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# Business Intelligence and Analytics Systems in Management Accounting Contexts: A "Journey" Through Enablers, Barriers, and Organizational Dynamics

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# INTRODUCTION

The contemporary business environment is marked by a deluge of data, stemming from diverse sources such as transactional records, customer interactions, and operational processes (Kokina et al., 2021). In this scenario, conventional methods of managing and interpreting data fall short of meeting the demands for real-time insights and comprehensive analyses (Begkos and Antonopoulou, 2020). In such a context, the integration of Business Intelligence and Analytics (BI&A) systems into Management Accounting (MA) contexts is a strategic response to this evolving landscape and offers organizations the tools and capabilities needed to harness the vast volumes of data at their disposal (Appelbaum et al., 2017).

The significance of BI&A systems in MA goes beyond mere technological upgrades as it also signifies a paradigm shift in how organizations approach data-driven decision-making (Korhonen et al., 2021). These systems provide not only the means to process and analyze data, but also the intelligence to derive actionable insights (Bhimani and Willcocks, 2014). Thus, the deployment of BI&A systems equips managerial accountants with the tools to produce and transmit complex information and to support sophisticated decision-making processes (Andreassen, 2020).

In view of the relevance of the link between BI&A systems and MA, this relationship has gained an increasing attention by academics (M˘ller et al., 2020; Knudsen, 2020; Moll and Yigitbasioglu, 2019) and practitioners alike (ACCA, 2016; IAESB, 2019; IMA, 2023). In particular, this relationship has been explored by different angles (Rikhardsson and Yigitbasioglu, 2018), such as the influence of information delivery and system feedback provided by BI&A systems for MA tasks, the influence of BI&A systems on MA techniques, or the use and satisfaction with BI&A systems in MA contexts, to name a few.

Despite the increasing and multifaceted interest in BI&A systems and MA, research indicates the existence of two distinct but interrelated research gaps. On the one hand,

research has acknowledged that BI&A systems have often fallen short in providing adequate support for the managerial decision-making process (Elbashir et al., 2013; Visinescu et al., 2016). In essence, despite substantial investments in time, money, and resources for the design and implementation of BI&A systems for MA purposes, these systems frequently remain underutilized, either partially or entirely (Audzeyeva and Hudson, 2015; Yeoh and Popovič, 2015). However, the stage of use has received inadequate attention in research (Popovič et al., 2012; Burton-Jones and Straub, 2006; Burton-Jones and Grange, 2013). Hou (2015), in particular, notes a lack of research investigating factors influencing usersì intention to continue using BI&A systems after its design and implementation, revealing significant challenges in user acceptance within the intersection of BI&A systems and MA. Consequently, a critical research avenue involves understanding the enablers and the barriers behind the use or non-use of BI&A systems for MA purposes.

On the other hand, research has shown that with the advent of BI&A systems, the impact on the role of Management Accountants is debated (Nielsen, 2015; Moll and Yigitbasioglu, 2019; AlAnsari et al., 2022). One perspective envisions Management Accountants as central protagonists, becoming the companyìs data hub, collaborating across functions, and supporting planning and decision-making operations (Wadan and Teuteberg, 2019; Esswein and Chamoni, 2018). An alternative perspective suggests risks of Management Accountants losing their distinct identity, facing threats related to the quality and quantity of tasks performed and potential conflicts with IT and data scientists (Guthrie and Parker, 2016; Dunne et al., 2013; Mertins and White, 2014; Arnaboldi et al., 2017). Thus, the literature underscores the need for more empirical evidence to understand how the introduction of BI&A systems reshapes the interactions and organizational power between Management Accountants and other actors in companies, providing insights into whether Management Accountants will play a central role or face diminishing importance.

This Doctoral Thesis comprises three interrelated papers that collectively contribute to advancing the understanding of the factors influencing the use of BI&A systems in MA contexts and their implications of the use of BI&A systems for Management Accountants.

The first paper is a literature review aimed at critically examining the current state of the art regarding the enabling and hindering factors in the use of BI&A systems within MA contexts. Employing the Grounded Theory Literature Review method, a sample of 65 papers was analyzed. Through the process of open, axial, and selective coding, numerous enabling and hindering factors were identified and classified into three macro-categories: organizational-related factors, technical-related factors, and human-related factors. In addition to systematizing the existing literature on the enablers and barriers to the use of BI&A systems in MA contexts, this paper identifies existing gaps in the literature and suggests future avenues of research.

The second paper aims to explore, through a cross-sectional field study, how and why BI&A systems may end up being used or not used for MA purposes. Specifically, eight case companies were selected through purposeful selection as these entities have already designed, implemented, and adopted BI&A systems for MA purposes. Semi-structured interviews were conducted with the Management Accountants responsible for using the BI&A systems. All interviews were transcribed and analyzed using a structural coding approach, that is, through a code tree capable of reflecting the main sections included in the interview guide. The paper shows that the factors capable of hindering or facilitating the use of BI&A systems do not come into play singly but interact with each other. Furthermore, these factors do not all have the same importance since some manifest with greater intensity, while others with lesser intensity.

The third paper aims to explore, through a single in-depth case study, how BI&A systems reshape the organizational relevance of Management Accountants within companies. Specifically, the case company was selected through purposeful selection as in this entity various occasions have occurred where the implementation and use of BI&A systems have led to a reshaping of the power, responsibilities, activities of the Management Accountants, as well as their interactions with other organizational actors. Data were collected through document analysis and through semi-structured interviews to Management Accountants (information producers) and corporate managers (information consumers). All interviews

were transcribed and analyzed using a structural coding approach, reflecting the main sections included in the interview guide. The paper demonstrates that the use of BI&A systems increases the organizational relevance of the Management Accountants, especially due to the opportunity to devote more time to the analysis and interpretation of information, but it adds some nuances on the î costsï to be incurred to play such a more relevant role, i.e. new responsibilities on IT-related tasks and increased workload.

Collectively, these three papers contribute to the growing body of knowledge on the intricate relationship between BI&A systems and MA. By addressing gaps in the existing literature and providing empirical insights, this Thesis aims to deepen the understanding of the factors influencing BI&A system utilization in MA contexts and their broader organizational implications for Management Accountants.

# CHAPTER 1

## *AN OVERVIEW ON MANAGEMENT ACCOUNTING SYSTEMS*

### 1.1 MANAGEMENT ACCOUNTING SYSTEMS: AN HISTORICAL PERSPECTIVE

When addressing the concept of MA and its related tools and approaches in companies, the theoretical framework proposed by Robert N. Anthony represents the starting point. Robert N. Anthony was indeed a prominent accounting scholar and educator and his work focused on planning and control systems[1], making significant contributions to the understanding of budgeting, cost control, and management decision-making. The book î Planning and control systems: a framework for analysisï is still considered a classic in the field, even though it dates back to 1965.

The author defines planning and control systems as the set of tools and processes through which the top management pursue the objective of effectiveness and efficiency in the use of the resources for the achievement of the corporate objectives (Anthony, 1965). The author divides planning and control systems into three segments:

1. strategic planning;

2. managerial control;

3. operational control.

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[1] Borrowing from Giannessi (1960), it can be stated that the systematic order is characterized by the continuous succession of operations, each of which does not occur randomly but in close connection with the others and, together with them, in accordance with the purpose pursued by the company. This particular state of order determines the formation, within the overall operations carried out by the company, of a higher-level structure which can be defined as "system".

Strategic planning, as defined by the author, is î *the process of deciding the goals of the organization, the modifications in these goals, the resources utilized to achieve these goals, and the policies that govern the acquisition, use, and management of these resources*ï. (Anthony, 1965, p. 4). He states that planning process concerned the setting of goals and developing strategic solutions to achieve them within a predominantly corporate context. This specification is significant because the author highlights the existence of two types of planning: one at the corporate level and another integrated into control and administration. These two types of planning are distinct, assigned to different entities, and recognized as independent components within the broader system of planning and control.

Managerial control is defined as î *the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organizationìs objectivesï (Anthony et al., 1965. p.2). With the concept of managerial control, Anthony outlines several fundamental characteristics, such as the aim to achieve business objectives and the focus on the effective and efficient use of resources. Additionally, he defines its peculiar aspects, acknowledging its nature as a system with distinctive requirements. The managerial control system is described as ícomprehensiveì because it encompasses all aspects of business activity and provides information to managers about every part of the company. Anthony also refers to it as a írhythmicì process, structured around precise íitinerariesì that dictate the sequence of steps in the process. Finally, he characterizes the managerial control system as ícoordinated and integratedì, meaning that although the information produced may pertain to different aspects depending on the reasons for its production, it is crucial to maintain an adequate level of integration among them. This characterization of the control system as a unique system necessitates the coordination among the various types of information it can generate.

Finally, the author defines operational control as î *the process of assuring that specific tasks are carried out effectively and efficiently*ï (Anthony et al., 1965, p. 7). This definition highlights the intention to distinguish between two types of control, each with its own unique characteristics and nature. The distinguishing factor, as identified by the author, lies in the

subject matter of the two types of control and the level of detail in the tasks on which control is exercised. When it comes to operational control, it pertains specifically to employee tasks, whereas management control relates to the activities of executives.

Anthonyìs framework thus structures the planning and control systems into three distinct parts. This division arises from the need to separate activities with different characteristics, purposes, and execution methods. Furthermore, assigning responsibility for these activities to individuals in various organizational positions facilitates the functioning of the model.

Anthonyìs contributions have become reference points for the literature because they were the first important frames of the concept of planning and control systems and laid the groundwork for all the evolutions the subject had over the years. The first developments were published just some years later Anthonyìs works if 1965. By taking into consideration Italian Scholars, Coda contributed to the theme by specifying that management control could be divided into economic control and executive control (Coda, 1968). Economic control is defined as the one with the object the convenience of the strategic choices, while executive control is identified as the one with the purpose of monitoring the behavior of low-level employees. Airoldi (1980) too builds upon Anthonyìs definitions. The Author states that there are two main control systems: the planning one, on the one hand, and the programming and control one, on the other hand. The originality of his model concerns the relationships between control systems and the other systems of the firm, with a particular attention to the organizational aspect of the managerial control systems (Airoldi, 1980).

The Anthonyìs ideas of managerial control were strongly revisited from the 80s, years during which the studies on this research area started to radically change. Companies found themselves competing in very different business environments compared to the past and they had to undertake processes to adapt their subsystems, including the control system. The reasons behind the considerable success of Anthonyìs model were, in fact, identifiable in the close relationship between the characteristics of the competitive context and the structuring of the control process.

