aspects that the research aims to investigate. Specifically, the structure of the interview guide reflects the organization of the discussed topics in the previous chapters, focusing firstly on the technologies actually implemented, and then, on the impact of those technologies respectively on tasks, techniques, on the skills and on the role of management accountant. Furthermore, the definition of the interview guideline includes also the choices about the specific ordering, the phrasing of the questions and the type of the communication to adopt (Berg and Lune, 2012). The rationale behind these decisions is to provide a structure of the questions which should be functional as much as possible to the aim of the research. For this purpose, in addition to the predefined questions, some clarifying questions were asked to the participants during the interview. The flexibility of the semi-standardized interviews allows to add these questions that summarize the main concepts of the previous answers. The aim of these questions is twofold: it permits to check that the interviewer has correctly understand and interpret the answers, and it

represents a stimulus for further topics to discuss. Another important aspect for the data collection techniques includes the sampling strategy. The selection of the cases of the research is relevant because they should be able to provide further knowledge of the researched phenomenon (Moll et al., 2006). In particular, cases were chosen purposefully (Patton, 1990) because the case companies designed and implemented digital technologies for managerial accounting purposes. The contact with the participants was made via e-mail, through a request of availability with a brief summary of the purpose of the research and the interview guideline in order to disclose the main objects of the study. The interviews were carried out through an online platform and after the permission of the participants, they were recorded. The communication with the interviewees allows to have intangible elements that helps the interviewer to identify the real perspective of the participant. For this reason, immediately after each interview, a brief summary of the interview was prepared, summarizing and transcribing the main elements that emerged from the interview. This step represents a crucial support for the analysis because each participant focuses his/her attention on particular aspects of the topic and being able to written them down immediately after the interview allows to define the basis for later, more in-depth analysis. The qualitative nature of this research is reflected also in this step of the data collection because, although the topics and the aspects to investigate are the same for all the participants, each interviewee provides a specific and peculiar perspective that is

relevant to take into account and explore in depth. Moreover, the brief summary allows to fix the impressions that the interviewer can obtain from the discussion, identifying the main concepts that the interviewee wants to highlight. Afterwards, the entire interviews were transcribed in their full length and a structural coding approach was applied in the analysis of them (Krippendorff, 1980). More in detail, the data analysis techniques used in this research involves a code system based mainly on the structure of the interviews. The definition of the codes was based on the main objects that the research aims to investigate and the codes were functional to summarize and organize the large amount of data in a more structured way. The most important objects of the research are related to the categories identified in the literature review, which can be summarized in the impacts on the techniques and tasks of managements accounting and the effects on the skills and the role of management accountant. The coding approach helps the analysis of the data because it allows not only to recognize for each answer the topics that it addresses, but also to easily link the codes to the main investigated objects. The interview transcripts were utilized to assign the predefined codes to the answers of the participants in order to perform the data analysis. This method, therefore, has guaranteed time savings and a more structured data analysis.

4.2.2. The case companies

The sample of this research includes four management accountants and one Chief Financial Officer (CFO) operating in different business sectors. Company A, in fact, is a leader in dairy sector with a share over 90% in Italy and high presence also in Europe. The historical biggest national leader, and one of the international players in the production and distribution of musical instruments, in particular guitars, is the company B. Company C, instead, is a furniture company that produces home furniture made from melamine-faced particleboard panels that are sized, edgebanded, and ecological, serving large-scale and small-scale retail and the contract sector channels. In the lighting engineering sector, the Company D produces high performance lighting fixtures and design fixtures both for outdoor and indoor environments. Company E, instead, represents a world leader in innovation of wood and glass paints. The heterogeneity of the sample and the holistic view that allows is guaranteed not only by an individual perspective but also by the various business environments the participants belong to. The fact that the interviewees operate in different business contexts allows to take into account different viewpoints and knowledge. Therefore, it is important to clarify that the contribution of each interviewee regarding his perspective of digitalization on management accounting is affected by the core business, the values, the structural organization, and the level of innovation of the company.

4.3. Analysis of cases

4.3.1. Analysis on the effects of digital technologies on management accounting techniques

This research aims to investigate the impacts of digitalization on management accounting considering the following as the main digital technologies in this field: Business Intelligence (BI), Big Data Analytics, Cloud, Internet of Things, Blockchain and social media. However, from the analysis, it can be stated that the common denominator of the different cases is the massive use of Business Intelligence. Despite the participants have declared either the use of Cloud services as a data company storage (Company D) or Blockchain for the contracts signature (Company B) and social media in marketing departments (B, C, D, E), the analysis described in this chapter focuses mainly on the Business Intelligence technology, as it represents the technology that all participants (Company A, B, C, D, E) use for management accounting purposes. From the analysis, a recurrent theme that has emerged regards the process of data collection, analysis and elaboration. In general, all the case companies (A, B, C, D, E) have highlighted the improvement of these processes thanks to the implementation of digital technologies, especially the BI systems. In particular, the management accountants of company A, B, D, E have mentioned that the use of BI software increases the data accuracy for management accounting analysis. Before the implementation of BI systems, the manual action for data collection and

processing through Excel files entailed high risks of errors and of miscalculations. The Chief Financial Officer (CFO) of Company B claimed that:

"*There was a personalization of the Excel files (...) everyone had personalized queries (...) there was a very high risk of mistakes (...) you can handle hundreds of parameters, it takes a moment that one person misses a flag and clearly the data is wrong*" (Chief Financial Officer - Company B).

From this statement, it is evident that the huge amount of data along with the manual elaboration through Excel files could affect the accuracy of the data and the related information. From this perspective, the Business Intelligence software have decreased, if not eliminated, the risk of errors because the human and manual intervention on data extraction from management corporate systems is now excluded. Another important aspect, that this interviewee has emphasized, regards the personalization of the data. In this regard, the management accountant of Company E, has described a similar condition, claiming that the implementation of the BI tool has arisen from the problem to have a "*diversified and heterogeneous*" set of information, which was available only in a "*fragmented and disorganized way*". Therefore, the use of this technology allows management accounting to have a regular, structured and uniform set of data available. The relevance of this aspect lies on the fact that management accounting information

should be objective; the analysis performed by different individuals should lead to the same outcome. If this condition lacks, the impact is necessarily negative for all the business areas and, in general, for the whole organization. From this point of view, BI systems are able to solve this problem and ensure more accurate and reliable information. In addition, instead of sharing a huge amount of Excel files, the implementation of BI software improves the governance of overall process of collection, elaboration and analysis of data. In this regard, management accountant of Company D clarified that:

"*The whole process has been reconstructed within a series of sub-processes and activities that all involved actors follow. They have to enter the data and then we see what they add, we can ask for explanations* "(management accountant – Company D).

Referring to data collection and processing, this statement allows to understand that BI tools also improve the traceability of changes made by the users, reducing the complexity of controlling the data elaboration process. As one of the main features of the management accounting information, the timeliness represents another relevant element that the interviewees have highlighted. The management accountant of Company D has considered the "*risk of not having timely data*" due to the increase of data to be analysed, as one of the reasons for the implementation

of BI tool in management accounting techniques. The interviewee added also that the BI makes the measurement of some quantities "*daily, constant, in real time*". The finance and operation director of Company B emphasized also the relevance of the information timeliness to guarantee the responsiveness of the business context, claiming that the BI system allows the information flows to be "*continuous*" and it permits to

> "*shortened so much the time-to-decision with the boards of directors. (...). We absolutely have to be responsive*." (Chief Financial Officer - Company B).

A further common element of the different cases analysed, involves the use of BI software for budgeting processes. All the participants of the research declared that this type of process is implemented through a Business Intelligence software. In Company E, the implementation of BI "*made the whole flow easier and smoother*" (management accountant – Company E) improving the accuracy, the velocity, the flexibility of the data and the agility of data sharing among different business functions. Nevertheless, it is important to clarify that the impact of the use of this technological tool on budgeting procedures does not radically transform the process itself, as well as it does not change its structure. Despite the advantages in terms of practical improvements, the effectiveness of the budget as a planning tool is still linked to the management accounting system of the

organization. In contrast to budgeting that all participants perform through BI tools, from the sample analysed, only Company E uses the BI for predictive analysis. In particular, the management accountant of Company E has specified:

"It *has also made it possible to develop our own systems of the predictive analysis (...) we used the same tool also to do simulations, such as what if analysis (...) before (the implementation of BI) it was not possible to do these predictions because the variables we were going to analyse were so many that basic tools of analysis would not be sufficient*." (management accountant – Company E).

Company E, therefore, thanks to the BI, is now capable to do predictions, simulations and profitability analysis that otherwise were not possible to perform.
A relevant element that has emerged from the analysis of the interviews concerns the reverse impact that management accounting is able to produce with respect to digital technologies. Specifically, the CFO of Company B has emphasized the active role of management accounting in the utilization of technologies, arguing that the digital technologies are the ones that are shaped and moulded to suit the needs of management accounting and not the other way round. According to this theory, the digitalization and the related technologies do not affect and modify management accounting techniques and activities. On the contrary, the interviewee has highlighted the functional role of the digital technologies, because

they are the outcome of a designing process based on management accounting needs and structures. Considering the BI, the Chief Financial Officer of Company B claimed:

"*BI does what you ask it to do, BI doesn't influence anything (...). It is a machine that has to be driven, we were the ones who gave the directions on how it should be done, the ones telling it what it had to do (...) and we did something tailor-made*" (Chief Financial Officer - Company B).

The perspective that this interviewee has shown and defined in a clear way was shared also by the management accountant of Company C that considered management accounting and the whole business organization as the main factors capable to affect digital technologies. The latter should be considered only as tools that need to be driven, need to be designed according to the necessities, and need to be customized in relation to who use them. In this regard, the management accountant of Company A has pointed out that management accounting represents the driving force, whereas the BI technology is only the "*tool, the enabler, the facilitator*". The rationale behind this definition involves the connection between the technology and the purpose of its use because its implementation necessarily implies a multi-year project that starts from the definition of the needs, and it ends with creation of adequate solutions. Moreover, the management accountant of

Company C has emphasized the importance of providing a structured process to be adapted to the BI system in order to obtain a relevant advantage in terms of utility. Within the Company C, the condition to be able to exploit the functionalities of these technologies, otherwise not possible to implement, is based on providing a well-designed and structured process with clear specifications. Therefore, the way management accountant designs systems, processes and settings represents a crucial factor for the implementation of BI systems, capable to affect its effectiveness. Furthermore, in line with this perspective, another relevant aspect that the research was able to highlight regards the management accounting purposes for the implementation of BI tools in business organizations. Company A, B, D and E considered the management accounting purposes as causal factor for the adoption of Business Intelligence systems. The increasing complexity of the business contexts, along with the huge amount of data available to be analysed, has determined the necessity to use technological tools to facilitate and improve management accounting techniques. In this regard, the management accountant of Company E, has defined the management accounting as "*the advocate, the promoter of the implementation of these tools within the company*", highlighting how the application of BI technologies within the organization was led by management accounting in order to meet its informative needs. In addition, as the Company A's management accountant specified:

"*The BI was born for management control objectives, it then had very different implications. For example, we have extended the approach of assisted management control process to the entire Supply Chain world*" (management accountant – Company A).

In this specific context (Company A), the BI represents the enabling factor to extend the management accounting approach to other business areas. Specifically, in the Supply Chain department of Company A, the use of the BI tool has provided a new assisted control approach which through KPIs helps management accountant to understand how to improve corporate efficiency and/or reduce wastes. From this perspective, the BI is considered as a powerful instrument to allows management accounting to broaden toward other business areas. The role of BI in Company A, therefore, represents one of the main tools capable to connect management accounting with the other company areas. The information delivery represents another crucial aspect that emerges from the analysis of the interviews. All sample companies (A, B, C, D, E) have claimed a fundamental benefit of BI systems in terms of improvements in data delivery and exchange within the organization. This impact should not be considered only in terms of speed of data transmission but should be understood in relation to a different and enhanced usability of the data. Therefore, within the organization, one of the advantages that the BI tool provides regards to the availability of data and

information, which are reachable from anyone and in any time. Moreover, the management accountant of Company C has also emphasized how the whole data distribution process is much more structured and efficient compared to past thanks to the use of BI software. Cases' analysis has shown how this benefit is the result of planning the distribution of data and information to other business functions. The BI software, thus, takes care of the scheduling process of the distribution of information to the recipients within the company.

"*Once the report is defined, once it is set up, we have the ability to schedule the execution and the distribution to the users and therefore we don't have to worry anymore about checking, executing because it is the tool that has its remind and therefore sends all the data at the time we have decided*" (management accountant - Company C).

With the only exception of Company B, all case companies described only the benefits that BI entails within the business organization, without identifying criticalities or negative effects that the implementation of this digital tool can generate. However, the management accountant of Company B has considered the real-time updating of information as a potential threat for the trustworthiness of management accounting information. The example provided in the interview to explain this perspective regards technical mistakes or a nightly database update

which can entail errors on the data. A direct and crucial consequence is the sharing of inaccurate information to the recipient. Company B has highlighted the importance of management accountant in these specific circumstances since his main function should involve the ensuring the information accuracy and reliability.

4.3.2. Analysis of the changes of management accounting tasks due to digitalization

Following the interview structure, this paragraph aims to investigate if and how the management accounting activities are affected by the implementation of digital technologies. Also in this analysis, the attention is exclusively directed to the use of Business Intelligence tools, because all the companies involved in the study (A, B, C, D, E) have declared to have implemented this technology for carrying out management accounting. What emerges from the business contexts investigated is a common lightening of management accounting tasks thanks to the functionalities of the BI system. The managements accountants of all the companies interviewed (A, B, C, D, E) have agreed on the fact the BI software implemented reduces the workload of low value-added activities. Apart from the Company C, the kinds of activities that the other companies (A, B, E, D) considered lightened thanks to the use of BI systems are characterized by a

repetitive and operational nature, such as the data extraction from corporate systems. As the management accountant of Company D noted:

"*Many activities were on data extraction from the various ERPs, such as exporting Excel tables and then working on those Excel tables (...) now certainly all that time is saved*" (management accountant – Company D).

In addition, in Company A, C and D the implementation of BI technology has entailed a crucial shift of management accounting tasks from data extraction and information production to business consulting activities to support decision making. In these business settings, much less time is spent on information production and much more on active and frequent participation in decision making support. As observed in Company C:

"*Management accountant can participate in the decision-making activity and can support managers much more effectively because he has compressed the low-value activities to a minimum*." (management accountant – Company C).

Therefore, the freed-up time through to the use of BI software allows to change some of the typical and routine management accounting tasks, increasing the activities directed to support decision making. In this specific regard, the more

active participation on decision making processes has emphasized the importance not only to provide an objective, reliable and relevant information but also to provide the right interpretation of it. The management accountant of Company A has highlighted this concept:

"*The real object is not the production of data, but the production of analysis which are actually understood and correctly analysed by who has to use them to improve processes*" (management accountant – Company A).

The possibility to participate actively in and to support decision making activities allows the management accountant to provide managers his interpretation and his perspective in order to have a better understanding of the information and consequently have a more informed decision-making process. Another relevant impact on management accounting tasks that in the sample was detected only in Company B, regards the creation of an internal checklist within business organization. The CFO of Company B has explained that having a fixed date in the BI software, by which all tasks must have been completed, has generated a sort of to-do list for all the actors involved. BI software is set to automatically send reports on the pre-set date, without any kind of delay. Therefore, by that day:

"*everyone must have done their tasks. The to-do-list, the task list is extremely strict and followed. It allowed us to create a kind of internal check-list, thanks to which we are all ready* "(Chief Financial Officer - Company B).

From this statement, BI seems to represent a coordination mechanism not only for management accounting tasks but also for the actors involved. This digital tool allows to have a clearer definition and schedule of the activities that have to be performed. Moreover, BI facilitates the tasks organization between the actors because the digital infrastructure of the system automatically sets deadlines that necessarily need to be met. In Company B, this mechanism reduces the human intervention in the time-consuming activities and improves the efficiency of management accounting tasks, avoiding especially delays on information delivery. In addition to the fact that the use of BI unburdens management accounting from repetitive and low value-added activities, this study was able to detect a relevant aspect that displays also how this technology entails new types of activities. As previously mentioned, within companies, management accounting represents a central business function for the implementation of digital technologies because they should be adapted to its informative needs. Regarding this perspective, Company A has highlighted that the implementation of BI software involves multi-year and complex projects, that especially in the first phase of implementation, designing and structuring requires a lot of time and efforts to

management accounting. In addition, in two of the sample companies, D and E, the use of BI software introduces new types of activities related to up-dates and up-grades due to changes of information needs, transformations in corporate organization, or changes of shareholding structure. In addition to the adjustments of tasks, the information delivery and the data visualization represent elements affected by changes in the majority of the sample companies (A, B, D, E). In particular, in Company A the implementation of BI has improved the flexibility, the speed and the conciseness of reports. The relevance of these features lies on the fact that management accounting needs to use a visualization method which should be functional to the recipient of the information. Therefore, the possibility to have visualization techniques more flexible and focused through the use of BI software allows to present the data in a more appropriate and functional way to the users of the information. In this regard, the management accountant of the Company B has highlighted the enhancement of data visualization in terms of clearness, readability and comprehension. Whereas Company A, B and E have agreed on the enhancement of visualization methods through BI software, Company D has displayed an opposite perception, highlighting the fact that the improvement of the effectiveness of the visualization should not be taken for granted. On the contrary, the management accountant of Company D has emphasized the dependence of the quality of the data presentation from the specific features of the adopted BI software:

"*It depends on the software. There are some software that maybe are more devoted to "look and feel", to catch the reader's eye, to make more appealing and interactive charts, others less (...) each software has its specificities and some may be more or less advanced for this aesthetic side*." (management accountant – Company D).

4.3.3. Analysis of the impacts of digital transformation on the role and skills of management accountants

In order to have an in-depth comprehension of the impact of digital technologies on management accounting, it appears crucial to define the transformation in relation to the role of the management accountant and to its skills. From the sample of this research, all the companies involved (A, B, C, D and E) have experienced a relevant change in terms of the skills of management accountant within business organization. In Company B and A, the adoption of the BI software has entailed a general evolution of the skills toward the digital field. This phenomenon occurred also in Company C, D and E, where the implementation of this tool on management accounting has determined the need for specific knowledge of the instrument itself. Management accountant plays a role that necessarily implies the ability to use and master digital instruments, and therefore this leads to the need to possess the adequate digital skills. The fact that external consultants are responsible for the technical functionalities of the software has

created the necessity for management accountant to have a proper knowledge of the tool because:

"*having an external (consultant) means not having a complete knowledge of the origin of the data, of how the data are produced, how they are made available and also what are the criteria underneath*." (management accountant – Company E).

In this regard, Company E has emphasized the importance of specific competencies related to the BI software adopted in order to be able to manage and use the tool with more control:

"*We have chosen to increase our level of skills to the use of the tool, to increase it at the level of database development and we also have an expertise to understand how to build the database. This also implies knowledge about the language and the operational mode of the tool*" (management accountant - Company E).

Therefore, in Company E, the BI implementation has generated a shift toward specific IT skills that allows to have a deeper understanding of the digital instrument itself. According to the management accountant of Company E, this extension of management accounting skills toward the IT world comes from the

need to be aware of the features and functionalities of the BI tool in order to be able to manage and use it effectively. Thus, it can be stated that the implementation of BI tools is the one of the factors that can generate a change of management accountant skills toward the information technology field. Despite the need to develop and improve this kind of skills, the CFO of Company B has claimed that the implementation of BI systems allows also to generate a "*common language*" which not only is the same for all the business functions, but it is also easily understandable from everyone within the organization. The improvement in terms of communication due to the implementation of BI software increases the relevance of the management accountant within business organizations because, given his centrality in terms of the relationships with the other business areas, his role shifted toward an information hub for the entire company. Following this perspective, considering this new function as the information keeper, and given the central role he plays, the need to develop appropriate soft and relational skills necessarily arises. In this regard, Company D and A have highlighted the importance of relational skills for the management accountants, especially because of the implementation of BI software. The relevance of this kind of skills depends on the new position of management accountant within companies. As the Company A's management accountant noted, the fact that digital technologies improve the information delivery to other business functions in terms of speed and flexibility has resulted in a condition where the management accountant should be

able to explain the information itself. The ease with which the information is available to all the business areas of the company, in fact, has raised the issue about the actual comprehension of the data. Management accountants, therefore, should possess the adequate relational skills to ensure that the other business functions, which do not have accounting knowledge, fully understand the information provided. Despite the fact that the management accountant represented the information exchange hub for all the business areas even before the implementation of these technologies, the latter have entailed the need to make the recipient thoroughly understand the information. Therefore, the implementation of BI tools defines a new role for the management accountant, that should be the information interpreter capable to distribute knowledge to all the other business areas. Moreover, although as previously mentioned the information sharing among business functions and the data accuracy have been highly facilitated by BI software, the Company D claimed that the management accountant remains:

> "*the figure that guarantees the data accuracy and the correct design of the control system*" (management accountant – Company D).

In addition, the implementation of digital technologies affects another aspect about the role of management accountant. Company A, C, and D have

experienced a transformation that leads to a business partner role that actively participate in decision-making. The reason of the involvement of management accountants in decision making activities is not only related to the freed-up time that the BI software allows (as Company C claimed), but also on the importance to provide the right meaning and interpretation of the data in order to take the best decision. In fact, as the management accountant of Company A stated:

> "*The real topic is the data interpretation in order to transform the data in information and then in decision*" (Management Accountant - Company A).

Moreover, Company D stated that today the management accountant:

> "*is an internal consultant for the evaluation of the economic and financial impact of their actions*" (management accountant – Company D).

The actions which this statement refers to are the activities performed by the other business functions. Therefore, following this perspective, the management accountant acts as an advisor not only to decision-makers, but also to other corporate functions. Nevertheless, the management accountant of Company A has specified that rather that considering digital technologies as the determinant factor that has caused this role change:

"*The technologies are a reinforcement, an accelerator of this role change, necessary for its survival, affirmation and recognition*" (management accountant – Company A).

It can be stated from this perspective that, although the digital technologies are not the sole cause, the transformation of the role of management accountant has been influenced by them. The introduction of BI within business organizations is also the responsible for a cultural revolution that involved the whole company. According to Company B and Company A, which defines the digital technologies as the "*engine of cultural growth*", the digitalization has enabled a cultural leap toward the digital world, defining a revolution through all corporate areas. In addition, Company A has also highlighted how the link between management accounting, the other business functions and the management has been affected by this cultural revolution, claiming that:

"*The technologies have shortened the cultural distance between management accounting, operational functions and management*" (management accountant – Company A).

From this perspective, it can be stated that the impacts of digitalization affect also the relationship of management accountant with all the business actors within the

company. In general, from this analysis, it emerges that the adoption of digital technologies allows to intensify the relationship between management accounting and the other corporate functions. Three out of five sample companies (Company C, A, E) have described this transformation as a strengthening of the relationship. In particular, the implementation of BI software entailed a better coordination and cooperation among business functions. In company E, the collaboration with the other functional areas is defined as the key element in order be able to exploit the functionalities of the tool since to create the databases, it is needed to implement collaborative information flows. To this aim, as Company E noted:

"*Management accounting is the traît d'union between the highest part of the management of the company and the information that comes from the bottom, the operational part, because we have tried to put them in communication through models of analysis that could be shared but, above all, that can be understandable by everyone*" (management accountant - Company E).

A similar perspective, but with different reasons behind it, is the one found in Company C, where the freed-up time is the main factor for the intensification of the relationship between management accounting and the other business functions. The possibility to reduce the workload of repetitive and time-consuming activities leads to openness to other business areas, allowing an

improvement in terms of cooperation and collaboration with them. An opposite condition is the one experienced by Company D, which has described a weakening of the relation between management accountant and the other corporate actors due to the implementation of digital technologies. The reason of this phenomenon is that, before the use of BI tools, the business functions that had less digital skills referred to the management accountant to ask information, analysis or data. Today, as the management accountant of company D has clarified:

"*They can find them (data) available in the BI online system whenever they want. Therefore, the relationships with these entities have weakened because we are no longer asked for a whole series of analyses that we used to do*" (management accountant - Company D).

According to this perspective, the data availability, the easier and faster access to information and the improved data visualization through the BI system have reduced the interactions between management accountant and the other business functions. In Company D, the implementation of digital technologies has decreased the role of management accountant as information provider for the others business actors. Following this line of reasoning, this phenomenon can entail an issue for the relevance of the management accountant within companies.

The greater autonomy of other business functions in terms of data availability and the easier access to information thanks to the use of BI software can partially exclude the management accountant from performing different types of analysis and supporting the users of those analysis. On the contrary, in companies where the digitalization of tools has strengthened the relationship with the other corporate functions, the collaborative approach led to a different change on the perception of management accounting. In particular, Company A, C and E noted a better awareness of the role of management accountant from the other business areas which, in turn, are more proactive toward the control of their processes. According to the management accountant of Company A, the implementation of digital technologies, such as BI software, and the previously mentioned related effect of shortening the cultural distance among different corporate functions:

"*improve the understanding of what management accounting does, what it asks, and what it can give back. This has created a very strong awareness (of management accounting) in relation to how to use it and exploit the utility of it in order to reach the predefined objectives*" (management accountant – Company A).