In the context of largely static markets, defined by a standardized demand for goods and services that exceeded supply, the key to success was identified in efficiency. This focus was primarily on internal processes and production costs. Goals were well-defined and easily measurable in economic and financial terms, allowing for straightforward monitoring of activities. However, this form of control was largely retrospective and thus of limited strategic use.

## 1.2 THE LIMITATIONS OF TRADITIONAL MANAGEMENT ACCOUNTING SYSTEMS

The competitive conditions that emerged from the 80s led to significant changes. The high level of competition and a shift in the demand-supply relationship needed a change in the approach to business control. Companies needed more than just to monitor efficiency and effectiveness since there was an increasing need for information that could facilitate business management. The components of the control system had to adapt to these changes to support both operational and strategic management.

Its main strengths were obscured by its bigger limitations (Marasca, 1989). A relevant strength of the model was its high degree of pragmatism. Anthonyìs model replicated the most common processes of the organizations that started with the definition of the strategic objectives, continued with the action plan of the decisions and ended with the monitoring and verification of the actual results compared to the planned ones. Another determinant strength is the easiness to implement and adapt the system to each organization because it was.

Despite these points in favor of Anthonyìs model, many serious limitations came out with the environmental changes mentioned earlier. First, the new context in which organizations were operating implied a continuous mix between strategic and operational logics and the three sections approach used by Anthony did not seem adequate anymore. Also, organizations could not use anymore only financial measures to monitor their performance: they were obliged to widen the view and include other qualitative or quantitative non-financial measures. With the evolution of market contexts as previously cited, competitive

success had to be measured by monitoring aspects like customer satisfaction and not only financial indicators. Another crucial limitation was the absence of schemes for the visualization of causal relationships among indicators that became strategic during next years. Finally, Anthonyìs model did not foresee the analysis and monitoring of behavioral measures of the people of the organization.

To synthesize, the characteristics of Anthonyìs traditional planning and control systems are:

- focus on short-term goals: the utilized reference parameters are confined to assessing the companyìs short-term performance, lacking the ability to offer insights into the organizationìs capacity to achieve medium to long-term objectives;

- primarily quantitative financial information: the system predominantly relies on quantitative financial data to assess the effectiveness of corporate management by comparing objectives and outcomes. However, this approach falls short in turbulent environments, where attention must be consistently directed towards identifying even subtle external signals. This is not just to shift from feedback to feed-forward control positions but also to develop crucial strategic control. It is essential to employ qualitative controls that seek parameters beyond economic or financial metrics, emphasizing different characteristics as indicators of external changes;

- historical focus: traditional control systems hinge on feedback mechanisms, involving continual ex-post comparisons between achieved results and predetermined objectives. While effective in stable environments with repetitive decisions, this approach is unable to adapt flexibly to unforeseen circumstances, whether opportunities or threats;

- internalized approach: the traditional control systemìs application is limited to the production process stages, often neglecting factors beyond the companyìs production boundaries. It fails to measure crucial aspects such as service quality and timeframes from both suppliers (upstream) and customers (downstream) in the production process.

Furthermore, it tends to overlook observed results in relative terms, neglecting their comparison to direct and indirect competitors;

- vertical focus: control activities often adopt a îfunctionalï perspective of the organization, utilizing mechanisms that operate vertically along the organizational structure through responsibility centers. This approach may compromise the understanding of îhorizontalï processes, including interdependencies between various functions and the roles of staff functions[2].

## 1.3 THE COMPONENTS OF MANAGEMENT ACCOUNTING SYSTEMS

Kaplan and Johnson (1987) were among the main authors to contribute to this theme during the 80s. With their work titled î*Relevance Lost. The rise and fall of management accounting*ï these authors highlighted the limitations of the traditional MA systems[3]. In doing so, they specifically referred to the incapacity of those systems to supply adequate information to managers, the difficulty to implement effective costing systems and the excessive orientation to the short period. The main message of the authors was not even connected to the changing of the environment in which the firms were operating. Instead, they criticized traditional accounting and control systems because, from their point of view, those systems should have prioritized supporting managers in the decision-making process with the appropriate information production system. The authors then affirmed that the systems should have evolved from considering only short period economic measures to integrate them with mid and long period quantitative and qualitative indicators.

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[2] In view of these limits, several authors started to question the concept and the peculiarities of the MA. This process resulted in the birth of the concept of Strategic Control. Strategic Control did not substitute the MA one, instead it complemented it thanks to the wider spectrum of views and analysis it comprehended. For further details on the concept of Strategic Control and the related tools, refer to Ansoff (1974), Paolini (1993), Bergamin Barbato (1991), Marchi (2003), Coda (1988), Mintzberg (1996), Marasca and Silvi (2004), Bruni (1990).

[3] From here on, the focus of the Thesis will be on a specific component of planning and control systems, i.e. MA systems. MA systems can be defined as a set of tools and approaches that managers can use to support planning, controlling, and decision making activities (Garrison et al., 2022).

The seminal work of Kaplan and Johnson stimulated abundant research that started to revisit initial Anthonyìs framework and contributed to the literature with further advancements (Paolini, 2004). The main idea of this new stream of literature was that the MA system lost its initial nature of system aimed at just managing numbers and evolved into a system in which cultural, organizational, behavioral and quantitative aspects were all closely integrated (Catturi, 2004). It was with these changes that MA evolved from a group of different technicalities to a complete and articulated process to support the effectiveness and efficiency of the decision-making processes (Busco, 2005) and from these considerations stemmed the definition of the three components of the MA system: organizational structure, informational-accounting structure, and processual structure (Brunetti, 1992). The informational-accounting and organizational structure identify the static dimension of the MA, while the processual one identifies the dynamic dimension of the MA. These are all components of the material dimension of the MA.

For each of these categories several in-depth studies were published and the information technology one was born to identify the adequate technical and informatic solutions to support the implementation of the MA systems (Paolini, 2004). As several authors point out, today the material dimension of MA can therefore be identified as already mentioned and the three levels of it can be described as follows.

The informational-accounting structure represents the set of MA tools through which the planning and control system collects, processes, and distributes information. Over the years, the informational-accounting structure has undergone significant changes, leading to a progressive expansion of the number of tools and solutions available to support corporate decision-making processes. The considerable set of tools proposed in literature and practice can be systematized into three classes: accounting solutions, non-accounting solutions, and information and communication technology (ICT) solutions.

Accounting solutions comprise tools of an accounting nature that provide monetary information. Examples include general ledger accounting, cost accounting, and variance analysis systems that enable the economic measurement of goal achievement. In contrast,

non-accounting solutions lack an accounting nature and ensure the production of non-monetary quantitative information. This category encompasses tools that draw from various corporate information systems, producing an information flow not necessarily focused on economic or financial dynamics but predominantly on managerial aspects or those more closely related to customers, competitors, and the market. Information and communication technology solutions, on the other hand, represent the technical and technological infrastructure that enables the collection, management, and distribution of information through accounting and non-accounting solutions. This refers to modern solutions such as Enterprise Resource Planning (ERP), Corporate Performance Management (CPM), and Business Analytics that support control information solutions in retrieving information from often heterogeneous sources and presenting it to corporate managers.

Concerning studies on the accounting structure, those concentrating on Cost Management systems were particularly significant. This area held primary importance as it introduced a novel perspective on accounting topics. The logic of cost containment formed the foundation of accounting structure studies, whereas Cost Management transformed that perspective into a more management-oriented approach rather than mere containment (Bergamin Barbato, 1999).

The Cost Management stream is the result of a new conception of accounting more oriented on managerial aspects (Barbato, 1999). In this context, the static dimension of MA acquired new functions and influenced the whole MA system. The cost management tendency over cost containment improved the informative role of the MA (Blocher et al., 2002).

The organizational structure of MA refers to the set of economic responsibilities and how they are distributed within the organization. Accountability, as mentioned earlier, represents one of the purposes attributable to the planning and control system and involves assigning each manager a goal, along with suitable management levers to achieve it. To pursue accountability, there is a need for prior identification, within the broader organizational structure, of roles and relationships between roles or organizational units, i.e., responsibility

centers, to assign goals and monitor their achievement. In this perspective, the organizational structure of control forms the framework of corporate economic responsibilities based on which the entire corporate planning and control system is designed. Normally, it is defined starting from the so-called responsibility centers, i.e., organizational units led by a manager who has the decision-making and managerial levers necessary to influence the results achieved by the center.

The organizational structure attracted considerable interest. The analyses were primarily focused on the relationships between MA systems and other systems, as well as on the impact of the organizational structure on the MA function. In this context, the emerging idea was that the organizational configuration has a significant impact on the types of information produced by different systems, which MA needs to process. However, while initial contributions asserted that MA systems should be constructed by retracing the organizational structure, subsequent ones shifted their focus to other topics directly related to the third identified category, the processual structure.

The need to link business results and costs to specific areas initially led to the implementation of accounting systems where cost objects, whether intermediate or final, were typically identified in individual organizational units. According to this logic, the expenditure, cost, revenue, profit, or investment centers mirrored the individual business units, partly because closely aligning with the organizational structure facilitated accountability for achieved results or used resources. However, developments in organizational studies have led to a renewed understanding of the relationship between control and organizational structure. The latter is no longer just the simple íframeworkì on which to design and build the control system. The primary informational function of control, rather than its controlling aspect, coupled with the need to adopt a process-oriented view rather than one focused on individual organizational units, has given organizational structure a new role as an íinfluencerì on the type of information produced (Collini, 2001; Brunetti 1992). This change also affected the MA systems and the information it generates, due to varying informational needs that arise.

The fact that the organizational structure and the informational-accounting structure of control are part of what is defined as the static dimension of the planning and control system should not imply that they are not subject to changes over time. On the contrary, both the organizational structure of control and the informational-accounting solutions must undergo constant review and updating.

Concerning the organizational structure of control, there is a constant need to verify that the responsibility centers within it reflect the system of economic responsibilities existing within the organization. Changes in strategy or organizational restructuring could lead to the inclusion or elimination of new roles and, consequently, new economic responsibilities. Simultaneously, informational-accounting solutions need constant updating to make them suitable for supporting corporate decision-making processes. Changes in managersì information needs require new information flows that control informational-accounting solutions must be able to produce. Therefore, updating and revising informational-accounting solutions occur both in terms of the number and type of solutions employed and in terms of adapting existing solutions to the changed information needs of those at the forefront of corporate decision-making processes.