Therefore, the relationship between management accounting and the other business functions is changed in terms of a better comprehension of the role of

management accountant. The adoption of digital instruments has generated a more collaborative business environment that helps business functions not only to have an in-depth knowledge of the informative needs of management accounting but also to understand the relevant contribution that this function can provide to the whole company. From this perspective, the digital technologies have enabled an enhancement in terms of the diffusion of the control culture through the whole organization, allowing to increase the relevance of the management accountant. Therefore, the use of the same digital tool and the previously mentioned "*common language*" that the BI provides, has made the other business functions more willing to provide information and data to the management accountant, recognizing his value for the whole organization. Another change that has been connected to the utilization of BI software regards the relationships with the IT department within business organizations. The majority of the sample companies (A, B, C, D) has attributed a particular attention to this kind of relationship, emphasizing the strong and intense link among these functions. In Company B, for instance, the boundaries between management accountant and IT manager, with few specific exceptions, have been defined as extremely blurred. This phenomenon detected in Company B represents a crucial starting point for further studies since it describes how the increasing digitalization in business organizations is currently starting to produce a change of the role of management accountant directed toward the IT world.

On the contrary, according to the Company A:

"*The real key to success was the big merger, the great alliance that has been created between the management accountant that must have clear in mind the model to which tend and the IT manager that has to codify the requirement, orienting towards the best technology*" (management accountant - Company A).

From this point of view, the relationship between the IT manager and the management accountant seems crucial in order to be able to implement a technology in an effective way. This perspective, however, seems to be opposite to the one of Company B, since the role of management accountant is clearly distinguished from the IT manager. Furthermore, according to this theory, it is the actual coordination of the two functions that can provide a greater advantage in the use of digital technologies.

Conclusions

The main aim of the thesis was to explore the effects of digitalization on management accounting. The empirical research conducted permitted to investigate several aspects of the impact of digitalization on management accounting, providing in some cases confirmations of the potential effects that the literature highlighted and in other cases new aspects that need further in-depth studies. The contribution of this research can be distinguished respectively in relation to the analysis of the effects on management accounting techniques, tasks and the implications for the skills and the role of management accountants. Although the sample size and the insights provided do not allow to generalize the results of the study, it can be stated that the results provide anyway a contribution in understanding the phenomenon under analysis. The object of this study represents a relevant topic on management accounting that needs further in-depth analysis and research from both a theoretical and business practice perspective. The previous chapters are focused on the digital technologies including Business Intelligence, Big Data Analytics, Cloud services, Internet of Things, Artificial Intelligence, social media and Blockchain. However, the research demonstrates that, within the sample, the digitalization on management accounting occurred only through the use of Business Intelligence. As a result, the contribution of this study is limited to the analysis of the effects of BI on management accounting because the business organizations analysed have implemented the other

technologies but not for management accounting purposes. This first aspect already defines the distance between the opportunities about the topic described on literature and the business practice. For instance, according to Rikhardsson and Yigitbasioglu (2018), Big Data and the possibility to analyse this vast amount of information rather than samples will generate transformations in the use of many management accounting techniques. Furthermore, Vasarhelyi et al., (2015) stated the due to the advancements of Big Data analytics, methods for current inventory, asset valuation, depreciation and valuation of intangibles will prove inadequate and obsolete or will have to change in the future. In addition to the improvement of data accuracy, the literature emphasizes also various benefits from the use of Big Data in management accounting, especially in terms of the expansion of scope, including both structured and unstructured data on the analysis (e.g., textual information). According to Liu and Vasarhelyi (2014) and Geddes (2020), this transformation should lead to a widening of management accounting monitoring techniques. However, this research demonstrates that the actual use of Big Data Analytics in management accounting is still not present in the business contexts of the participants because all the sample companies confirm that they do not use Big Data for management accounting purposes. Despite the advantages that Big Data can provide in terms of overcoming the shortage of data, the real-time dimension, the reduction of error or trustworthiness issues (Ibrahim et al., 2021), the interview research proves that management accounting techniques are

still based on structured internal data. Nevertheless, among the enterprises involved, Company E provides a new perspective in this regard: the expansion of scope that the management accountant of this company has referred to, instead of the use of Big Data, regards the inclusion of an "*operational control*". Although the focus of management accounting is usually considered of financial nature, in this context, the BI system has allowed to collect information, do predictive analysis and scenario analysis referring not to objects normally proper to management accounting, but to operational concepts typical of other business functions. However, the inclusion of new types of sources does not involve customer feedbacks, or insights from social media in the profitability analysis and cost behaviour analysis, as Davila (2019) suggests. They refer mainly to information coming from supply chain, logistics, or production departments. This difference between the expansion of sources of information that the literature suggests and the result of this study, represents a starting point for further research. In particular, since the current study demonstrates the inclusion in management accounting of "*operational control*" and new sources of information from supply chain, logistics or production departments, additional studies should consider how and why this source expansion can occur in business contexts. In addition, according to Ibrahim et al., (2021) the budgeting represents an important element of convergence with Big Data and management accounting techniques. On the contrary, the companies of the research confirm only the use of Business

Intelligence systems in the budgeting process. Regarding the latter, the research interviews demonstrates that the BI software improved not only the accuracy, the speed, the trustworthiness of the data but also the flexibility of data sharing among different business functions. Nevertheless, it can be stated that it is needed a further study in order to have an in-depth understanding of how budgeting is changed due to the use of BI, as the interview research had not explored specific features of the budgeting process transformation. Specifically, it is necessary to investigate what are the adaptations, the changes, the improvements and the criticalities that the use of BI in the budgeting process can entail. Another important benefit of the implementation of digital technologies that the literature highlights, regards data visualization. The BI visualization methods increase the flexibility of the information delivery, allowing users to present information in formats that suit their specific purposes (Cardinaels and Van Veen-Dirks, 2010; Rikhardsson and Yigitbasioglu, 2018). The easy visual way through which business metrics and KPIs are shown in BI dashboards enables the selection of the adequate visualization that fits the user and the task and also allows decision makers to quickly understand the organization's performance (Rikhardsson and Yigitbasioglu, 2018). According to Trigo et al. (2014), BI dashboards improve the interactivity and the autonomy of management accountant, who can easily choose what information should be put in the reports, performing analysis and scenario creation. In this regard, the companies interviewed claimed that, in fact, the

implementation of BI has improved the flexibility, the speed and the conciseness of reports. Moreover, the management accountants involved in this study have highlighted the need to adapt the presentation of the data in relation to the recipient. To fulfil this aim, BI software have provided more flexible and focused visualization techniques that have led to an enhancement of data presentation in terms of clearness, readability and comprehension. A further advantage connected to the implementation of BI systems that the analysis was able to capture, involves the information delivery and exchange within business organization. According to Bellucci and Manetti (2017), digital technologies may enable a faster and more comprehensive delivery information. The analysis performed allows to confirm this hypothesis because the companies involved have experienced a relevant improvement in terms of exchange of information among the different corporate functions. Specifically, with reference to the use of BI system, this study was able to identify an enhancement not only in terms of speed and visualization as the literature suggests, but also in term of ease of information distribution. Comparing the literature and the results of the research interviews, this facilitating function of BI tool for the information sharing represents an additional contribution that this study was able to provide. Its relevance is related to the fact that BI software not only speed up the delivery of information and provide a better data presentation but is also able to make the whole information exchange process more flexible. Therefore, it can be stated that, in addition to the above-mentioned studies about

the improvements in terms of speed of information and understandability of data visualization, this study was able to capture also the positive impact of BI on the information sharing. Moreover, the fact that through BI systems data are available to all business functions with less difficulty, entails a fluid and faster collaboration within the sample organizations. According to Nielsen (2018), new digital technologies, in order to generate value for the company, require an alignment between behaviours, values, outcomes from all the departments within the organization, determining a high level of interaction between management accounting and other corporate functions. In this regard, this study supports the Nielsen's findings (2018), identifying also a common strengthening of the relationship between management accounting and the other business areas. In addition, the interview analysis performed was able to provide a different interpretation of the Nielsen's study (2018), since it focuses on the relevance attributed to the coordination and cooperation among business functions. Considering the perspectives emerged in this research interview, the sample companies consider them as key essential elements to exploit the functionalities of the BI tools. Therefore, according to the management accountants interviewed, coordination and cooperation are the enabling factors that allows an effective use of BI software. Moreover, regarding the impact of BI on the coordination between actors, this study provides a new peculiar point of view. From the analysis, indeed, it emerges a new function of BI, embodying a coordination mechanism for

all actors involved in management accounting. This coordination ability is connected to the fact that BI facilitates the tasks organization through a technological infrastructure that automatically sets deadlines that all actors necessarily need to meet. Therefore, the BI tool generates a mechanism that thanks to the reduction of the human intervention in the time-consuming activities, improves the cooperation and coordination, avoiding also delays on information delivery. Despite these mentioned improvements connected with the BI implementation, the research interview performed captures also potential criticalities which are not highlighted in the literature. In particular, this study identifies the risk for management accountant to take a back seat or to be excluded from some specific analysis due to the implementation of BI software. The reason for this potential change lies on the "*self-service*" analysis that the BI tool provides also to other business functions. The BI system allows data availability through an easier, faster access to information and enhanced data visualization, thus, reducing the need to have frequent interactions between management accountant and the other business functions. Following this line of reasoning, the BI implementation can represent a threat for the role of information provider of the management accountant. Specifically, an easier access to information and data through the BI tools and the possibility to have better data visualizations can reduce the relevance of the management accountant within companies because of greater autonomy and self-management of data by the other business functions.

This phenomenon can generate negative consequences in relation to the potential exclusion of the management accountant and, as the literature suggests, this can lead to the absence of the overview across the organization and an objective 'big picture' perspective that, instead, he is able to provide (CIMA, 2016). Therefore, the effect of this potential change can deteriorate the management accountant's contribution to the whole organization, decreasing his/her relevance in helping the organization to translate data insights into company value. In relation, instead, to the position of management accounting during the digital transformation process, the perspective proposed by Oesterreich et al. (2019) in which it represents the change agent that plays a leading role in the transition is also confirmed by this research. Within the sample companies, the management accountant appears to play a central role on the implementation and the design of digital technologies. In particular, management accounting was described as the business function that promoted and was directly involved in the first phase of choosing, designing, implementing, controlling the BI tool and then, in improving its use. In addition, in the majority of the cases, the BI software were put in place to meet management accounting needs and objectives and, after the actual application in the business organization, they were extended to other business areas and functions. Moreover, a further element that this research was able to highlight regards the consideration of BI as the "*Trojan horse*" to get management accounting more interconnected and coordinated with new business functions.

Although from the literature review conducted this specific aspect does not emerge, this study identifies the BI software as the enabler for expanding the boundaries of management accounting. Specifically, in Company A the BI system was able to extend management accounting approaches and methods to the Supply Chain area, improving also the efficiency of management process and control activities to reduce wastes. An additional crucial aspect that the research detects involves the ability of BI to spread a culture of control throughout the business organization. This digital tool plays an essential role in diffusing a common control culture because it shortens the cultural distance among different corporate functions. According to this study, the reasons behind this phenomenon regard the use of the same digital instrument and the related previously mentioned "*common language*" for all the business functions, enabling a common information infrastructure for the different corporate areas. Following this perspective, the digitalization and in particular the BI implementation represents the enabler for a cultural revolution within business organizations, which need further in-depth studies. In addition, the research identifies a change of the relationship between management accounting and the other business functions in terms of a better comprehension of the role of management accountant. The adoption of BI software allows a more collaborative environment that helps business functions to be not only aware about the informative needs of management accounting but also to fully grasp the relevant contribution that this

function can provide to the whole organization. From this perspective, digital technologies and in particular the BI have changed the perception of the management accountant by improving its relevance and power in the company. Although several papers disclose that BI is able to support specific management accounting tasks, such as profitability analysis, planning and sustainability accounting (Petrini and Pozzebon, 2009; Kowalczyk and Buxmann, 2015; Bronzo et al., 2013; Marx et al., 2012), the business practice demonstrates only a lightening of repetitive, low value, labor and time-intensive activities mainly connected with the data extraction and processing from corporate management systems. Thus, in the sample companies, the implementation of current BI software is not advanced to a level that can replace specific and complex accounting tasks. Regarding the role of management accountant, AlAnsari et al. (2022) claim that, in order to succeed in the digital era, it is necessary an acquisition of high level of mastery and skills in technology field. This study proves the expansion of management accountant skills toward the world of digital technologies. All the companies surveyed witnessed a shift in digital skills in the role of the management accountant, highlighting how these are essential in order to exploit the opportunities of business intelligence software. However, it is important to clarify that, despite the acquisition of digital skills, the management accountant plays an active role in assisting IT personnel to choose the best match between the features of the BI&A system and the requirements of the users

(Rikhardsson and Yigitbasioglu, 2018). The analysis of the interviews has supported this perspective, not only identifying a strengthening of the relationship with the IT managers, but also identifying the role of management accountant as the information interpreter. Regarding the latter aspect, it can be stated that although the easier access to data and the enhanced data visualization of BI software have facilitated the information delivery between different business functions, they have also raised the issue about the actual understanding of the information. Therefore, in these business contexts the management accountant is responsible for explaining the data and spread the proper related information especially to functions that do not have accounting knowledge or expertise. The role of information interpreter emerged from the analysis represents another crucial element that does not come out from the literature review which needs in-depth studies. Moreover, referring to the interaction with IT department described by Rikhardsson and Yigitbasioglu (2018), the business contexts that this research has investigated confirm the role of management accountant as the professional figure that is able to collaborate intensively with the IT managers, defining the specific requirements that the digital instrument should possess. Furthermore, the research identifies not only a strengthening the relationship with the IT managers but was also capable to detect a direct effect of this change. As a matter of fact, the intense interconnection between these two functions has generated a shift of management accountant competencies toward specific IT skills. In addition to the

studies of the current literature about this change, this study suggests also the reason of this skills evolution. According to the sample companies, the rationale behind this change lies on the need for management accountant to be more aware of the features and functionalities of the BI tool in order to be able not only to manage and use it effectively but also to have more control over it. Furthermore, Company B defined the current boundaries between management accountant and IT as extremely blurred. This closeness with the IT world, which emerges from this interview research, represents an important element because it can potentially affect the future role of the management accountant and it constitutes an important starting point for further in-depth studies. Regarding the potential evolution of the role of the management accountant, several publications emphasize the importance to shape his professional identity in order to preserve and strengthen the business partner role (Oesterreich et al., 2019; Nielsen, 2018). From the study of Cavélius et al. (2020), the business partner role is strongly evident in the companies with digital processes already in place, where management accountants don't need to spend a lot of their time for data-collection tasks. The findings of this study confirm this result because the interviewees not only ascertain the increase of business partnering activities, but they also connect this phenomenon to the freed-up time that digital technologies have generated in terms of data processing and extraction tasks. The role of management accountant that emerges from the different business contexts analysed reflects what the literature suggests,

that is a combination of strategic, leadership skills and expertise in areas such as cost structures, profitability analysis, revenue streams and management control with the knowledge of the utilization of new digital technologies (Rikhardsson and Yigitbasioglu, 2018). In conclusion, it is crucial to clarify that, as Quattrone (2014) claims, digitalization by itself cannot drive change. Business Intelligence, in this specific case, should not be considered the only causal and powerful factor that generates the above-mentioned effects on management accounting techniques, tasks and skills. The changes that the companies of this study referred to, are the consequences not only of the implementation of digital tool, but they are the outcomes of decisions, values, behaviours that belongs to the more complex business processes. Business intelligence, in these specific business contexts, should be conceived as a stimulus, an accelerator, a catalyst of the transformations, improvements, adaptations that have been extensively discussed in this study. Despite the contributions that this research is able to provide, the study includes also some limitations. One of the limitations that affects the generalization of the results of the research is the sample size. Despite the choice of the interview participants includes managements accountants from different business organizations and this aspect represents a consistency element for the analysis of the phenomenon, the sample size does not allow to extent the outcomes of the research to other business contexts. Therefore, further studies about the topic should preferably include a larger sample for the analysis. The

limited contribution of this study to the effects of BI on management accounting can represent another constraint of the analysis. The fact that the research's results are mainly referred to the implementation of BI can be considered as an indirect consequence of the sample size, thus future studies which involve more business organizations could overcome this limitation. The research was able to explore several aspects of the phenomenon, providing confirmations of the literature knowledge and also new unexplored perspectives. However, a limit in terms of depth of analysis can emerge, as in order to fully grasp the results of this research it is needed to consider and analyse individually each new concept or emerged point of view. This can be carried out through single in-depth case studies. For instance, in relation to the effects of the management accounting techniques, it may be of interest of future studies investigating how the budgeting process is affected by the adoption of BI systems, since the research interviews did not allow to explore it with high degree of detail. The impact of BI on management accounting tasks should need also further studies in order to define additional potential changes that this technology is able to generate in the future. Regarding the role of the management accountant, the perceptions of the participants identify interesting points of view. In conclusion, this study allows to have a general overview of the impact of digitalization on management accounting, through the review of the current state of literature knowledge about the topic, and especially through an empirical analysis that provides interesting insights. Considering the

above-mentioned contributions, this thesis can represent a starting point that could extend the analysis in order to explore whether and how the influence of digitization on management accounting techniques, tasks and on the role and skills of management accountant could in turn have an impact also on corporate business models, i.e., how companies create, distribute and capture value (Osterwalder and Pigneur, 2010).

Bibliography

Abbas N., Asim M., Tariq N., Baker T., Abbas S. (2019), A mechanism for securing IoT-enabled applications at the fog layer, *Journal of Sensor and Actuator Networks*, Vol. 8 No. 1, pp. 1-18.

ACCA, IMA (2013), *Big data: Its Powers and Perils*, available at: https://www.accaglobal.com/gb/en/technical-activities/technical-resources-search/2013/december/big-data-its-power-and-perils.html

ACCA (2013), *Understanding investors: the road to real-time reporting*, available at: https://www.accaglobal.com/content/dam/acca/global/PDF-technical/financial-reporting/pol-afb-ui03.pdf

Agostino D., Sidorova Y. (2017), How social media reshapes action on distant customers: some empirical evidence, *Accounting, Auditing and Accountability Journal*, Vol. 30 No. 4, pp. 777-794.

Ahlmeyer M., Chircu A. M. (2016), Securing the internet of things: A review, *Issues in Information Systems*, Vol.17 No. 4, pp. 21-28.

Alalwan A. A., Rana N. P., Dwivedi Y. K., Algharabat R. (2017), Social media in marketing: A review and analysis of the existing literature, *Telematics and Informatics*, Vol. 34 No. 7, pp. 1177-1190.

AlAnsari A., Alqadhi B., Aljawder A., Abu Wadi R. (2022), Management Accounting in the Digital Era: Literature Review in Abdalmuttaleb M. A., Musleh

Al-Sartawi (edited by) *Artificial Intelligence for Sustainable Finance and Sustainable Technology*, first edition, Springer Cham, pp. 512-521.

Al-Htaybat K., von Alberti-Alhtaybat L. (2017), Big Data and corporate reporting: impacts and paradoxes, *Accounting, Auditing & Accountability Journal*, Vol.30 No. 4, pp. 850-873.

Andersen T. J. (2000), Strategic Planning, Autonomous Actions and Corporate Performance*, Long Range Planning*, Vol.33 No. 2, pp. 184-200.

Appelbaum D., Kogan A., Vasarhelyi M., Yan Z. (2017) Impact of business analytics and enterprise systems on managerial accounting, *International Journal of Accounting Information Systems*, Vol. 25, pp. 29-44.

Armitage H.M., Webb A., Glynn J. (2016), The use of management accounting techniques by small and medium-sized enterprises: a field study of Canadian and Australian practice, *Accounting Perspectives*, Vol.15 No.1, pp. 31-69.

Arnaboldi M., Azzone G., Sidorova Y. (2017a), Governing social media: the emergence of hybridised boundary objects, *Accounting, Auditing & Accountability Journal,* Vol. 30 No. 4, pp. 821-849.

Arnaboldi M., Busco C., Cuganesan S. (2017b) Accounting, accountability,social media and big data: revolution or hype? *Accounting, Auditing & Accountability Journal,* Vol. 30 No. 4, pp. 762-776.

Ashcroft P. (2005), Real-Time Accounting, *The CPA Journal*, Vol. 75 No. 4.

Askool S., Nakata K. (2011). A conceptual model for acceptance of social CRM systems based on a scoping study, *AI & Society*, Vol. 26, pp. 205-220.

Atkinson A.A., Kaplan R.S., Young S.M. (2011*), Management Accounting*, International Edition, Pearson Prentice Hall, Upper Saddle River, NJ.

Atrill P., McLaney E. (2009), *Management Accounting for Decision Makers*, sixth edition, Pearson Education Limited, Harlow, Essex.

Baerdemaeker J., Bruggeman W. (2015), The impact of participation in strategic planning on managers' creation of budgetary slack: The mediating role of autonomous motivation and affective organisational commitment, *Management Accounting Research*, Vol. 29, pp. 1-12.

Bagire V., Namada J. (2013), Managerial Skills, Financial Capability and Strategic Planning in Organizations, *American Journal of Industrial and Business Management*, Vol.3 No.5, pp. 480-487.

Baines A., Langfield-Smith K. (2003), Antecedents to management accounting change: a structural equation approach, *Accounting, Organizations and Society*, Vol. 28 No. 7, pp. 675-698.

Baird C. H., Parasnis G. (2011), From social media to social CRM: Reinventing the customer relationship, available at: https://www.emerald.com/insight/content/doi/10.1108/10878571111161507/full/html

Barro-Torres S., Fernndez-Carams T.M., Prez-Iglesias H.J., Escudero C.J. (2012), Realtime personal protective equipment monitoring system, *Computer Communications*, Vol. 36 No. 1, pp. 42–50.

Begkos C., Antonopoulou K. (2020), Measuring the unknown: Evaluative practices and performance indicators for digital platforms, *Accounting, Auditing and Accountability Journal*, Vol. 33 No. 3, pp. 588-619.

Bellucci M., Manetti G. (2017), Facebook as a tool for supporting dialogic accounting? Evidence from large philanthropic foundations in the United States, *Accounting, Auditing & Accountability Journal*, Vol. 30 No. 4.

Berg L.B., Lune H. (2012), *Qualitative Research Methods for the Social Sciences*, eighth edition, Pearson Education, United States of America.

Bergmann M., Brück C., Knauer T., Schwering A. (2020), Digitization of the budgeting process: determinants of the use of business analytics and its effect on satisfaction with the budgeting process, *Journal of Management Control*, Vol. 31 No. 3, pp. 25–54.

Bhimani A., Willcocks L. (2014), Digitisation, "Bigdata" and the transformation of accounting information, *Accounting Business Research*, Vol. 44 No. 4, pp. 469-490.

Bianchi C., Andrews L. (2015), Investigating marketing managers' perspectives, on social media in Chile, *Journal of Business Research,* Vol. 68 No. 12, pp. 2552-2559.

Blocher E.J., Stou D.E., Cokins G., (2012), *Cost Management: A Strategic Emphasis*, fifth edition, McGraw-Hill Irwin, NY.

Bogsnes B. (2016*), Implementing beyond budgeting: unlocking the performance potential*, second edition, John Wiley & Sons.

Boisot M., Child J. (1999), Organizations as adaptive systems in complex environments: the case of China, *Organization Science*, Vol. 10 No. 3, pp. 237-252.

Booth P., Matolcsy Z., Wieder B. (2000), The impacts of enterprise resource planning systems on accounting practice – the Australian experience, *Australian Accounting Review,* Vol. 10 No. 22, pp. 4-18.

Borgia E. (2014), The Internet of Things vision: Key features, applications and open issues*, Computer Communications*, Vol. 54, pp. 1-31.

Bose S., Dey S. K., Bhattacharjee S. (2022). Big Data, Data Analytics and Artificial Intelligence in Accounting: An Overview in Akter S., Wamba S.F. (edited by) *Handbook of Big Data Methods,* Edward Elgar Publishing, United Kingdom, pp. 1-34.

Boyd N., Gessner B. (2013), Human resource performance metrics: methods and processes that demonstrate you care, *Cross Cultural Management*, Vol. 20 No. 2, pp. 251-273.

Brignall S. (1997), A contingent rationale for cost system design in services, *Management Accounting Research,* Vol. 8 No. 3, pp. 325-346.

Bronzo M., de Resende P.T.V., de Oliveira M.P.V., McCormack K.P., de Sousa P.R., Ferreira R.L. (2013). Improving performance aligning business analytics with process orientation, *International Journal of Information Management,* Vol. 33 No. 2, pp. 300-307.

Bruhn M., Schoenmueller V., Schafer, D.B. (2012), Are social media replacing traditional media in terms of brand equity creation? *Management research review*, Vol. 35 No. 9, pp. 770-790.

Bruns W. J. (1968), Accounting Information and Decision-Making: Some Behavioral Hypotheses, *The Accounting Review*, Vol. 43 No. 3, pp. 469-480.

Brynjolfsson E., Rock D., and Syverson C. (2021), The productivity J-curve: How intangibles complement general purpose technologies, *American Economic Journal*, Vol. 13 No. 1, pp. 333-72.