Shifting attention from the static dimension to the dynamic one, the latter is identified with the MA process. The MA process concern all activities undertaken to ensure the functioning of the planning and control system. In other words, it consists of the mechanisms used to provide managers with information useful for making decisions aligned with corporate objectives. The literature extensively discusses various mechanisms usable in the control process, emphasizing that, in modern competitive contexts, the control process proves more effective when it can use anticipatory mechanisms. These mechanisms allow for the early appreciation of the economic effects of choices made, enabling interventions, if necessary, to revise the defined courses of action. In contrast, control processes primarily or exclusively based on mechanisms aimed at ensuring mere ex-post control of achieved results present strong limitations in contexts where the ability to predict and intervene becomes increasingly critical for corporate success.

There are significant relationships and close mutual influences between the static and dynamic dimensions. The dynamic dimension must be shaped based on the existing organizational and informational-accounting structure. At the same time, the static dimension must constantly adapt to the control process. Different control processes presuppose different responsibilities and, especially, different tools. The effectiveness of a planning and control system, therefore, depends on the ability to integrate the two analyzed dimensions, updating them over time as necessary.

The immaterial dimension of MA started to be as relevant as the material one because it represented one of the main elements that made the implementation and diffusion of MA systems easier (Riccaboni, 2004). During those years it therefore increased the awareness that the incapacity of the MA systems to correctly work independently and that is the reason why the same systems do not always produce the same effects if implemented in different organizations. The technical components are only some of the whole group of material and immaterial ones and they must always be integrated and work together effectively to make the system produce positive effects.

Immaterial dimension concerns the way the MA system is managed while material dimension group the dynamic and static dimension of MA. Those years the immaterial dimension was born as a concept and became central in the evolution of MA systems (Riccaboni, 2004).

Immaterial dimension comprehends intangible variables, strictly connected to the organizational culture and to the way the system is experienced. These variables can be crucial both in positive and negative ways because they may determine a success or a failure of the system.

In particular, the immaterial dimension encompasses less overt and more profound elements of MA, which are typically not formally delineated in internal documents or reports. Specifically, attention is directed towards aspects such as:

1. the discretely role assigned by top management to MA, denoting the function that organizational leaders inherently attribute to MA itself. This role may not always align with the externally communicated stance towards other corporate stakeholders;

2. the methods by which the control mechanism is executed.

Concerning the discretely assigned role to MA, it is relevant to recognize that it does not invariably correspond to the assertions made in official statements and formal documentation. In practice, there is often an observed proclivity for symbolic engagement, manifested through ceremonial initiatives, with a limited impact on organizational and individual behaviors.

Another relevant intangible variable is the style of MA (Amigoni, 1979; Castellano, 2003; Marchi, 1988). Its configuration within a company depends primarily on the degree of participation in goal definition, the level of difficulty of these goals, and, finally, the method of performance evaluation. The effectiveness of a specific control strategy is, in turn, a function of the individual characteristics of the people involved in the process and the accuracy and reliability of the control parameters.

The various combinations of the above elements give rise to a series of MA strategies. At the ends of the continuum, two models can be identified: the ï external pressureï model and the ï internal motivationï model (Donna, 1981). The former is characterized by limited subordinate participation, with strict goals assigned to them. In these cases, superior control is stringent to prevent data manipulations; in turn, performance evaluation is exclusively linked to the results achieved. This model is typical of companies with a strong centralization, and thus, the style is authoritative. The MA style based on ï internal motivationï , on the other hand, is characterized by extensive participation, guiding objectives, and a ï globalï assessment of individuals, based not only on economic results but also on other factors. This style expresses its full potential in companies where delegation is broad, and there is therefore the capacity and desire for everyone to participate in the decision-making process.

The choice between these styles implies a different conception of human nature. In the case of control based on îexternal pressure,ï individuals are considered motivated by extrinsic rewards. In the other case, workers are seen as individuals seeking self-realization and, above all, as reliable people.

The two dimensions of MA are not entirely self-sufficient and autonomous; rather, they establish intricate relationships between them. Both the intimately assigned role of control and the methodologies employed in its management exert a considerable influence on the efficacy of this mechanism in influencing individual and organizational behaviors.

The form assumed by the immaterial dimension also exerts an impact on the structuring of the material facet of control, particularly the control process. For example, the analytical framework of the budget and the meticulousness applied in its preparation correlate strongly with the discretely assigned role to control by upper management. The material dimension, in turn, inevitably conditions the immaterial one. The delineation of responsibilities, for instance, constrains the objectives that leadership can assign to control.

The correlation and interaction between the two dimensions of control are pivotal for a nuanced understanding of the actual role played by this operational mechanismò namely, comprehending how and why it engenders specific benefits and distortions. The potential advantages and disadvantages of control hinge largely upon the interplay between the two dimensions and their intersections with internal and external factors.

The efficacy of control in influencing organizational and individual behaviors, therefore, is contingent not exclusively upon the correctness of formal aspects. Frequently, it is the immaterial dynamics that constitute critical success variables for control systems. Consequently, to ascertain whether and how control genuinely impacts the management of a company and its internal dynamics, one must engage not only with the formal facet of control but also with its immaterial counterpart.

## 1.4 THE FEATURES OF MANAGEMENT ACCOUNTING SYSTEMS

Today the MA infrastructure is identified as a group of principles having the purpose of supporting and orienting decision-making processes through the achievement of the strategic objectives. It therefore became determined for several activities (Marchi et al., 2018). First, it plays a crucial role in enhancing the decision-making process by providing comprehensive information. This includes evaluating the economic and financial aspects of operational programs, allowing for a proactive assessment of their validity and feasibility. Through this, it contributes to making the decision-making process more effective. Then, the system contributes to organizational coherence by coordinating management activities. This involves defining clear objectives and implementing controls to ensure their achievement at various organizational levels. By verifying the consistency of objectives across different units, the system promotes unity in corporate management and facilitates the coordination of activities to achieve overarching goals. Another significant aspect of the planning and control system is the empowerment of individuals. It assigns responsibility for achieving objectives to each person within the organization. Simultaneously, it ensures that individuals are provided with the necessary means and resources to meet these objectives, fostering a sense of accountability and ownership. Additionally, through the explicit setting of objectives and the articulation of business priorities, the system guides individual behavior. This orientation ensures that the actions of individuals align with the organizationìs mission and strategic goals, contributing to overall cohesiveness. The system serves also a motivational function by empowering individuals with shared goals. When individuals have a stake in the objectives and internalize them to some extent, it increases the likelihood that their behavior will be directed towards achieving these goals. The connection between the control system and reward mechanisms further reinforces this motivational aspect. Another integral part of the planning and control system is its capacity to facilitate organizational learning. By comparing planned results with actual outcomes, analyzing variances, and understanding the underlying causes, the system enables the accumulation of valuable experience. This, in turn, provides insights for continuous improvement and adjustments in the current management approach. Finally, the system actively contributes to the development of a meritocratic

culture within the organization. Through the formalization of objectives and the objective monitoring of their achievement, the system ensures that individuals contributing significantly to the organizationìs goals are duly recognized and rewarded. This fosters a culture where decisions and actions that actively contribute to the organizationìs objectives are acknowledged and incentivized.

In summary, the MA system is a vital component of organizational management, offering a range of functions that collectively support effective decision-making, organizational coherence, individual empowerment, strategic orientation, motivation, learning, and the development of a meritocratic culture. Its comprehensive approach addresses various aspects of organizational dynamics, making it indispensable in dynamic and competitive business environments.

MA infrastructure main characteristics should therefore concern the following aspects. Firstly, a MA has to be coherent, and it is considered coherent if it aligns with the companyìs strategy (e.g., cost leadership, differentiation, etc.), the concept of productive rationality, and organizational variables (e.g., organizational structure, leadership style, and other operational mechanisms). Coherence can also be understood in terms of congruence among the various tools within the system. It also has to be complete, and completeness refers to î the ability of the MA system to capture all dimensions of the companyìs strategic actionï. This attribute is closely related to coherence. For the MA system to fulfill its functions, it not only needs to align with the strategy but also must measure all critical factors for its implementation and, at the same time, highlight the cause-and-effect relationships between decisions. The MA system has to be relevant, and the relevance is higher when the information it provides supports decision-making processes and evaluates alternatives, considering both the set objectives and the predefined selection criteria. The relevance of information should be assessed based on the type of decisions and their frequency. Different decisions, even with regard to the temporal horizon in which they will have their effects, require the use of different information. Regarding frequency, only specific information related to decisions concerning î normal administrationï needs continuous collection and processing, while

special situations may require ad hoc information processing (e.g., calculation of notional charges). It then has to be selective because the companyìs behavior is influenced by numerous internal and environmental variables. Only a limited set of factors almost exclusively determines the achievement of corporate objectives. To avoid wasting time and resources, it is crucial to focus management attention only on relevant factors. A process of îscreeningï is necessary, reducing the amount of provided data without compromising their informational content. Therefore, a system is more selective when it provides only genuinely useful and practically usable data, omitting irrelevant aspects. MA systems has to be formal accountable that is an attribute characterizing these systems in companies where a delegation process is underway. In such situations, tasks are divided into specialized subtasks under the responsibility and authority of individuals. If the delegation process is substantial and not merely formal, individuals are assigned objectives to achieve rather than being told how to perform the work. Goal definition within formal accountability aims to coordinate the behaviors of business operators and evaluate their performance. Goals can make decentralization of decision-making more or less effective. They are termed synthetic if they leave operators significant freedom in deciding how to achieve them, and analytic otherwise. While defining the degree of formal accountability is challenging, it can be stated that a system with high formal accountability is characterized by a more comprehensive set of objectives, including synthetic and analytic goals for activities, costs, etc. Low or even non-existent formal accountability occurs when no specific and formally connected objective exists beyond the general company goal, as in undifferentiated structure companies or those where there is no alignment between goals declared by top management and goals pursued in reality. Furthermore, in implementing the MA system, one must consider not only the advantages but also the costs associated with the system. While having a system that allows governing the company in any situation and quickly adapting to changes in cognitive goals, corporate strategy, and organizational variables is desirable, it often comes with high costs. Consequently, MA systems are partially operated with predefined procedures to address routine problems. The choice of procedural rigidity level is critical because highly structured systems are relatively inexpensive but do not allow situational adaptation. When deciding on

the systemìs flexibility level, it is essential to consider both internal and environmental complexity and market turbulence. The higher these attributes, the more critical it is to have systems that can be modified or adapted at a low cost. Another important aspect is the responsiveness of the system, and this refers to the systemìs ability to bring forth environmental or business changes, new problems, or opportunities, regardless of whether they were defined during the systemìs design. The MA system should avoid the risk of bureaucratizing or stiffening the decision-making process. It must stimulate responsible individuals to constantly monitor goal validity, allowing them to quickly identify and evaluate new strategic alternatives. Timeliness is another attribute of the MA system related to the time limit within which the occurrence of an event must be communicated to the entities responsible for managing the phenomenon in question. The systemìs promptness enables quick action in response to internal and external events, ensuring better opportunities for promptly leveraging advantageous situations and mitigating negative events through appropriate corrective actions. The informationìs timeliness must be chosen in relation to the nature of the information, the involved decision-making level, and the characteristics of the environment. MA systems has also to be oriented and the orientation of a MA system can be assessed in relation to various dimensions. The scenarios are extremely diverse, and any listing would be inherently limiting. As an illustrative example, a MA system can be oriented towards characteristic management or compliance with legal obligations, highlighting financial or operational management consequences (financial or income orientation), and may be directed towards disseminating information to all levels or only to the top (centralization or diffusion orientation), etc. The systemìs orientation is never singular, the actual orientation results from a combination of various factors. A critical decision within the system involves choosing between past and future orientation. The difference lies in viewing the future either as an extrapolation of the past, akin to deterministic logic, or recognizing that the future may have developments not precisely predictable by observing past events, as there are multiple conceivable courses of action. The past is not used to make value judgments about choices made, but rather imposes constraints on future action. Within future orientation, a further classification can be highlighted between short-term and long-term

orientation. The latter is obviously the logic adhered to by a prudent, judicious, and responsible management aiming to ensure the companyìs long-term survival. If systems are oriented toward the short term, the company will undoubtedly be led to immediate success, but there is a high likelihood that management myopia will compromise the companyìs ability to generate income in the future. MA systems have to be reliable. Reliability is often confused with credibility. The more accurate interpretation aims to express a broader concept. Reliability is an attribute with a strong subjective connotation, referring to the effectiveness and degree of acceptance by the business organization of the measurement methodologies of information flows, as well as the selected symbolism. This quality is vital for the system; only if it is considered reliable will users utilize the tools and associated information for decision-making purposes, consider the values representative of their performance, share them, and identify with them. Otherwise, the MA system will be seen as a burden, an additional and unnecessary bureaucratic obligation to be obstructed and resisted against. It is noted that, for the system to be accepted, two conditions are necessary: a deep understanding of both the companyìs system and the formal and informal organizational structure, and the involvement of individuals in both the design and review of procedures to reconcile their interests with those of the organization. Finally, the last aspect is the comprehensibility. It is essential that the MA system î speaks the same languageï as its output users. Information must be understood, or more precisely comprehended, so that it is used efficiently and effectively.

## 1.5 THE ROLE OF THE MANAGEMENT ACCOUNTANT

Throughout this evolution, the role of the Management Accountant noticeably transformed and turned into what Roehl-Anderson and Bragg (2005) compared to the shipìs navigator for his functions of monitoring and warning the captain of potential problems.

Originally serving as a classical bookkeeper, the Management Accountantìs primary responsibilities involved documenting all financial transactions within the accounting department. These transactions predominantly concerned supplier payments, customer

invoicing, and cash management. The Management Accountant̀s duty was also the production periodic financial statements without the inclusion of supporting footnotes, executive summaries, or other analytical components. The purpose of his role was therefore the collection and dissemination of data for performance for supporting the decision-making process (Simon et al., 1954; Hopper, 1980; Sathe, 1983).

Its nature saw a transformation with the advent of computerization, marking accounting as an early adopter of automation within corporate departments. Consequently, Management Accountants found themselves compelled to possess not only a rudimentary understanding of computer systems but also the ability to select, install, and operate them. In numerous smaller companies, the Management Accountants assumed the role of overseeing the management information systems department, as the accounting department emerged as the primary beneficiary of computer applications. This shift in responsibilities necessitated a set of new qualifications and the recruitment of individuals was more directed towards ones with higher education levels into the position. The newly appointed Management Accountants demonstrated a willingness to adapt their systems to optimize the utilization of new computer software, consequently enhancing departmental efficiency.

During the 1970s and 1980s, Chief Executive Officers (CEOs) began expressing concern for the efficiency of all company departments, including the accounting function. Fueled by the influence of prominent consultants like Michael Hammer, the author of î Reengineering the Corporation,ï (Hammer and Champy, 1993). Management Accountants faced increasing pressure to innovate their departmental operations to eliminate inefficiencies systematically. This evolving landscape led to the departure of antiquated Management Accountants resistant to new systems.

Since the turn of the century, the trajectory of the Management Accountant̀s role has continued along the established trend, with a primary focus on meticulously managing the accounting department̀s costs and efficiencies. Simultaneously, the Management Accountant leverages their adeptness in process and financial analysis to provide valuable assistance to various segments of the corporation. The role of the Management Accountant

has therefore evolved from that of a senior clerk to one of the most sophisticated, highly educated, and indispensable positions within the entire corporate structure.

Nowadays, Management Accountants perform different activities, such as, for example, planning. They run task allocations, defining the nature and timelines for assignments within the accounting department. This particularly emphasizes the request handling of transactions and the production of precise financial statements. Furthermore, the Management Accountant extends their influence to guide the budgeting process across various departments. Management Accountants also have organization responsibilities. Central to the role, the Management Accountant secures well-trained accounting personnel, constituting a pivotal organizational priority. This extends to acquiring requisite floor space, office equipment, and computer infrastructure to facilitate the seamless completion of designated tasks. In fostering a collaborative environment, the Management Accountant also ensures harmonious teamwork among departmental employees, aligning their efforts with the strategic plans set forth. They of course diligently evaluate the departmentìs performance across key dimensions, striving to uphold or exceed established standards and promptly addressing any identified errors. They are proficient in both written and oral communication, the Management Accountant critically reviews, interprets, and provides recommendations on corporate financial performance, effectively conveying insights to the broader management team. Finally, they periodically scrutinize and evaluate the efficiency of major transactional processes, balancing the need for stringent financial controls with a commitment to cost-effective and efficient operations.

The role of Management Accountant is now described as being pivotal across the organization. He performs different tasks; he has different responsibilities, and he works with each of the other functions of the organization. The debate in the literature is in fact pointing at the Management Accountant as business partner thanks to his contributions to the decision-making process (JÊrvenpÊÊ, 2007; Ahid and Augustin, 2012). To be business partners means that Management Accountant should acquire great knowledge about the organization and all its processes, functions and actors (Pierce and OìDea, 2003; Spraakman et al., 2020).

# CHAPTER 2

## *THE RELATIONSHIPS BETWEEN MANAGEMENT ACCOUNTING SYSTEMS AND BUSINESS INTELLIGENCE & ANALYTICS SYSTEMS*

### 2.1 THE "JOURNEY" OF THE MANAGEMENT ACCOUNTING INFORMATION

The typical process of elaboration and diffusion of MA information was well theorized by Catas″s and Gr˘jer (2006). In particular, these authors identified three distinct but interconnected steps: production, transmission and reception.

The production phase is the one within which data and measurements are being identified and selected in order to produce information.

In this context the involvement of the Top Management could improve the results of this phase (Chiucchi and Montemari, 2016).

Existing research underscores the criticality of engaging managers from the inception of the production phase, aiming to foster collaborative engagement and heightened attention, thereby enhancing the prospects for strategic application of the ultimate measurement outcomes. Nevertheless, this stage alone is insufficient for the practical deployment of the generated information and insights in decision-making processes. The intensity and probability of analysis application are profoundly influenced by the effectiveness of subsequent transmission and reception phases.

Thus, the role of management transcends mere peripheral involvement in the information and knowledge creation process, extending to active participation in the definition and evaluation of the production phase. This approach cultivates a deeper sense of responsibility and awareness within the managerial cadre regarding the process.

In addition, this phase can never be standardized because of the peculiarities of each organization. However, there always are some common traits among the production phases.

First, it is always necessary to gather data. This task can be accomplished by selecting data from various sources, like operational systems, ERPs, or CRMs.

Raw data then need process of cleaning to prepare them for effective analysis. This refinement particularly addresses characteristics such as redundancy ó excessive data beyond practical utility, inaccuracy ó erroneous data entry, incompleteness ó missing value notifications, and inconsistency ó contradictory data values.

These issues are rectified through an Extract, Transform, and Load (ETL) process. This process empowers data analysts to cleanse and standardize data, facilitating its management and practical utility through stages of cleaning, transformation, aggregation, completion, and uploading into one or more organizational databases. The transmission phase involves selecting the appropriate information and disseminating it. In this stage, Management Accountants must carefully consider the relevance of the information provided to decision-makers and ensure effective presentation for maximum impact (Catas″s and Gr˘jer, 2006). The effective presentation is carried out also by selecting the right means to do it and how to do it (Hansoff I. H., 1987). The success of this step is identified by how much the organization will be mobilized to take actions after seeing the information they received with the BI&A system.

For an effective mobilization there are different approaches that could be used. The first one is developed by dramatizing indicators. Specifically, it comprehends visualization, classification, and dramatization activities. Visualization involves analyzing and highlighting a particular business context to the management and the entire organization; classification means creating indexes related by cause-and-effect and establishing a logical order of these indicators; dramatization of indicators aims to create attention and debate around the analyzed problem or phenomenon based on the produced indicators, to mobilize and interact with the managerial bodies. The fundamental idea here is to create a representation through

scenarios and characters, presented as a î dramaï with a sequence of episodes and elements linked logically and with a certain level of climax.

A second approach is the use of casual maps. Casual maps are tools able to define and formalize casual relationships among causes and effects of various determinants within the organization (Hansoff I. H., 1974). In relation to this phase the means and the most effective ways to communicate to the selected audience will be highlighted.

The transmission phase is so crucial that without an effective one there is the risk that information will be diffused but without impact and lose the possibility to take data oriented strategic decisions.

The final step involves receiving the information, which pertains to the consequences that occur after the information has been transmitted. If the information is well-received, it should prompt decision-making, and even deciding not to make any changes is a decision that reflects a certain level of awareness (Catas″s et al., 2007).

This phase accentuates the potential of a causal connection between the measurements, their presentation, and the managementìs responses to substantially influence the conduct and choices of the companyìs leadership, thereby affecting corporate outcomes (Mintzberg H., 1996).

A frequently discussed concern in numerous studies is the corporate leadershipìs disregard for produced measurements, particularly when dealing with specific types of measures and indicators.

For instance, Chiucchi and Montemariìs exploration in the domain of intellectual capital measurement within a small-medium enterprise context underscores this point (Chiucchi and Montemari, 2016). A critical variable that emerged, as previously alluded to, was the imperative of accurately defining and measuring human capital. This is intricately linked to the concept of management mobilization, defined as the process of transitioning an organization from a passive to an active state, focusing on resource organization (of all types)

to initiate action. Thus, mobilization entails the act of amassing attention, resources, and engendering action.