Bullock L. (2017), *Big 4 Firm UPS Use of `Robots' in Audit Division*, available at: https://www.accountantsdaily.com.au/technology/10542-big-4-firm-utilising-robots-in-audit-division

Burns J., Baldvinsdottir G. (2005) An institutional perspective of accountants' new roles – the interplay of contradictions and praxis, *European Accounting Review*, Vol. 14 No 4, pp. 725-757.

Busco C., Quattrone P. (2015), Exploring how the balanced scorecard engages and unfolds: articulating the visual power of accounting inscriptions, *Contemporary Accounting Research*, Vol. 32 No. 3, pp. 1236-1262.

Busco C., Quattrone P., Riccaboni A. (2007), Management Accounting Issues in interpreting its nature and change, *Management Accounting Research*, Vol.18 No. 2, pp. 125-149.

Busco C., Riccaboni A., Scapens R.W. (2006) Trust for Accounting and Accounting for Trust, *Management Accounting Research*, Vol.17 No. 1, pp. 11-41.

Butz M.V. (2021), Towards Strong AI, *Künstliche Intelligenz*, Vol. 35, pp. 91-10.

Byström H. (2019), Blockchains, real-time accounting, and the future of credit risk modelling, *Ledger*, Vol. 4, pp. 40-47.

Buyya R., Broberg J., Goscinski A. (2011), *Cloud computing: Principles and paradigms*, John Wiley & Sons, Hoboken, New Jersey.

Caicedo M. H., Mårtensson M., Hallström K.T. (2018), The development of the management accountant's role revisited: An example from the Swedish Social Insurance Agency, *Financial Accontability & Management*, Vol.34 No. 3, pp. 240-251.

Cardinaels E., Labro E. (2008), On the determinants of measurement error in Time-Driven Costing, *The Accounting Review*, Vol.83 No. 3, pp. 735–756.

Cardinaels E., Van Veen-Dirks P.M.G. (2010) Financial versus Non-Financial Information: The Impact of Information Organization and Presentation in a Balanced Scorecard, *Accounting, Organizations and Society*, Vol. 35 No. 6, pp. 565-578.

Casino F., Dasaklis T.K., Patsakis C. (2019), A systematic literature review of blockchain-based applications: Current status, classification and open issues, *Telematics and Informatics,* Vol. 36, pp. 55-81.

Cavalieri S., Maccarrone P., Pinto R. (2004), Parametric vs. neural network models for the estimation of production costs: A case study in the automotive industry, *International Journal of Production Economics*, Vol. 91 No. 2, pp. 165-177.

Cavélius F., Endenich C., Zicari A. (2020) Back to basics or ready for take-off? The tensions on the role of management controllers in the digital age, *Comptabilité Contrôle Audit*, Tome 26, pp. 89-123.

Chaudhuri S., Dayal U., Narasayya V. (2011), An overview of Business Intelligence technology, *Communications of the ACM,* Vol. 54 No. 8, pp 88-98.

Chen H., Chiang R. H. L., Storey V. C. (2012), Business Intelligence and Analytics: From Big Data to Big Impact*, Management Information Systems Quarterly*, Vol. 36 No. 4, pp.1165-1188.

Chenhall R.H., Langfield-Smith K. (1998), Adoption and benefits of management accounting practices: an Australian study, *Management Accounting Research*, Vol. 9 No. 1, pp. 1-19.

Chiucchi M.S. (2012), Il *metodo dello studio di caso nel management accounting,* first edition, Giappichelli, Turin.

CIMA (2016), *Business Analytics and Decision Making*, available at: https://www.cimaglobal.com/Research--Insight/Business-analytics-and-decision-making/

Clohessy T., Treiblmaier H., Acton T.,Rogers N. (2020), Antecedents of blockchain adoption: An integrative framework, *Strategic Change*, Vol. 29 No. 5, pp. 501-515.

Cokins G. (2014). Mining the past to see the future, *Strategic Finance*, Vol. 96 No. 11, pp. 23–30.

Cokins G. (2017), *Strategic business management: From planning to performance*, first edition, John Wiley & Sons, New York.

Constantinides E. (2014), Foundations of social media marketing, *Procedia - Social and Behavioral Sciences,* Vol. 148, pp. 40-57.

Constantiou I.D., Kallinikos J. (2015), New games, new rules: big data and the changing context of strategy, *Journal of Information Technology*, Vol. 30 No. 1, pp. 44-57.

Conti M., Das S.K., Bisdikian C., Kumar M., Ni L.M., Passarella A., Roussos G., TrösterG., Tsudik G., Zambonelli F. (2012), Looking ahead in pervasive computing: challenges and opportunities in the era of cyber-physical convergence, *Pervasive and Mobile Computing*, Vol.8 No. 1, pp. 2-21.

Corbetta P. (2003), *La ricerca sociale: metodologia e tecniche, Paradigmi di riferimento*, Il mulino, Bologna.

Cormode G., Srivastava D. (2009), Anonymized data: Generation, models, usage, contribution presented at *Proceedings of the 2009 ACM SIGMOD International Conference on Management of Data*, New York, 29 June - 2 July 2009.

Craglia M., Hradec J., Troussard X. (2020), The Big Data and Artificial Intelligence: Opportunities and Challenges to Modernise the Policy Cycle, in Šucha V. And Sienkiewicz M. (edited by), *Science for Policy Handbook*, Elsevier Limited, European Union, pp. 96-103.

Cuganesan S., Dumay J. (2009), Reflecting on the production of intellectual capital visualisations, Accounting, *Auditing and Accountability Journal*, Vol. 22 No. 8, pp. 1161-1186.

Dahal R. K. (2019), Changing role of management accounting in 21st Century. *Review of Public Administration and Management*, Vol. 7 No. 3, pp. 1-8.

Davenport T. (1998), Putting the enterprise into the enterprise system, *Harvard Business Review,* Vol. 76 No. 4, pp. 121–131.

Davenport, T. H. (2006), Competing on Analytics, available at: https://hbr.org/2006/01/competing-on-analytics

Davenport T.H., Kim J. (2013), *Keeping up with the Quants,* Harvard Business Review Press, New York, NY.

Davenport T. H. (2013), *Analytics 3.0 Spotlight on Making Your Company Data-Friendly*, available at:

https://webcache.googleusercontent.com/search?q=cache:lCywDyjUC78J:https://

www.academia.edu/34657775/Spotlight_SpotligHt_on_Making_YouR_CoMpanY_Data_FRienDlY+&cd=2&hl=it&ct=clnk&gl=it

Davenport T.H. (2000), *Mission Critical: Realizing the Promise of Enterprise Systems*, Harvard Business School Press, Boston, MA.

Davila A. (2019), Emerging Themes in Management Accounting and Control Research, *Revista de Contabilidad - Spanish Accounting Review,* Vol. 22 No.1, pp. 1-5.

De Vass T., Shee H., Miah S. J. (2020), Iot in supply chain management: a narrative on retail sector sustainability, *International Journal of Logistics Research and Applications*, Vol. 24 No. 6, pp. 605-624.

Debreceny R. S. (2015), Social media, Social Networks, and Accounting, *Journal of Information Systems*, Vol. 29 No. 2, pp. 1-4.

Dennis R., Owen G., (2015) Rep on the block: A next generation reputation system based on the blockchain, contribution presented at *10th International Conference for Internet Technology and Secured Transactions*, London, 14-16 December 2015.

Desroches D., Lawson R. (2013), *Evolving Role of the Controller*, available at: https://docplayer.net/6156962-Evolving-role-of-the-controller.html

Diepeveen B., Matcher J., Lewkowicz B. (2016), *Robotic process automation. Automation's next frontier,* available at: https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/digital/ey-robotic-process-automation.pdf

Dilla W., Janvrin D.J., Raschke R. (2010), Interactive data visualization: new directions for accounting information systems research, *Journal of Information Systems*, Vol. 24 No. 2, pp. 1-37.

Dimitriua O., Matei M. (2014), A New Paradigm for Accounting through Cloud Computing, *Procedia Economics and Finance*, Vol. 15, pp. 840-846.

Djatna T., Munichputranto F. (2015), An Analysis and Design of Mobile Business Intelligence System for Productivity Measurement and Evaluation in Tire Curing Production Line, *Procedia Manufacturing*, Vol. 4, pp. 438-444.

Dossi A., Meloni G. (2021), Nel controllo di gestione l'obiettivo è allineare misure e strategie, *Economia & management Online*, No. 4, pp. 68-73.

Drath R., Horch A. (2014), Industrie 4.0: Hit or Hype? *IEEE Industrial Electronics Magazine,* Vol. 8 No. 2, pp. 56–58.

Drummond C., McGrath H., O'Toole T. (2018), The impact of social media on resource mobilisation in entrepreneurial firms, *Industrial Marketing Management,* Vol. 70, pp. 68-89.

Drummond C., O'Toole T., McGrath H. (2022), Social Media resourcing of an entrepreneurial firm network: Collaborative mobilisation processes, *Journal of Business Research*, Vol. 145, pp. 171-187.

Duan L., Xiong Y. (2015), Big data analytics and business analytics, *Journal of Management Analytics*, Vol. 2 No. 1, pp. 1-21.

Dumeresque D. (2014), The chief digital officer: bringing a dynamic approach to digital business, *Strategic Direction*, Vol. 30 No. 1, pp. 1-3.

Eggert M., Alberts J. (2020), Frontiers of business intelligence and analytics 3.0: a taxonomy-based literature review and research agenda*, Business Research*, Vol. 13, pp. 685-739.

Eggert M. (2019) *Big Data Research—How to Structure the Changes of the Past Decade?* available at: https://www.researchgate.net/publication/330648347_Big_Data_Research-How_to_Structure_the_Changes_of_the_Past_Decade_Bridging_the_Gap_Between_Information_Systems_Research_and_Practice

Elkmash M.R.M., Abdel-Kader M.G., Badr El-Din B., (2021), An experimental investigation of the impact of using big data analytics on customers' performance measurement, *Accounting Research Journal,* Vol. 35 No. 1, pp. 37-54.

Emami-Naeini P., Agarwal Y., Cranor L.F. (2021), *Comments on "Establishing confidence in IoT device security: how do we get there?"* available at: https://iotsecurityprivacy.org/downloads/NIST_Label_Comments.pdf

Emmanuel C.R., Otley D.T., Merchant K.A. (1990), *Accounting for Management Control,* second edition, Chapman and Hall, London.

Esposito C., De Santis A., Tortora G., Chang H., Choo K.K.R. (2018), Blockchain: A panacea for healthcare cloud-based data security and privacy? *IEEE Cloud Computing*, Vol. 5 No. 1, pp. 31-37.

Etter M., Ravasi D., Colleoni E. (2019), Social Media and the Formation of Organizational Reputation, *Academy of Management Review*, Vol. 44 No. 1, pp. 28-52.

Fanning K., Centers D.P. (2016), Blockchain and its coming impact on financial services, *Corporate Accounting and Finance*, Vol. 27 No. 5, pp. 53-57.

Farooq U.,Tariq N., Asim M., Baker T., Al-Shamma'a A. (2022) Machine learning and the Internet of Things security: Solutions and open challenges, *Journal of Parallel and Distributed Computing*, Vol. 162, pp. 89-104.

Field J., Chelliah J. (2012), Social-media misuse a ticking time-bomb for employers: robust policies and procedures needed to reduce the risks, *Human Resource Management International Digest*, Vol. 20 No.7, pp. 36-3.

Fisher J.G., Maines L.A., Peffer S.A., Sprinkle G.B. (2002), Using budgets for performance evaluation: Effects of resource allocation and horizontal information asymmetry on budget proposals, budget slack, and performance, *Accounting Review*, Vol. 77 No. 4, pp. 847-865.

Forbes (2019), *IBM Tech Trends To Watch In 2020 … And Beyond*, available at: https://www.forbes.com/sites/ibm/2019/12/09/ibm-tech-trends-to-watch-in-2020--and-beyond/?sh=3e39b2994c1c

Fortune Business Insights (2021), *Cloud Computing Market to Hit USD 791.48 Billion by 2028*, available at: https://www.globenewswire.com/news-release/2021/08/11/2278451/0/en/Cloud-Computing-Market-to-Hit-USD-791-48-

Billion-by-2028-Rising-Demand-for-Improved-Virtual-Access-to-Information-among-Industries-to-Foster-Steady-Growth-Fortune-Business-Insights.html

Fraccastoro S., Gabrielsson M., Chetty, S. (2021), Social media firm specific advantages as enablers of network embeddedness of international entrepreneurial ventures, *Journal of World Business,* Vol. 56 No. 3.

Fuller S.H., Markelevich A. (2019), Should accountants care about blockchain? *Corporate Accounting & Finance*, Vol. 31 No. 2, pp. 34-46.

Furman J., Seamans R. (2019), AI and the economy. *Innovation Policy and the Economy*, Vol. 19, pp. 161-191.