In conclusion, it can be said that the reception phase is integrated and influenced by the activities of the production and transmission phases. The latter, in particular, implies the use of an effective communication to be impactful. This aspect will be explained during the thesis within the front-end step.

## 2.2 INFORMATION SYSTEMS: KEY CONCEPTS AND INFLUENCE ON MANAGEMENT ACCOUNTING SYSTEMS

In order to undertake the journey that leads MA information to be properly produced, transmitted and received, MA needs Information Systems. The connection between Information Systems and MA has been examined through various approaches since the 1980s. It was during this period that authors began to articulate their understanding of what constitutes an Information System. Camussone (1977) defined an Information System as a group of elements that gather, elaborate, exchange and register data with the purpose of producing and distributing the right information to the people that need it. Other authors focused more on the procedural aspect of the Information System. Marchi (1984) asserted that the Information System is an organized assembly of individuals, technicians, resources, and methodologies.

The initial definitions lacked an emphasis on the connections among elements, a concept that emerged in 1988 when Marchi, for the first time, proposed that the Information System could be identified not merely as a group of elements but as elements all interconnected by robust relationships (Marchi, 1988).

The definition of the concept of Information Systems reveals a distinct connection with the concept of MA. While MA is involved in generating financial and managerial information essential for the decision-making process within the organization, Information Systems comprise the computer systems and infrastructure that collect, process, and distribute data and information within the organization. They both play roles in the stages of information

production and distribution, and these aspects represent the primary links between them. In this context, the initiation of Information Systems implementation should commence with an analysis of the business environment, giving special consideration to the nature, frequency, and interrelationships involved in the decision-making process. This helps identify information needs and the corresponding desired responses (Marchi, 2003).

In summary, as highlighted by Chiucchi and Montemari (2021), the consistent evolution of Information Systems in recent decades has influenced MA systems in three key ways:

- temporal: Information Systems have significantly reduced the time lag between individual transactions and their reconciliation with the intended objectives. This has facilitated an enhancement in feed-forward analysis, a trend further intensified in recent years with the introduction of new forecasting features in the systems (Marchi and Quagli, 1997);
- spatial: the integration capabilities of Information Systems have facilitated the broader dissemination of MA principles throughout the organization, reducing certain informational barriers that were often a primary cause of conflicts (Mancini, 2010). The introduction of new Information Systems has also enabled the connection between internal and external sources, signifying a significant advancement in terms of spatial impact (Marchi, 2003);
- quantitative: Information Systems have created opportunities to handle vast volumes of data, whether historical, current, or future (Marchi and Quagli, 1997).

All these benefits can drive the evolution of MA systems. Starting from initially unstable, slow, and non-integrated systems, they are bound to transform into stable, timely, and integrated ones, complete with forecasting modules for forward-looking projections (Marchi, 2004). With well-structured Information Systems, it is also feasible to implement solutions aligned with Strategic MA, which aims not only to verify the attainment of strategic objectives but also to monitor the progress of internal and external factors to identify opportunities or threats (Brunetti, 1987; Paolini, 1993).

From a technical point of view Information Systems are all composed by three types of infrastructures: hardware, software, communication. The hardware infrastructure concerns the tangible components, and it is typically composed of 4 types of them: input technologies, elaboration technologies, memorization technologies, and output technologies.

Input technologies are the ones used to introduce data in a computer, elaboration ones are used to transform input into output; output ones are the ones used to present data, and the memorization are used to permanently store the information. Elaboration technologies are all the components created for the elaboration of the information, like ROM or RAM. Output technologies are used to visualize and present data, such as monitors or video components. Finally, memorization technologies concerns all the components in which data can be stored, like hard-disks.

The software infrastructure is composed of programs and procedures through which the computer can ran several functions. It is therefore an intangible asset and as already explained the main difference among information systems is their capacity and purpose to store and analyze data for transactional or decision-making purposes.

Finally, the communication infrastructure is the complete architecture that allows users and computers to be interconnected. It is composed by both tangible and intangible components. The main element of the communication infrastructure is the computer network. It is represented by the connection between two or more computers through a transmission medium in order to carry out data transmission. All computer networks require three essential components:

1. at least one sending and one receiving computer that have something to share;

2. a transmission medium or line, such as a cable, for sending the message;

3. a protocol that defines the communication rules between the sender and the receiver.

Information systems can be divided into two main categories: operational systems and informational systems.

The differences between them are several and make them two totally different types of systems, in relation to both their technical architecture and their concrete applications.

Operational systems are information systems whose purpose is to support the organization in doing all the daily activities, such as transactions and operations. These are the systems used for the accounting, warehouse, production, sales, etc.. They therefore are always used in a daily basis to register all the transactions of the organization.

They are built to register the transactions, plan and control the operations, acquire and organize knowledge, and elaborate organizational scenarios.

The Enterprise Resource Planning (ERP) is the main example of operational system.

On the other hand, informational systems are systems born to harness all the data heritage of the organization. The data used and produced during all the processes of the organization can now be gathered, elaborated, and analyzed for supporting the decision-making of the organization and that is the reason why informational systems were born. Operational information differs in a very clear way from the informational information for several aspects.

First, their while operational systems focus on managing daily activities and maximizing operational efficiency, informational systems are directed towards providing crucial information to support strategic decision-making and long-term management of the organization. Operational systems are designed to carry out daily transactions and operational activities of the organization. This includes tasks such as recording orders, managing inventory, billing, and other basic operations. They provide support for the organizationìs basic functions, ensuring that daily activities are carried out smoothly and consistently. For example, an operational system might be used to record orders and manage the supply chain.

Informational systems aim to provide information useful for strategic decision-making at all levels of the organization. These systems analyze historical and current data to identify trends and provide information supporting managerial decisions. The primary objectives of informational systems include data analysis and the generation of meaningful reports. These

tools provide a broader view of organizational performance, enabling the evaluation of strategies and identification of opportunities or issues. They contribute to efficient resource management by providing key information on organizational performance, resource utilization, and customer satisfaction. This helps optimize operations and ensure effective resource management. Informational systems support strategic planning by providing data and analysis that guide the organizationìs long-term decisions. These tools are used to predict future trends and develop growth strategies.

- structure: operational systemsì data concern events of the organization, while informational systemsì data concern analysis of the information.
- users: operational systems are used mainly by operative users and first lines of managers, while informational systems are used by decision makers.
- data timespan: operational systems are not built to keep track of the past and gather all the historical records of the organization: they concentrate on the actual flows. On the contrary, informational systems are based on historical data and for this reason the main data structure that constitutes the foundation of them is the data warehouse.
- detail: the level of details of the operational systems is at his maximum. Users of them should have the possibility to know all the possible details of the transaction it is processing at the moment. Instead, informational systems level of details could be less precise and more aggregated because decision-makers do not need that detail to take aware decisions.
- access type: operational systems allows interaction and users can update, add, or sometimes cancel data. Informational systems purpose is only the analysis of historical data and for this reason users can only take read only data without the possibility to change anything in the native sources of the data.

Given the aims of this Doctoral Thesis, the following section will present the key concepts and components connected to the Business Intelligence & Analytics systems, one of the main types of informational systems.

## 2.3 BUSINESS INTELLIGENCE & ANALYTICS SYSTEMS: KEY CONCEPTS AND COMPONENTS

### *2.3.1 An overview on Business Intelligence & Analytics*

In the ever-evolving landscape of digitalization, a considerable amount of confusion has ensued, particularly concerning the terminology and definitions related to Business Intelligence (BI), Business Analytics (BA), and Big Data. The rapid pace at which technology has advanced has given rise to various interpretations and proposed definitions, yet a shared consensus remains elusive. The dynamic nature of these fields has spurred ongoing debates, emphasizing the need for clarity and standardized definitions. It becomes crucial to foster a common understanding, facilitating more effective communication and collaboration in the realm of Business Intelligence & Analytics.

In 2017, Mashingaidze and Backhouse took a significant step towards bringing order to the literature by publishing an article that meticulously reviewed both academic and practitioner perspectives on the topic. Due to the various terms used to define tools and techniques to exploit data and improve decision-making, their objective was to synthesize them and the main result of their work was the production of the definitions of the following terms: Business Intelligence, Business Analytics, and Big Data.

From the 1970s the technology that allows the data to support the decision-making process has never stopped its growth and this resulted in a severe confusion in terms of definitions and taxonomy (Watson and Marjanovic, 2012; Gillon et al., 2014).

To cite some examples, C˜rte-Real et al. (2014) combined BA and BI and used the BI&A term for their article; Bayrak (2015) treated the three terms as synonymous; the majority of the authors who investigated data-driven tools to support decision-making almost exclusively used BI as leading term and this is clear in the work that Chen et al. (2012): from 2000 to 2011 the keyword î Big Dataï was used 243 times, the keyword î Business Analyticsï was used 213 times, and the keyword î Business Intelligenceï was used 3.146 times (Chen et al., 2012).

All the terms were analyzed both within the academic literature and the practitioner one and the definitions were all then gathered and compared.

The academic definitions of the term îBig Dataï were all describing it by its dimensions. The common aspect of all of them was the letter îVï as starting letter but they sometimes differed among definitions because some authors wanted to emphasize some dimensions rather than others. Velocity, Variety, and Volume were always cited as dimensions. Then, Veracity, Value, Variability were added during the years (Akerkar, 2014; Ebner et al., 2014; Dhar and Mazumdar, 2014; Gupta et al., 2015; Bergelt et al., 2014).

Academic authors also highlighted the fact that conventional technologies were not capable of working with Big Data because their structure implies advanced technologies and techniques (Chen et al., 2012; Ebner et al., 2014; Kabir and Carayannis, 2013).

Moreover, also practitioners defined the term îBig Dataï by describing its dimensions and even in this case the definitions were not homogeneous in relation to the dimensions used. Davis (2014), Lamont (2012), Watson and Marjanovic (2012), and Williams (2014) defined Big Data with the traditional three dimensions: Volume, Variety, and Velocity. Liu (2015) and Vahn (2014) added Veracity as fourth dimension, while Brands (2014) added Validity, Venue, and Vocabulary.

Regarding the term îBusiness Intelligenceï, academic authors defined it as an umbrella term that gather applications, technologies and processes to collect, elaborate and analyze data (Gupta et al., 2015; Hu et al., 2014) and they were totally aligned with practitioners because they agree in defining the aforementioned term as an umbrella term for applications, processes, and technologies to explore and analyze data for supporting the decision-making (Brands, 2014; Hyle, 2012; Jaeger, 2010; Watson, 2015).

In defining the last term îBusiness Analyticsï, academic authors focused on the analytical nature of the aspects connected to Business Analytics. In fact, Sharda et al. (2013) described it as the process of making decisions based on descriptive, predictive, and prescriptive

analytics. Marjanovic (2013) defined it as a set of applications, technologies and processes for collecting, storing and analyzing data to support the decision-making process.

Practitioners were not always aligned. Someone used the same approach of academics, like Levis (2012) and Vahn (2014), while other emphasized the mathematical and statistical techniques related of the Business Analytics concept (Williams, 2014; Watson, 2015).

To summarize, all the definitions of the term î Big Dataï referred to it as î great volume of data that cannot be storedï and they all used dimensions with î Vï as initial letter to define the characteristics of Big Data, such as Volume or Velocity. The main difference among practitioner and academic definitions was the fact that academic ones took a step forward and highlighted the need for advanced technologies to manage and techniques to manage Big Data.

The î Business Intelligenceï term was not so differently defined between academics and practitioners. For both of them BI has always been the term to define the technologies and procedures for collecting, storing, organizing, and analyzing data for supporting the decision-making processes.

Finally, î Business Analyticsï was referred to the analytical part of the BI process. Practitioners and academics were almost aligned in affirming that BA as a term was referred to the descriptive, predictive, and prescriptive analytics methods. They then used this term when speaking about the technical peculiarities of the analysis side of the BA.

Thus, given that BA is usually conceptualized as a part of BI, after 2012 that some Scholars proposed the amalgamation of these two concepts into a unified term. Chen et al. (2012) advocated for the unification of Business Intelligence and Analytics (BI&A), emphasizing their substantial similarities, and this perspective gained traction also among other researchers. For instance, Lautenbach et al. (2017) employed the unified term to examine factors influencing the extent of BI&A usage in South African organizations. Similarly, Jaklic et al. (2018) utilized the unified term to explore the role of compatibility in predicting BI&A use intentions. Rikhardsson et al. (2018) also embraced the definition of

Chen et al. (2012), as it accommodated emerging areas in analytics, including mobile and sensor-based content, as well as Big Data. Consequently, it can be asserted that in recent years, the traditional concept of BI has evolved into BI&A within the scholarly discourse.

### 2.3.2 The architecture of Business Intelligence & Analytics Systems

Kemper (2013) accurately described the architecture of the BI&A tools, procedures and activities. In doing so, he presented a three layers framework representing the entire flow of data typical regarding the BI&A as shown in the figure below.

Figure 1 - The architecture of a BI&A system
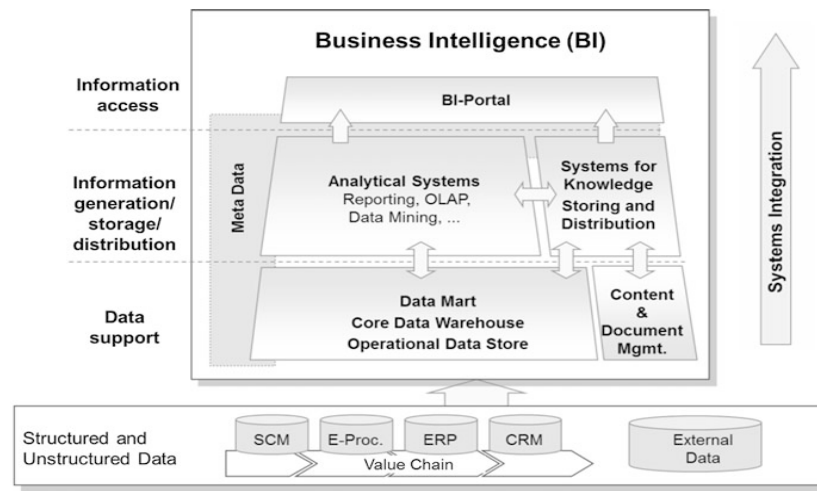


Source ó Kemper (2013, p. 23)

#### 2.3.2.1 The architecture for data collection and preparation

At the foundational level of the structure lie the data sources. Data, primarily, can be categorized as internal or external. Internal data are generated by the organization itselfò examples include sales data, operational data, and human resources data. These data emanate from various databases where the organization maintains its information. On the other hand,

external data are acquired from sources outside the organization. For instance, if the finance function wishes to assess the current status of certain customers or suppliers, it might procure specific balance sheets data from financial data banks and integrate this external information with its existing data related to the particular subject of analysis.

Another categorization of data pertains to its structure. Data can be classified as either structured or unstructured. Structured data possess fixed formats that facilitate transformation and analysis for organizational reporting. Typically stored in relational databases, these data are overseen by specialists in data management. In contrast, unstructured data lack fixed formats and are often associated with images, text, or multimedia content. Importantly, they cannot be accommodated within relational databases.

As illustrated in figure 2, the amalgamation of all data sources into the BI&A flow involves various stages. These phases collectively constitute the broader Extract, Transform, and Load process (ETL).

The ETL process serves as the core of the Business Intelligence and Analytics flow, encompassing distinct phases. As shown in figure 2, these phases involve extracting data from the original sources, transforming it to meet specific information requirements, storing and structuring it in data warehouses, and disseminating it throughout the organization via dedicated distribution channels (Jun et al., 2009).

Figure 2 - The ETL process
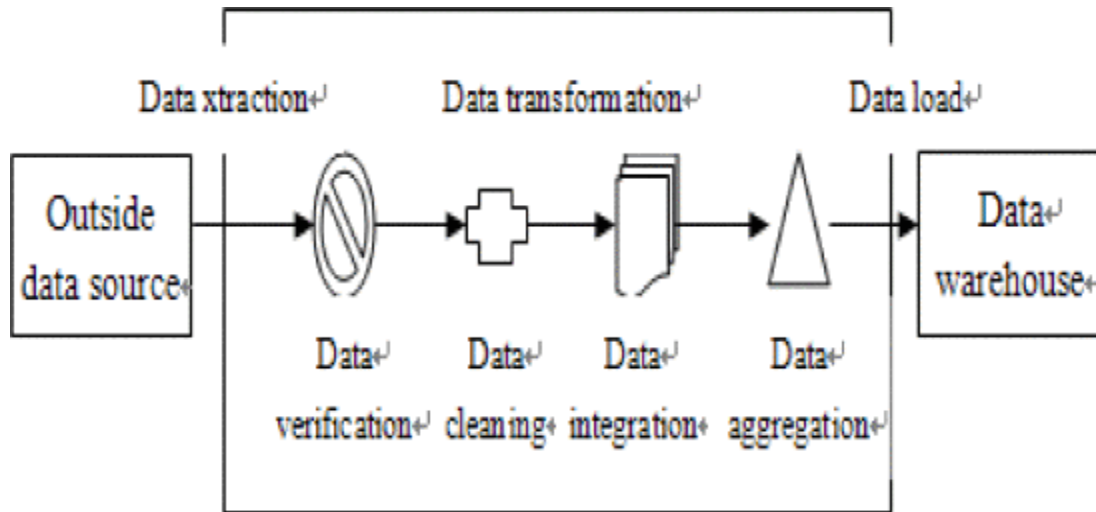


Source – Jun et al., (2009, p. 620).

Following the extraction of data from internal or external sources, an immediate assessment of data quality is imperative. Analyzing data quality involves examining for missing, redundant, incorrect, or duplicated data. Additionally, it entails scrutinizing the structure of tables containing the data, as they may be incorrect or unsuitable for the analysis phase. The outcomes of the data verification phase dictate the actions to be taken during the data cleaning process, a set of procedures designed to cleanse and prepare the data for subsequent phases.

Once the data is prepared for analysis, it is integrated and aggregated in a comprehensive relational database known as a data warehouse. The data warehouse forms the foundation for data visualization tools, facilitating analysis and distribution procedures.

Datawarehouse are specific collections of data conceptualized during the late 90s for BI&A needs (Debei, 2011). Differently from well-known On-Line Transaction Processing (OLTP) databases, which are application-oriented, detailed, and operational (Ramamurthy et al., 2008), the Datawarehouse is îa *subject-oriented, integrated, non-volatile, and time*

*variant, non-updatable collection of data to support management decision-making processes and business intelligence*ï (Inmon, 2002: p. 31).

Datawarehouse are the basis of an effective BI&A system because they are the place in which data are gathered, integrated, certified and supplied to the reporting and visualization tools to diffuse the information within the organization. (Negash, 2004; Ramamurthy et al., 2008).

One of the main peculiarities of a datawarehouse is its capacity to provide useful and valuable information at all levels of the firm. As Alshawi et al. (2003) explain in their work, datawarehouse comprehend the features mentioned in table 1 below.

Table 1 - The features of a datawarehouse

| Features | Description |
|---|---|
| Subject-Oriented | Datawarehouse are subject-oriented, focusing on specific subjects or areas relevant to the organizationìs decision-making needs, such as sales, finance, or customer relations. |
| Integration of Data | They integrate data from disparate sources, including operational databases, external data, and other relevant repositories, creating a unified and consistent view of the organizationìs information. |
| Time-Variant Data | Datawarehouse store historical data, allowing users to analyze trends and changes over time. This time-variant nature |

| | enables organizations to make informed decisions based on historical context. |
|---|---|
| Non-Volatile Storage | Data in a warehouse is typically non-volatile, meaning that once stored, it is not frequently updated or changed. Instead, new data is added to the warehouse to maintain historical accuracy. |

Source -  Alshawi et al. (2003)

These peculiarities are the ones that make them informational databases rather than transactional ones. In fact, datawarehouse differ from the most common transactional databases because they are informational structures of data (Someh and Shanks. 2016)

Transactional IT systems are informatic architectures built to automate organizational processes to cut costs and increase efficiencies (Aral and Weill, 2007).

Once the ETL process is complete and the datawarehouse is built, data are ready to be elaborated to design the most adequate visualizations and reports to answer the information needs of the decision makers and all the users of that information.

### 2.3.2.2 The architecture for data analysis

The main data analysis techniques that could be used in this moment descriptive, predictive, and prescriptive ones.

Descriptive analysis uses data mining procedures to get insights on what has happened in the past. This technique serves as the initial stage of the data analysis process, providing an overview of past or current events. It lays the groundwork for further analysis stages by facilitating an understanding of trends and patterns within the data. Predictive analysis uses statistical methodologies and forecasting to know what is likely to happen in future. It relies

on patterns identified in historical and transactional data to assess risks and opportunities, offering forecasts about what may occur in the future under specific conditions. Finally, prescriptive analysis uses specific algorithms to find the best actions considering what is likely to happen in future. It not only anticipates future events, including their timings and reasons, but it therefore is crucial to suggest decision options for leveraging future opportunities or mitigating future risks, and illustrates the implications of each decision option. Prescriptive analysis advises specific actions based on the outcomes of predictive and descriptive analyses (Roy et al., 2022).