Gad A.G., Mosa D. T., Abualigah L., Abohany A. A. (2022), Emerging Trends in Blockchain Technology and Applications: A Review and Outlook, *Journal of King Saud University - Computer and Information Sciences.*

Gaidienė Z., Skyrius R. (2006), The usefulness of management accounting information: user's attitudes, *Ekonomika*, Vol. 74, pp. 21-37.

Gamboa A.M. Goncalves H.M. (2014), Customer loyalty through social networks: lessons from Zara on Facebook, *Business Horizons*, Vol. 57 No. 6, pp. 709-717.

Garrison R. H, Noreen E.W., Brewer P.C. (2018), *Managerial Accounting*, sixteenth edition, McGraw-Hill Education, New York.

Gärtner B., Hiebl M.R. (2018), Issues with big data in Quinn M., Strauss E. (edited by) *The Routledge Companion to Accounting Information Systems*, first edition, Routledge, London, pp. 161-172.

Geddes B.H. (2020), Emerging Technologies in Management Accounting, *Journal of Economics and Business*, Vol. 3 No. 1, pp. 152-159.

Ghosh A., Chakraborty D., Law A. (2018), Artificial intelligence in Internet of things, *CAAI Transactions on Intelligence Technology*, Vol. 3 No. 4, pp. 208-218.

Ghosh A., Mishra N.S., Ghosh S. (2011), Fuzzy clustering algorithms for unsupervised change detection in remote sensing images, *Information Sciences*, Vol. 181 No. 4, pp. 699-715.

Gianfrancesco M.A.,Tamang, S. Yazdany J., Schmajuk G. (2018), Potential Biases in Machine Learning Algorithms Using Electronic Health Record Data, *JAMA internal medicine*, Vol. 178 No. 11, pp. 1544-1547.

Gietzmann M., Grossetti F. (2021), Blockchain and other distributed ledger technologies: Where is the accounting? *Journal of Accounting and Public Policy*, Vol. 40 No. 5.

Goddard K., Roudsari A.,Wyatt, J. C. (2012), Automation bias: A systematic review of frequency, effect mediators, and mitigators, *Journal of the American Medical Informatics Association*, Vol. 19 No.1, pp. 121-127.

Granlund M., Lukka K. (1997), From bean-counters to change agents: the Finnish management accounting culture in transition, *The Finnish Journal of Business Economics*, Vol. 3, pp. 213-255.

Granlund M., Malmi T. (2002), Moderate impact of ERPS on management accounting: a lag or permanent outcome? *Management Accounting Research*, Vol. 13 No. 3, pp. 299-321.

Granlund M., Mouritsen J. (2003), Special section on management control and new information technologies, *European Accounting Review*, Vol. 12 No. 1, pp.77-83.

Gruber D.A., Smerek R.E., Thomas-Hunt M.C., James E.H. (2015), The real-time power of Twitter: crisis management and leadership in an age of social media, *Business Horizons,* Vol. 58 No.2, pp. 163-172.

Gul F.A. (1991), The effects of management accounting systems and environmental uncertainty on small business managers' performance, *Accounting and Business Research*, Vol. 22 No. 85, pp. 57-61.

Gullberg C. (2016), What makes accounting information timely? Qualitative Research, *Accounting & Management*, Vol. 13 No. 2, pp. 189-215.

Gupta A., Prabhat P., Sawhney S., Gupta R., Tanwar S., Kumar N., Shabaz, M. (2022), Robotic Process Automation use cases in academia and early implementation experiences, *IET Software*, pp.1-10.

Haefliger S., Monteiro E., Foray D., von Krogh G. (2011), Social software and strategy, *Long Range Planning*, Vol. 44 No. 5-6, pp. 297-316.

Hansen S. C., Otley D., Van der Stede W. A. (2003). Practice Developments in Budgeting: An Overview and Research Perspective. *Journal of Management Accounting Research*, Vol. 15 No.1, pp. 95-116.

Hansen S.C. (2011), A theoretical analysis of the impact of adopting rolling budgets, activity-based budgeting and beyond budgeting, *European Accounting Review*, Vol. 20 No. 2, pp. 289-319.

Hayes B. (2008), Cloud computing, *Communications of the ACM*, Vol. 51 No. 7, pp. 9-11.

Homburg C. (2001), A note on optional cost driver selection in ABC, *Management Accounting Research*, Vol. 12 No. 2, pp. 197-205.

Hopper T. (1980), Role conflicts of management accountants and their position within organisation structures, *Accounting, Organizations and Society*, Vol. 5 No. 4, pp. 401-411.

Hopper T., Northcott D., Scapens R. (2007) *Issues in Management Accounting*, third edition, Prentice Hall, Germania.

Horlach B., Drews P., Schirmer I. (2016), Bimodal IT: Business-IT Alignment in the Age of Digital Transformation, contribution presented at *MKWI conference*, Ilmenau, 9-11 March 2016.

Hossain E., Khan I.,Un-Noor F., Sikander S.S., Sunny M.S.H. (2019), Application of big data and machine learning in smart grid, and associated security concerns: a review, *IEEE Access*, Vol. 7, pp. 13960-13988.

Hu X., Liu H. (2012), Text analytics in social media, in Aggarwal C.C., Zhai C. X., *Mining text data,* Springer, New York, pp. 385-414.

Iansiti M., Lakhani K. R. (2017). *The truth about blockchain*, available at: https://enterprisersproject.com/sites/default/files/the_truth_about_blockchain.pdf

IBM report (2021), *5 trends for 2022 and beyond. Building persistence, resilience, and a sense of purpose*, available at: https://www.ibm.com/thought-leadership/institute-business-value/report/business-technology-trends-2022

IBM Research Insight, (2021), *Cloud's next leap - How to create transformational business value,* available at: https://www.ibm.com/thought-leadership/institute-business-value/report/cloud-transformation

Ibrahim A.E.A., Elamer A. A., Ezat A. N. (2021), The convergence of big data and accounting: innovative research opportunities, *Technological Forecasting & Social Change*, Vol. 173.

IMA (2008), *Statements on Management Accounting*, available at https://www.imanet.org/insights-and-trends/statements-on-management-accounting?ssopc=1

Institute of Chartered Accountants in England and Wales (ICAEW) (2014), *Big data and Analytics- What's New*, available at: https://charteredaccountantsworldwide.com/wp-content/uploads/2018/07/what-is-new-about-big-data-v2-2.pdf

International Federation of Accountants (IFAC) (2002), *Competency profiles for management accounting practice and probationers*, International Federation of Accountants, New York.

Iqbal M.A., Hussain S., Xing H., Imran M. (2020), Internet of Things (IoT) Fundamentals in Iqbal M.A., Hussain S., Xing H., Imran M. (edited by) *Enabling the Internet of Things: Fundamentals, Design, and Applications,* first edition, John Wiley & Sons, Hoboken, NJ, pp. 1-28.

Janvrin D., Mascha M.F. (2014), The financial close process: implications for future research, *International Journal of Accounting Information Systems,* Vol. 15 No. 4, pp. 381-399.

Järvenpää M. (2007), Making Business Partners: A Case Study on how Management Accounting Culture was Changed, *European Accounting Review*, Vol. 16 No.1, pp. 99-142.

Jeacle I., Carter C. (2014), Creative spaces in interdisciplinary accounting research, *Accounting, Auditing & Accountability Journal,* Vol. 27 No. 8, pp. 1233-1240.

Jia Z. (2019), The Impact of the Arrival of the Big Data Era on Accounting Work, contribution presented at the *IOP Conference Series: Materials Science and Engineering*, Shanghai, 30-31 December 2019.

Kaplan A., Haenlein K. (2010), Users of the world, unite! The challenges and opportunities of Social Media, *Business Horizons*, Vol. 53 No. 1, pp. 59-68.

Kaplan R. S. (1995), New roles for management accountants, *Journal of Cost Management*, Vol. 9 No. 3, pp. 6-13.

Kaplan, A., Haenlein, M. (2019), Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence, *Business Horizons*, Vol. 62 No.1, pp. 15-25.

Khanom T. (2017), Cloud Accounting: A Theoretical Overview, *IOSR Journal of Business and Management,* Vol. 19 No. 6, pp. 31-38.

Khedr A.E., Abdel-Fattah M.A., Solayman M. M. (2015), Merging Balanced Scorecards and Business Intelligence Techniques: An Applied case on the IT Subsidiary Company in the Egyptian Civil Aviation, *International Journal of Computer Applications*, Vol. 121 No. 11, pp. 26-51.

Kietzmann J.H., Hermkens K., McCarthy I.P., Silvestre B.S. (2011), Social media? Get serious! Understanding the functional building blocks of social media, *Business Horizons*, Vol. 54 No. 3, pp. 241-251.

Kim K-J., Han I. (2003), Application of a hybrid genetic algorithm and neural network approach in activity-based costing, *International Research Journal of Applied and Basic Sciences*, Vol. 24 No.1, pp. 73-77.

Kloock J., Schiller U. (1997), Marginal costing: cost budgeting and cost variance analysis, *Management Accounting Research*, Vol. 8 No. 3, pp. 299-323.

Knudsen D-R. (2020), Elusive boundaries, power relations, and knowledge production: A systematic review of the literature on digitalization in accounting, *International Journal of Accounting Information Systems*, Vol. 36.

Kokina J., Blanchette S. (2019), Early evidence of digital labor in accounting: Innovation with Robotic Process Automation, *International Journal of Accounting Information Systems*, Vol. 35.

Kokina J., Mancha R., Pachamanova D. (2017), Blockchain: Emergent industry adoption and implications for accounting, *Journal of Emerging Technologies in Accounting*, Vol. 14 No. 2, pp. 91-100.

Korhonen T., Selos E., Laine T., Suomala P. (2021), Exploring the programmability of management accounting work for increasing automation: an interventionist case study, *Accounting, Auditing & Accountability Journal*, Vol. 34 No. 2, pp. 253-280.

Kostoff R.N., Boylanb R., Simons G. R. (2004), Disruptive technology roadmaps, *Technological Forecasting and Social Change*, Vol. 71 No. 1-2, pp. 141-159.

Kowalczyk M., Buxmann P. (2015), An ambidextrous perspective on business intelligence and analytics support in decision processes: insights from a multiple case study, *Decision Support Systems,* Vol. 80, pp. 1-13.

KPMG, ACCA (2015), *Planning, Budgeting and Forecast – an Eye on the Future*, available at: https://www.accaglobal.com/an/en/technical-

activities/technical-resources-search/2015/july/kpmg-acca-thought-leadership-report.htm.html

Kreitner R., Cassidy C.M. (2012), *Managemen*t, twelve edition, Cengage Learning, South Western.

Krippendorff K. (1980), *Content Analysis: An Introduction to its Methodology*, Sage Publications, London.

Kshetri N. (2018), Blockchain's roles in meeting key supply chain management objectives, *International Journal of Information Management*, Vol. 39, pp. 80-89.

Kvale S., Brinkmann S. (2009), *Interviews Learning the Craft of Qualitative Research Interviewing*, second edition, Sage Publications, Thousand Oaks, California.

Lacoste S. (2016), Perspectives on social media ant its use by key account managers, *Industrial Marketing Management,* Vol. 54, pp. 33-43.

Lambert C., Sponem S. (2012), Roles, Authority and Involvement of the Management Accounting Function: A Multiple Case-study Perspective*, European Accounting Review*, Vol. 21 No. 3, pp. 565-589.

Langfield-Smith K., Thorne H., Hilton R. (2005), *Management Accounting: Information For Managing and Creating Value*, fourth edition, McGraw-Hill-Irwin, Sydney.

Lawson R. (2019), *Management Accounting Competencies: Fit for Purpose in a Digital Age?* Available at: https://www.imanet.org/insights-and-trends/the-future-

of-management-accounting/management-accounting-competencies---fit-for-purpose-in-a-digital-age?ssopc=1

Leão P., da Silva M. M. (2021), Impacts of digital transformation on firms' competitive advantages: A systematic literature review, *Strategic Change*, Vol. 30 No. 5, pp. 421-441.

Le Clair C. (2017), *Inquiry spotlight: Forrester's RPA inquiries reveal activity but low maturity*, Forrester.

Lee I., Sokolsky O. (2010), Medical cyber physical systems, contribution presented at *47th Design Automation Conferenc*e, Anaheim, 13-18 June 2010.

Lee J.H., Park S.C. (2005), Intelligent profitable customers segmentation system based on business intelligence tools, *Expert Systems with Applications*, Vol. 29, pp. 145-152.

Li F., Larimo J., Leonidou, L. C. (2021), Social media marketing strategy: Definition, conceptualization, taxonomy, validation, and future agenda, *Journal of the Academy of Marketing Science*, Vol. 49, pp. 51-70.