### 2.3.2.3 The architecture for information delivery

At this point of the process data are gathered to build what is defined as a graphic user interface which comprises a combination of information and visualization methods for monitoring data and support decision-making (Pettit and Leao, 2017). Performance dashboards are therefore the final output of the whole BI&A data flow, and they are the ground in which decision makers will daily work and their window to all the information of the organization. These representations of data are not easy to build because users can be biased or differently experienced in working with data or technological systems. For this reason, there are several issues that should always be taken into account when implementing a performance dashboard.

User interface is critical and, thus, designers should pay attention to the way final users will navigate the information because it will affect their productivity and the effectiveness of the consequent decisions (Few, 2006).

Secondly, as it will be deeply explained in the following sections, dashboards should be implemented by following specific visualization principles. These aspects help reducing the time spent on analyzing the data and improve the quality of the information (Malik, 2005).

As Eshraghi (2008) affirmed, the performance dashboards should focus on design, accessibility, and security and should be easy to use, web accessible, and business driven.

They should of course be customizable for the different users and for the different scenarios the organization lives (Resnick and Miami, 2003).

The main risks that could be encountered while implementing a performance dashboard are connected to aspects like the overload of information. Excessive information has the potential to create a cluttered dashboard, causing distractions for users. It is advisable to offer detailed information only when users explicitly request it (Cleverley, 2001; DeBusket al., 2003). Another aspect is the limited information. A well-designed dashboard should encompass not only current or past data but also feature a diverse range of data types to ensure its usability (Hansoti, 2010). Also, dashboards should have simple user interfaces because they are typically designed for executives and managers with limited time to familiarize themselves with new technology. The navigation should be crafted for user-friendly accessibility, ensuring that users can effortlessly navigate through the dashboard without any difficulty (Collier et al., 2008). Finally, implementing a dashboard requires incorporating security as a crucial element. To guarantee data integrity, it is essential to include audience targeting and role-based security measures (Eshraghi, 2008).

As already mentioned, the core focus of the design of the dashboards is the implementation of the graphic and interactive features of them, aspects that are part of the subject of Data Visualization. Surprisingly (or not) the ability to communicate with data is not obvious, instead it is very difficult to find the right way to diffuse information and make them turn into knowledge.

The most common mistakes are related to the peculiarities of the instrument, the ability to use the adequate graph in specific situations, and the ability to respect graphic rules in the design phase (Knaflic, 2015).

A particular problem is the graphic excellence. With this term the Knaflic (2015) refers to the ability to accurately present data, emphasizing the clear, precise, and efficient communication of particularly intricate concepts. Graphic excellence also aims to provide the observer with a multitude of ideas in the briefest timeframe, utilizing minimal ink and

space. It generally involves incorporating various elements and necessitates consistently conveying truthful information about the data.

Stephen R. Midway (2020) in the article titled î Principles of Effective Data Visualizationï designs the ten principles to follow to be build effective visualization of data.

First, the designer should start by prioritizing the information to convey before diving into the technicalities of visualization. Moreover, the designer should focus on the message rather than getting caught up in geometric details. Whether mentally or with pen and paper, the designer should think about the core information you need to communicate. Additionally, the designer should save effective figures from scientific literature for inspiration and to develop his/her eye for detail and technical skills. Secondly, effective visuals demand proficiency in specialized software. Using basic tools limits the creation of complex, technical figures. To overcome this, the designer should learn new software or enhance existing skills. While crafting impactful visuals may pose challenges, it is a skill that requires adopting new methodologies. Similar to improving lab methods, data visualization proficiency necessitates change and learning. Fortunately, numerous affordable or free visualization tools with extensive online support are available. The designer should also use effective geometries and show data. Geometries define the shapes in data visualization, but choosing the right one is crucial. The data-ink ratio, emphasizing efficient data representation, should guide this choice. Geometries fall into categories like amounts, compositions, distributions, and relationships. Common geometries include bar plots for amounts, cautioning against their low data density. Compositions can use alternatives like stacked bar plots. Distributional data benefits from underused visuals like box plots. Relationships often employ scatterplots, with a reminder to distinguish raw data from statistical models. Despite the prevalence of bar plots, their misuse is common. Compositions have diverse alternatives, while distributions benefit from high-density visuals. Relationships are foundational, with scatterplots being effective. Emphasizing the importance of displaying data alongside geometries provides context without detracting from the figureìs focus. Designers should also always pay attention to colors. Color is a powerful tool in visualization, and its use is generally recommended. Even

if print costs deter color figures, most journals allow free digital color. Research indicates that colorful visuals are more memorable, especially with seven or more colors. In todayìs digital era, color is cost-effective, but its use should be intentional. Color conveys information directly or subtly, with three common schemes: sequential, diverging, and qualitative. Recommendations include designing figures effective in both color and black-and-white, considering colorblind readers, and using transparency for nuanced visuals. Strategic color use enhances visual messages, making it crucial in digital environments where itìs readily accessible. Uncertainty is another important aspect to consider. Understanding systems inherently involves uncertainty and neglecting it in visuals can mislead. Challenges in incorporating uncertainty include omission and misrepresentation. Figures often skip uncertainty, leaving parts of the statistical message unaddressed. Adding uncertainty is feasible with error bars or shaded intervals, either explicitly or implicitly. Representing uncertainty involves metrics like standard deviation, standard error, confidence, and credible intervals. Choosing the right measure requires reader familiarity. Standard deviation reflects population spread, while standard error focuses on mean uncertainty. Confidence intervals show reliability, and credible intervals, tied to Bayesian methods, have probabilistic implications. Emphasizing uncertainty is crucial, but clarity in interpretation is vital. Error bar presence does not ensure significance, emphasizing the need for specifying uncertainty type and interpretation. Some caution against standard error use due to unclear information on mean differences. Showing data, especially with low sample sizes, helps avoid misinterpretations. Furthermore, an effective visual strategy involves employing the technique of small multiples, also known as paneling or faceting, where a specific figure is repeated to emphasize variations. The underlying principle of small multiples lies in maintaining consistent design elements such as axes, axes scales, and geometry across panels. This uniformity facilitates the clear representation of differences in the data. Each panel within this approach signifies a change in a specific variable, such as a time step, a group, or another relevant factor. The primary objective of employing small multiples is to ensure the inherent comparability of data, with successful implementations invariably achieving meaningful comparisons. It is then important to understand that data and models are different

things. Information in plots can be raw data, summarized data, or inferential statistics like fitted regression lines. Raw and summarized data are usually straightforward, but explaining a plotted model may be necessary for full replication. Any model in a study should be reported comprehensively for reproducibility. When featuring a model visually, the figure caption or document should explain or reference complete details. It is unacceptable to show a model in a figure without allowing readers to trace back its details. Mere addition of a modelìs geometry to a figure is not sufficient; clarity and transparency are crucial considerations. It is then important to ensure clear communication in visual data and this involves not just maximizing data-ink ratios but also crafting detailed, standalone captions. Captions should independently convey key points, even if separated from the rest of the study. While not all figures can be fully standalone, the principle remains: captions must thoroughly explain visualizations, clarifying any geometries used. For instance, in a scatterplot, it should be stated that black dots represent the data. Even seemingly familiar visuals like box plots require detailed geometry descriptions, as assumptions about universal symbols may not hold true in all cases. It is then important to consider infographics. Distinguishing figures from infographics can be challenging, but figures typically represent data, while infographics incorporate text, images, and other visual elements. Although not universally recommended, studies show infographics have the highest memorability scores. Scientists can enhance information transfer with effective blending of diverse elements in infographics. These visuals are particularly impactful in non-peer-reviewed settings, such as presentations, requiring less technical detail. Even if infographics are not widely adopted, adding text or annotations to technical visuals is beneficial. However, as figures move towards infographics, it is essential to avoid unnecessary visual elements, ensuring clarity and eliminating chart junk. Finally, effective data visualization transcends theoretical principles; it hinges on reader connection. Authors are urged to seek external reviews for their figures, often swiftly created without objective scrutiny. Engaging colleagues or external reviewers exclusively for figure assessment not only streamlines the process but also garners insightful feedback, untainted by textual context.

## 2.4 THE RELATIONSHIPS BETWEEN MANAGEMENT ACCOUNTING SYSTEMS AND BUSINESS INTELLIGENCE & ANALYTICS SYSTEMS

In view of the close connection between BI&A systems and MA, research has started to investigate such relationship. In particular, Rikhardsson and Yigitbasioglu (2018) have recently reviewed literature on this topic showing that the relationship between BI&A systems and MA has been explored up to date along five distinct but interconnected research streams: information delivery and system feedback for MA tasks; BI&A systems to improve MA tasks and techniques; Big Data impact on MA; use and satisfaction with BI&A systems in MA contexts; BI&A systems and data quality.

In the following sub-section, each research stream will be examined in detail.

### 2.4.1. Information delivery and system feedback for Management Accounting tasks

The primary objective of the publications related to this theme was to ascertain the most effective way to present data in terms of visualization, interactivity, and system feedback to support the decision-making process. The research focused on three main categories: how information is presented by BI&A systems; the level of interaction between users and BI&A systems; the type of feedback provided by these systems.

Information can be presented in various ways, but the main formats include tabular or graphical representations. The research in this area builds upon early contributions to cognitive fit theory (Vessey, 1991; Vessey and Galletta, 1991). The level of interaction examines the system's capabilities to select, navigate, and drill into information across multiple dashboards. Meanwhile, the type of feedback provided by the system is associated with feedback and recommendation functionalities, and how these features impact the quality of information.

Aligned with the primary findings in cognitive fit theory, the majority of publications on this theme suggest that a fit between the presentation format, tasks, and user knowledge

enhances decision quality (Yigitbasioglu and Velcu, 2012; Dilla et al., 2010). On the contrary, when not carefully designed and diffused, accounting information may create bias.

BI&A solutions have increased the level of flexibility the organizations have in terms of management and design of the presentation format. In the past these tasks were handled by specific technical roles within the firms while now there is a wide range of users that can interact with the systems and create their own visualizations and models to analyze and to share information (Rikhardsson and Yigitbasioglu, 2018). This may be risky when managers may seem to be satisfied with some initial visualizations without fully exploiting the potential of multidimensional analysis (Peng et al., 2007).