Libby T, Lindsay R. M. (2010), Beyond Budgeting or Budgeting Reconsidered? A Survey of North-American Budgeting Practice, *Management Accounting Research*, Vol. 21 No. 1, pp. 56-75.

Liu Q., Vasarhelyi M. A. (2014), Big Questions in AIS Research: Measurement, Information Processing, Data Analysis, and Reporting, *Journal of Information Systems,* Vol. 28 No. 1, pp. 1-17.

Luckett P.F., Eggleton I.R. (1991), Feedback and management accounting: A review of research into behavioural consequences, *Accounting, Organizations and Society*, Vol. 16 No. 4, pp. 371-394.

Lukka K. (1998), Total accounting in action: reflections on Sten Jo¨nsson's Accounting for Improvement, *Accounting, Organizations and Society,* Vol. 23 No. 3, pp. 333-342.

Macintosh N. B., Quattrone, P. (2010). *Management accounting and control systems: An organizational and sociological approach*, second edition, John Wiley & Sons Ltd, Chichester.

Mahesh B. (2019), Machine Learning Algorithms - A Review, available at: https://www.researchgate.net/publication/344717762_Machine_Learning_Algorithms_-A_Review

Maisel L., Cokins G. (2014), *Predictive Business Analytics: Forward Looking Capabilities to Improve Business Performance*, first edition, John Wiley & Sons, New York.

Malmi T. (2001), The practice of management accounting in Finland – a change? *The Finnish Journal of Business Economics*, Vol. 4, pp. 480-501.

Mancini D., Dameri R.P., Bonollo E. (2016) Looking for synergies between accounting and information technologies in Mancini D., Dameri R.P. and Bonollo E., *Strengthening Information and Control Systems,* Springer, Cham, pp.1-12.

Manea D. (2012), *The evolution of managerial accounting*, available at: https://ideas.repec.org/a/fmb/journl/v16y2012i2p226-231.html

Marchi L., Marasca S., Chiucchi M.S. (2018), *Controllo di Gestione,* Giappichelli Editore.

Marston S., Li Z., Bandyopadhyay S., Zhang J., Ghalsasi A. (2011), Cloud computing - The business perspective, *Decision Support Systems*, Vol. 51 No. 1, pp. 176-189.

Marx F., Lahrmann G., Winter R. (2010), *Aligning corporate planning and business intelligence: a combined maturity model*, available at: https://scholar.google.it/scholar?q=Aligning+corporate+planning+and+BI:+towards+a+combined+maturity+model.&hl=it&as_sdt=0&as_vis=1&oi=scholart

Marx F., Wortmann F., Mayer J. (2012), A maturity model for management control systems - five evolutionary steps to guide development, *Business & Information Systems Engineering,* Vol. 4, pp. 193-207.

McCurdy C., Thompson S., Fisher L., Parham G. (2021), *Getting started with zero trust security A guide for building cyber resilience*, available at: https://ibm.co/zero-trust-security

McKinsey Global Institute, (2013) *Disruptive technologies: advances that will transform life, business, and the global economy, Executive Summary*, available at: https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/disruptive-technologies

Mell P., Grance T. (2011), *The NIST Definition of Cloud Computing*, available at: https://csrc.nist.gov/publications/detail/sp/800-145/final

Merchant K.A., VanderStede W.A. (2003), *Management Control Systems: Performance Measurement, Evaluation and Incentives*, Prentice Hall, Harlow.

Meske C., Bunde E., Schneider J., Gersch, M. (2022), Explainable artificial intelligence: objectives, stakeholders, and future research opportunities, *Information Systems Management*, Vol. 39 No. 1, pp. 53-63.

Mihalache A. (2011), Cloud Accounting, *Ovidius University Annals - Economic Sciences Series*, Vol. 11 No. 2, pp. 782-787.

Mikut R., Reischl M. (2011), Data mining tools, *Wiley interdisciplinary reviews: data mining and knowledge discovery*, Vol. 1 No. 5, pp. 431-443.

Milana C., Ashta A. (2021), Artificial intelligence techniques in finance and financial markets: A survey of the literature, *Strategic Change*, Vol. 30 No. 3, pp. 189-209.

Miller G.S., Skinner D.J. (2015), The Evolving Disclosure Landscape: How Changes in Technology, the Media, and Capital Markets Are Affecting Disclosure, *Journal of Accounting Research,* Vol. 53 No. 2, pp. 221-239.

Minoli D., Occhiogrosso B. (2019), Practical aspects for the integration of 5G networks and IoT applications in smart cities environments, *Wireless Communications and Mobile Computing*.

Moffitt K., Vasarhelyi M. A. (2013), AIS in an age of big data, *Journal of Information Systems*, Vol. 27 No. 2, pp. 1–19.

Moll J., Yigitbasioglu O. (2019), The role of internet-related technologies in shaping the work of accountants: New directions for accounting research, *The British Accounting Review*, Vol. 51 No. 6.

Möller K., Schäffer U., Verbeeten F. (2020), Digitalization in management accounting and control: an editorial, *Journal of Management Control*, Vol. 31, pp. 1-8.

Muller O., Junglas I., Brocke J.V., Debortoli S. (2016), Utilizing Big data analytics for information systems research: Challenges, promises and guidelines, *European Journal of Information Systems*, Vol. 25 No. 4, pp. 289–302.

Nair M. (2011), Understanding and measuring the value of social media, *Journal of Corporate Accounting & Finance*, Vol. 22 No. 3, pp. 45-51.

Nakamoto S. (2008) Bitcoin: A Peer-to-Peer Electronic Cash System, *Decentralized Business Review*.

Negash S.,Gray, P. (2008),Business intelligence in Burstein F., Holsapple C. (edited by) *Handbook on decision support systems 2,* Springer, Berlin, Heidelberg, pp. 175-193.

Nielsen S. (2015), *The Impact of Business Analytics on Management Accounting*, available at: http://dx.doi.org/10.2139/ssrn.2616363

Nespeca A., Chiucchi M.S. (2018), The Impact of Business Intelligence Systems on Management Accounting Systems: The Consultant's Perspective in Lamboglia R., Cardoni A., Dameri R.P., Mancini D. (edited by) *Network, smart and open*, first edition, Springer Cham, pp. 283-297.

Nielsen S. (2018), Reflections on the applicability of business analytics for management accounting – and future perspectives for the accountant, *Journal of Accounting & Organizational Change*, Vol. 14 No. 2, pp. 167-187.

Nilsson F., Olve N.G., Parment A. (2011), *Controlling for competitiveness: Strategy formulation and implementation through management control*, Copenhagen Business School Press, Copenhagen.

Obermayer N., Kovari E., Leinonen J., Bak G., Valeri M. (2022), How social media practices shape family business performance: the wine industry case study, *European Management Journal,* Vol. 40 No. 3, pp. 360-371.

Odera P. A. (2014), *Factors Influencing Strategic Planning Process by Major Sugar Producing Firms in Kenya*, available at: http://erepository.uonbi.ac.ke/bitstream/handle/11295/75814/Odera_Factors+influencing+strategic+planning+process+by+major+sugar+producing+firms+in+Kenya.pdf?sequence=1

Oesterreich T. D., Teuteberg F. (2019), The role of business analytics in

the controllers and management accountants' competence profiles. An exploratory study on individual-level data, *Journal of Accounting & Organizational Change*, Vol. 15 No. 2, pp. 330-356.

Oesterreich T. D., Teuteberg F., Bensberg F., Buscher G. (2019), The controlling profession in the digital age: Understanding the impact of digitisation on the controller's job roles, skills and competences, *International Journal of Accounting Information Systems*, Vol. 35, Issue C.

Olanrewaju A-S.T., Hossain M. A., Whiteside N., Mercieca P. (2020), Social media and entrepreneurship research: A literature review, *International Journal of Information Management*, Vol. 50, pp. 90-110.

O'Leary D.E. (2017), Configuring blockchain architectures for transaction information in blockchain consortiums: The case of accounting and supply chain systems, *Intelligent Systems in Accounting, Finance and Management*, Vol. 24 No. 4, pp. 138-147.

Osterwalder A., Pigneur Y. (2010), *Business model generation: Business model generation: a handbook for visionaries, game changers, and challengers*, John Wiley & Sons.

Panarello, A., Tapas N., Merlino G., Longo F., Puliafito A. (2018), Blockchain and iot integration: A systematic survey, *Sensors*, Vol. 18 No. 8.

Paolini A. Chiucchi M.S., Gatti M. (2020), *I sistemi di pianificazione e controllo della gestione, Controllo di gestione. Pianificazione, programmazione e reporting*, Giappichelli, Italia.

Park K.J., Zheng R., Liu X. (2012), Cyber-physical systems: milestones and research challenges, *Computer Communications*, Vol. 36 No. 1, pp. 1-7.

Patton M.Q. (1990), *Qualitative Evaluation and Research Methods*, second edition, Sage Publications, Beverly Hills, CA.

Paulsson G. (2012), The role of management accountants in new public management, *Financial Accountability & Management*, Vol. 28 No. 4, pp. 378-394.

Payne R. (2014), Discussion of 'Digitisation, 'Bigdata' and the transformation of accounting information' by Alnoor Bhimani and Leslie Willcocks*, Accounting and Business Research*, Vol. 44 No. 4, pp. 491-495.

Peng J., Viator R.E., Buchheit S. (2007), An experimental study of multidimensional hierarchical accounting data: drill-down paths can influence economic decisions, *Journal of Information Systems*, Vol. 21 No. 2, pp. 69-86.

Perera S., Harrison G., Poole M. (1997), Customer-focused manufacturing strategy and the use of operations-based non-financial performance measures: a research note, *Accounting, Organizations and Society*, Vol. 22 No. 6, pp. 557-572.

Petrini M., Pozzebon M. (2009), Managing sustainability with the support of business intelligence: integrating socio-environmental indicators and

Organisational context, *The Journal of Strategic Information Systems*, Vol. 18 No. 4, pp. 178-191.

Phillips J. (2013), *Building a Digital Analytics Organization: Create Value by Integrating Analytical Processes, Technology, and People into Business Operations*, Pearson Education, Upper Saddle River, New Jersey.

Pickard M. D., Cokins G. (2015), From bean counters to bean growers: Accountants as data analysts—A customer profitability example, *Journal of Information Systems*, Vol. 29 No. 3, pp. 151-164.

Poovendran R. (2010), Cyber-physical systems: close encounters between two parallel worlds (point of view), *Proceedings of IEEE*, Vol. 98 No. 8, pp. 1363-1366.

Porter M. E. Heppelmann J. E. (2014b), How smart, connected products are transforming competition, Harvard business review, Vol. 92 No. 11, pp. 64-88.

Porter M.E., Heppelmann J.E. (2014a), *How smart, connected products are transforming companies*, available at: https://hbr.org/2015/10/how-smart-connected-products-are-transforming-companies

Quattrone P. (2016), Management accounting goes digital: will the move make it wiser? *Management Accounting Research,* Vol. 31, pp. 118-122.

Qu S. Q., Dumay J. (2011), Qualitative research interview, *Qualitative Research in Accounting & Management*, Vol. 8 No. 3, pp. 238-264.

Redden J. (2018), Democratic governance in an age of datafication: Lessons from mapping government discourses and practices, *Big Data & Society*, Vol. 5 No. 2.

Richins G., Stapleton A., Stratopoulos T.C., Wong C. (2017), Big data Analytics: Opportunity or Threat for the Accounting Profession, *Journal of Information Systems*, Vol. 31 No. 3, pp. 63-79.

Rikhardsson P., Yigitbasioglu O. (2018), Business intelligence & analytics in management accounting research: Status and future focus, *International Journal of Accounting Information Systems*, Vol. 29, pp. 37-58.

Risius M., Spohrer K. (2017), Blockchain Research Framework. What We (don't) Know, Where We Go from Here, and How We Will Get There, *Business & Information Systems Engineering*, Vol. 59 No. 6, pp. 385-409.

Rom A., Rohde C. (2007), Management accounting and integrated information systems: a literature review, *International Journal of Accounting Information Systems*, Vol. 8 No. 1, pp. 40-68.

Rout J. K., Choo K.K.R., Dash A. K., Bakshi S.,Jena S. K.,Williams K. L. (2018), A model for sentiment and emotion analysis of unstructured social media text, *Electronic Commerce Research*, Vol. 18, pp. 181–199.

Russell K.A., Siegel G. H., Kulesza C.S. (1999), Counting More, Counting Less – Transformations in the Management Accounting Profession, *Strategic Finance*, Vol. 81 No. 3.

Rust R.T. Huang M.H. (2014), The service revolution and the transformation of marketing science, *Marketing Science*, Vol. 33 No. 2, pp. 206-221.

Sallam R. L., Richardson J., Hagerty J., Hostmann B. (2011), *Magic Quadrant for Business Intelligence Platforms, Gartner RAS Core Research Note*, available at: https://cdn2.hubspot.net/hubfs/2718528/Infrastone-Dec2016/PDF/2011%20Business%20Intelligence%20Platform%20Magic%20Quadrant.pdf?t=1495020659585

Santos M. Y., Oliveira J., Sá, Andrade C., Vale Lima F., Costa E., Costa C., Martinho B., Galvão J. (2017), A Big Data system supporting Bosch Braga Industry 4.0 strategy, *International Journal of Information Management*, Vol. 37 No. 6, pp. 750-760.

Scapens R.W., Jazayeri M. (2003), ERP Systems and Management Accounting Change: Opportunities or Impacts? A Research Note. *European Accounting Review*, Vol. 12 No. 1, pp. 201-233.

Schäffer U., Gaensslen S., Losbichler H., Rieder L. (2013), The Essence of Controlling - The perspective of the Internationaler Controller Verein (ICV) and the International Group of Controlling (IGC), *Journal of Management Control*, Vol. 23 No. 4, pp. 311-317.

Schaupp L. C., Be´langer F. (2014), The Value of Social Media for Small Businesses, *Journal of Information Systems*, Vol. 58 No. 1, pp. 187-207.

Seal W., Rohde C., Garrison R., Noreen E. (2014), *Management Accounting*, fifth edition, McGraw-Hill, New York.

Sharda R., Delen D., Turban E. (2015), *Business Intelligence and Analytics: Systems for Decision Support*, tenth edition, Pearson Education, Upper Saddle River.

Sheldon R. (2021), A timeline and history of blockchain Technology, *Blockchain: Research and Applications*, Vol. 3 No. 2.

Simon H. A., Kozmetsky G., Guetzkow H., Tyndall G. (1955), Organizing for controllership: centralization and decentralization, *The Controller Copyright Financial Executives Institute*, Vol. 33, pp. 11-18

Sivabalam P., Booth P., Malmi T., Brown D. A. (2009), An exploratory study of operational reasons to budget, *Accounting & Finance*, Vol. 49 No. 4, pp. 849-871.

Soh C., Ken Sia S., Fong Boh W., Tang M. (2003), Misalignments in ERP implementation: a dialectic perspective, *International Journal of Human-Computer Interaction*, Vol. 16 No. 1, pp. 81-100.

Sotomayor B., Montero R. S., Llorente I. M.,Foster I. (2009), Virtual infrastructure management in private and hybrid clouds, *IEEE Internet Computing*, Vol. 13 No. 5, pp. 14–22.

Spraakman G., Sanchez-Rodriguez C., Tuck-Riggs C. A. (2021), Data analytics by management accountants, *Qualitative Research in Accounting & Management*, Vol. 18 No. 1, pp. 127-147.

Stern M., Reinstein A. (2021), A blockchain course for accounting and other business students, *Journal of Accounting Education*, Vol. 56.

Strauss E., Kristandl G., Quinn M. (2015), *The effects of cloud technology on management accounting and decision making*, available at: https://www.cimaglobal.com/Research--Insight/The-effects-of-cloud-technology-on-management-accounting/

Strauß S. (2021), Deep Automation Bias: How to Tackle a Wicked Problem of AI? *Big Data and Cognitive Computing,* Vol. 5 No. 2.

Surender M., Geetu G. (2021), Artificial intelligence and technical efficiency: The case of Indian commercial banks, Special Issue: Artificial intelligence in finance, *Strategic Change*, Vol. 30 No. 3, pp. 235-245.

Sutton S. G., Arnold, V., Holt, M. (2018), How much automation is too much? Keeping the human relevant in knowledge work, *Journal of Emerging Technologies in Accounting*, Vol. 15 No. 2, pp. 15-25.

Taddy M. (2019), The technological elements of artificial intelligence in Agrawal A., Gans J., Goldfarb A. (edited by) *The Economics of Artificial Intelligence: An Agenda*, first edition, University of Chicago Press, Chicago, pp. 61–87.

Tang V.W. (2017), Wisdom of crowds: cross-sectional variation in the informativeness of third-party-generated product information on twitter, *Journal of Accounting Research*, Vol. 56 No. 3, pp. 989-1034.

Tarifi, N. (2021), A Critical Review of Theoretical Aspects of Strategic Planning and Firm Performance, *Open Journal of Business and Management*, Vol. 9 No. 4, pp. 1980-1996.

Tariq N., Asim M., Al-Obeidat F.,Zubair Farooqi M.,Baker T.,Hammoudeh M.,Ghafir I. (2019), The security of big data in fog-enabled IoT applications including blockchain: a survey, *Sensors*, Vol. 9 No. 8, pp. 1-33.

Tench R., Jones B. (2015), Social media: the Wild West of CSR communication, *Social Responsibility Journal*, Vol. 11 No. 2, pp. 290-305.

Tourani N. (2021), Thriving in a shifting landscape: Role of social media in support of business strategy, *Asia Pacific Management Review*.

Trainor K.J., Andzulis J.M., Rapp A., Agnihotri R. (2014), Social media technology usage and customer relationship performance: a capabilities-based examination of social CRM, *Journal of Business Research*, Vol. 67 No. 6, pp. 1201-1208.

Trigo A., Belfo F., Estébanez R. P. (2014), Accounting Information Systems: The Challenge of the Real-Time Reporting, *Procedia Technology*, Vol. 16, pp. 118-127.

Valos M. J., Habibi F. H., Casidy R., Driesener C. B., Maplestone V. L. (2016), Exploring the integration of social media within integrated marketing communication frameworks: Perspectives of services marketers, *Marketing Intelligence & Planning*, Vol. 34 No. 1, pp. 19-40.

Van der Aalst W., Weijters T., Maruster L. (2004), Workflow mining: discovering process models from event logs, *IEEE Transactions on Knowledge and Data Engineering*, Vol. 16 No. 9, pp. 1128-1142.

Vasarhelyi M.A., Kogan A., Tuttle B.M. (2015), Big data in accounting: an overview, *Accounting Horizon*, Vol. 29 No. 2, pp. 381–396.

Wang H., Ma C., Zhou L. (2009), A Brief Review of Machine Learning and its Application, contribution presented at *International Conference on Information Engineering and Computer Science*, Wuhan,19-20 December 2009.

Warren J. D., Moffitt K. C., Byrnes P. (2015), How Big Data Will Change Accounting, *Accounting Horizons*, Vol. 29 No. 2, pp. 397-407.

Wixom B., Watson H. (2010), The BI-based organization, *International Journal of Business Intelligence Research*, Vol. 1 No. 1, pp. 13-28.

Wörner D., Von Bomhard T., Schreier Y.P., Bilgeri D. (2016), The bitcoin ecosystem: disruption beyond financial services? Contribution presented at *24th European conference on information systems*, Istanbul, 12-15 June 2016.

Yigitbasioglu O. (2016), Firms' information system characteristics and management accounting adaptability, *International Journal of Accounting and Information Management*, Vol. 24 No. 1, pp. 20-37.

Yigitbasioglu O.M. (2017), Drivers of management accounting adaptability: the agility lens, *Journal of Accounting & Organizational Change*, Vol. 13 No. 2, pp. 262-281.

Youseff L., Butrico M., Da Silva D. (2008), Toward a unified ontology of cloud computing, in *Proceedings of the 2008 Grid Computing Environments Workshop*, Austin, 12-16 November 2008.

Youssef M.A.E.-A., Mahama H. (2021), Does business intelligence mediate the relationship between ERP and management accounting practices? *Journal of Accounting & Organizational Change*, Vol. 17 No. 5, pp. 686-703.

Yu H., Yang X., Zheng S., Sun C. (2019), Active learning from imbalanced data: A solution of online weighted extreme learning machine, *IEEE Transactions on Neural Networks and Learning Systems*, Vol. 30 No. 4, pp. 1088 -1103.

Yu Y., Yin G., Wang T., Yang C., Wang H. (2016), Determinants of pullbased development in the context of continuous integration, *Science China Information Sciences*, Vol. 59.

Zhang Y., Wua M., Miao W., Huang L., Lu J. (2021), Bi-layer network analytics: A methodology for characterizing emerging general-purpose technologies, *Journal of Informetrics,* Vol. 15 No. 4.

Zhang Y., Xiong F., Xie Y., Fan X., Gu H. (2020), The Impact of Artificial Intelligence and Blockchain on the Accounting Profession, *IEEE Access*, Vol. 8, pp. 110461-11047.

Zheng Z., Xie S., Dai H., Chen X., Wang H. (2017), An overview of blockchain technology: Architecture, consensus, and future trends, contribution presented at

6th IEEE international congress on big data (BigData congress), Honolulu, 25 - 30 June 2017.

Zuboff S. (2015), Big other: Surveillance capitalism and the prospects of an information civilization, *Journal of Information Technology*, Vol. 30 No. 1, pp. 75-89.

Acknowledgements

Ho sempre immaginato il mio percorso universitario come una linea retta che mirava direttamente al traguardo. Seppur con degli ostacoli, ho vissuto questi anni proseguendo questa traiettoria, risoluta e decisa verso la meta che pian piano si avvicinava. Non è una novità per chi mi conosce, che per ottenere ciò che voglio punto l'obiettivo e cammino dritta per ottenerlo, senza battere ciglio. Prima o poi, però, arriva un momento in cui ci si ferma per riflettere. Nel mio caso ho pensato alla parola percorso, per - currere, dal latino significa correre attraverso. Ho riflettuto quindi su cosa significasse per me "attraverso", "mediante". Mi sono resa conto che non ero minimamente sola in questo tragitto ma che, anzi, sono state le persone che avevo accanto che mi hanno aiutato a percorrerlo. Sono stati proprio loro a darmi la spinta per fare l'ennesimo passo avanti, ad aiutarmi a non inciampare o a rialzarmi quando cadevo. In primis, dedico questa laurea alla mia famiglia perché senza di loro, niente di tutto ciò sarebbe stato possibile. Questo traguardo, insieme ai prossimi che spero di realizzare in futuro, sono merito dell'opportunità di studiare che i miei genitori mi hanno dato, e non è scontato ricordarlo. Sono stata fortunata anche perché, oltre a questo, sono nata in una famiglia che mi ha sempre spronato a dare il meglio di me, a credere in me stessa ed a non abbattermi davanti alle difficoltà. Per questo motivo, devo ringraziare mia madre, il mio esatto opposto, la mia parte mancante, la mia dose quotidiana di energia, forza e leggerezza, tutto nella stessa persona. La sua presenza nella mia

vita è come lo sguardo delle mamme che osservano i bambini farsi il bagno al mare. Mi ha sempre sostenuto, ma da lontano, lasciandomi libera, e non preoccupandosi perché per lei io ero sempre abbastanza forte da andare avanti da sola. Devo dire grazie a mio padre, che mi ha insegnato il valore dell'impegno e del sacrificio per ottenere ciò che si vuole, che ha sempre compreso i miei sforzi e le mie ambizioni senza che dovessi spiegarli, così come a me è sempre bastato guardarlo negli occhi per capire quanto fosse orgoglioso di me. Devo assolutamente ringraziare il mio fratellone, perché anche se non glielo dico e forse non lo dimostro, gli voglio un bene dell'anima. Il merito è anche suo, per avermi sopportato, e per aver resistito ai miei sbalzi di umore con l'allegria e la positività che lo contraddistingue, riuscendo sempre a strapparmi un sorriso. So che è felice dei miei successi come se fossero i suoi, così come io sono orgogliosa delle sue vittorie e della persona che è. In generale, un grazie è dovuto alle nonne, agli zii e ai cugini che mi sono stati di supporto durante questi anni. Alla mia migliore amica, Gioia, devo dire grazie con tutto il cuore, perché è la sorella che non ho mai avuto. Anche se non sono semplice da gestire, lei riesce sempre a trovare il modo giusto per starmi accanto, il momento giusto per farmi ridere o quello per starmi semplicemente vicino senza parlare. Non avrei mai potuto chiedere di meglio. Ad Ilenia, Alessandro, Martina, Lucrezia, Dante e tutte le persone che mi sono state vicine devo un grazie enorme per esser sempre presenti con una risata o con un consiglio da darmi, e per aver saputo conoscermi ed accettarmi con tutti i

miei difetti. Alle mie compagne d'avventura, Benedetta ed Alessia, con cui ho condiviso scleri, emozioni, ansie, delusioni e gioie. Nonostante il periodo ci abbia un po' tenuto lontane e gli schermi accesi riempivano le nostre giornate, siamo state in grado di farci forza l'una con l'altra, percorrendo questo tragitto insieme. Inoltre, un ringraziamento speciale e assolutamente necessario è rivolto alla Professoressa Chiucchi ed al Professor Montemari per essere stati una grande guida nella realizzazione di questo lavoro che coronerà questo piccolo ma importante traguardo della mia vita.