It is clear that the design of a performance dashboard is a topic that requires additional research and should never be underestimated, especially when delivering multidimensional data. They are effective when the purpose of the communication is aligned with the functional and visual design features and are customizable for the specific type of user (Yigitbasioglu and Velcu, 2012).

Moreover, some authors pointed out that the presentation format interactivity is not always critical in terms of decision quality (Locke et al., 2015).

Some authors have extended these findings, emphasizing that decision-making strategies are carried on differently by the users, depending on whether and to what extent they are experienced or not (Yigitbasioglu and Velcu, 2012; Dilla et al., 2010). Users with low-level task-specific knowledge tend to rely more on graphical displays to minimize cognitive effort (Benbasat and Schroeder, 1977) while users with high-level task-specific knowledge apply analytical strategies. Arnold et al. (2004) affirmed that the usersì level of knowledge is determinant even when designing decision support systems because they may influence bias and lead to wrong perspectives. Aligned to this aspect, Dilla et al. (2013) found that the usersì expertise influenced the judgement and consequently the decisions that decision makers would take after interacting with a BI&A system (Dilla et al., 2013).

Consequently, research in this field should take into account the level of experience of the end users under investigation when analyzing how they value information delivery settings and decision quality.

Some researchers in the stream of information delivery warned that the features and presentation formats could create severe bias and designers should be aware of that. Chen and Koufaris (2015) found that the more the users are free to choose and interact and the more they may elaborate inaccurate conclusions because of their overconfidence (Chen and Koufaris, 2015).

Feedback and recommendations options are another relevant area of research in this theme. Some authors brought to attention the importance of feedback and recommendations features to allow a deeper understanding of the data (Cardinaels and van veen dirks, 2010), while others highlighted the risk that excessive dialogues with the system may decrease the space for taking decisions or constrain and bias user behavior (Seow, 2011).

The level of difficulty of the tasks should also be taken into account when designing the feedback and recommendation features for the system. Mascha and Smedley (2007) pointed out that feedbacks and recommendations should be well used for less-complex tasks to avoid the deskilling of accountants. Furthermore, accountants may also abandon the system if feedbacks and recommendations contradict them and it is crucial for the designers to acknowledge this danger (Jensen et al., 2010; Elkins et al., 2013).

Also, a factor that highly influences the interaction between the users and the BI&A system is the expertise. Jensen et al. (2010) studied the differences among different types of users in terms of expertise and they noted that feedback and recommendation features were more used by less experienced users while high experienced ones would rely more on their knowledge and competences. However, they also found out that both types of users improved their decision-making accuracy thanks to the system.

Beyond this challenge, there exist several research gaps that can be addressed through additional publications.

First, literature has often focused on the best between graphs or numerical data when data can also be communicated with different visualization techniques. Studies to understand what other visuals can be used and how to measure the effectiveness of them could be carried out. Also, what visuals are more appropriate for some specific tasks is an aspect that deserves additional attention. Case studies may be suitable methods to contribute to this need of knowledge.

It could also be interesting to map the different features of the systems in relation to the tasks of the Management Accountants since certain tasks may require more interactivity or visual design than others.

Furthermore, in the realm of advanced analytics, Machine Learning, or Artificial Intelligence, questions arise regarding the most suitable visualizations for communicating algorithmic results. An example of research question might be: how can clustering or classification procedures be effectively represented, especially for non-technical users? Qualitative case studies could shed light on the application of these emerging techniques. Furthermore, a deeper examination of the ífitì of visualization techniques for specific MA tasks is crucial. Different tasks may necessitate distinct features from a system; for instance, budgeting might require more interactivity or system recommendations, whereas monitoring performance might not.

Finally, understanding the evolving role of Management Accountants in this context is paramount. Their role may shift from being designers of management reporting systems to adopting more consultative and assistive roles. This shift involves aiding end-users in data interpretation and collaborating with IT personnel on BI&A system features. Additionally, as IT transforms tasks such as data registration and reporting, the value of creating knowledge from data increases. This points to a new role for Management Accountants, requiring them to be trained in data analysis, interpretation, and presentation, and to collaborate with emerging analytical functions within organizations (Phillips, 2013).

### 2.4.2. Business Intelligence & Analytics to improve Management Accounting tasks and techniques

The articles within this research stream delved into the examination of the influence of Business Intelligence and Analytics (BI&A) on tasks and techniques within the realm of MA. Comprising both conceptual frameworks and empirical contributions, these studies primarily explored the ways in which BI&A applications shape various MA tasks, decision-making processes, and their impact on diverse performance measures.

The key findings of these investigations are intricately linked to the transformative potential of BI&A in MA tasks and techniques. This encompasses areas such as cost forecasting, product profitability analysis, the alterations in business measures or dimensions, and the assessment of customer segment profitability. Consequently, the findings are closely associated with advanced analysis or impact analysis, as outlined by Bronzo et al. (2013) and Lee and Park (2005).

Management Accountants are therefore using BI&A systems to improve their work and support knowledge workers in their decision-making activities (Vuksic et al, 2013) and this improves organizational performance in several dimensions (Bronzo et al., 2013)

For this point the gaps that open the need for new contributions are highly connected to the process that should lead Management Accountants evolve their tasks.

Further exploration is warranted into potential tensions that may arise within the MA department and between IT and other functional areas (Kowalczyk and Buxmann, 2015). Questions arise about whether Management Accountants should be the ones applying complex analyses, their capacity to do so, the difficulties they may face in acquiring new technical competencies for this purpose, and how such endeavors might impact their behavior and relationships with other departments.

Additionally, an area that has been insufficiently investigated is the impact of advanced analytics techniques on MA tasks and techniques (Schneider et al., 2015). Research questions in this regard include: how do analytical techniques influence revenue and cost forecasting

as well as budgeting? What are the implications in terms of timeliness and accuracy? Delving into these aspects will provide valuable insights into the evolving landscape of MA in the context of advanced analytics.

### 2.4.3. Impact of Big Data on Management Accounting

Up until now, this theme has received relatively less attention, with the existing contributions predominantly adopting a conceptual approach. These contributions center on examining the implications of Big Data in the realms of MA, Financial Accounting, and Auditing.

A fundamental assertion is that Big Data is poised to exert a profound influence on Accounting as a whole. Disruptive changes are anticipated, particularly in tasks like real-time data registration, leading to a continual diminishing role for bookkeepers (Bhimani and Willcocks, 2014).

Furthermore, the capability to leverage entire datasets instead of samples suggests that Big Data will significantly impact procedures such as inventory or asset valuation methods, as well as the valuation of intangibles (Bhimani and Willcocks, 2014). Moreover, the inclusive nature of Big Data, encompassing unstructured data like images, text, or audio, opens up new frontiers of information for analysis. This expansive dataset complements the structured data that organizations have traditionally processed and analyzed (Warren et al., 2015).

One of the most significant influences that Big Data is poised to exert on MA is intricately tied to the decision-making process (Kitchin, 2014). Traditionally, decision-making involves scrutinizing the relationships between causes and events, with the Top Management team, supported by the MA department, aiming to predict future occurrences based on these relationships. In contrast, data-driven decision-making, facilitated by a comprehensive Big Data infrastructure, shifts the focus to discerning patterns in data to support actions, often overlooking the traditional emphasis on understanding the î whyï. The profound impact of data-driven decision-making extends to both Management Accountants and other functional

areas. For Management Accountants, this entails the ability to analyze economic and financial data with a broader spectrum of connections between causes and events. Simultaneously, other functions benefit from the integration of their performance data with economic and financial data. As highlighted by Phillips (2013), there is a prospect for MA to evolve into an integral component of a broader analytical function within the organization. This broader analytical function may encompass customer analytics, process analytics, and environmental analytics, reflecting the transformative potential of Big Data in reshaping organizational decision-making processes.

Themes such as data quality, data ownership, and data access have also been explored in the context of the impact of Big Data on MA. The significance of data quality in shaping Accounting practices serves as a cornerstone in this domain. Controls and reporting, particularly external ones, rely heavily on dependable data, and the procedures for certifying their quality are of utmost importance. However, the exponential growth in data quantity introduces a heightened risk of being unable to implement adequate procedures to certify all the data. This becomes particularly critical in scenarios where data is analyzed directly from transactional information systems without the establishment of suitable data warehouse (Troyansky, 2015; Word, 2014).

Linked to the data quality concern are the issues of î data ownershipï and î access.ï The pivotal questions revolve around determining who will assume ownership of vast amounts of data and the extent to which these data sets will be accessible and by whom. This poses a critical challenge for Management Accountants, and this domain warrants further investigation as it has been relatively underexplored.

The final area of exploration involves the impact of Big Data on MA competencies. Divergent perspectives exist, with some authors suggesting that Management Accountants merely need to comprehend the potential of Big Data without acquiring any new technical skills (Bhimani and Willcocks, 2014). Conversely, others argue that various new activities associated with Big Data will fall under the purview of Management Accountants, necessitating an update to their skillset with new technical competencies (Payne, 2014).

Numerous research gaps exist within the realm of the impact of Big Data on organizations and MA. Firstly, it is unclear what are the determinants of success when utilizing Big Data and it could be useful to deepen this stream to understand what technological, organizational and environmental factors affect Big Data usage and the value for the organization.

In this context there are several specific calls for research to study the impacts of Big Data on business models and business organizations. Lycett (2013) affirmed that with Big Data companies could change the way they create value through the process of dematerialization, density and liquification.

Big Data implies additional sources of data and additional categories of usable data and the analytics technologies allow the identification of new insights. This influences business models and Management Accountants have to adapt to the new forms of organization models and processes and this aspect should be better studied (Woerner and Wixom, 2015).

Also, clarity is lacking on how Management Accountants will effectively leverage îBig Dataï and the specific competencies required for this task. With the advent of social media and mobile computing, questions arise about the nature of new dashboards. Some potential research questions might include: How will these dashboards be designed to encapsulate the vast Big Data landscape of an organization? What elements will they incorporate to aptly represent this intricate environment?

Another significant gap pertains to the influence of MA on decision-making processes. If Management Accountants can discern correlations among numbers, there is potential for them to enhance decision support by providing a comprehensive view of the causal relationships underlying all events within the organization, both internal and external.

Big Data is also allowing organizations to better evaluate the performance of the employees through techniques like process mining web traffic activity and other behaviors (Van der Aalst, 2014). It would be interesting to study if and to what extent this possibility will lead to better organizational performance and if and to what extent this will instead lead to deflate motivation or borderline activities in terms of democracy and privacy.

In this sense, there is a wider need to understand all the possible negative impacts of Big Data both for organizations and market in general, like the potential to predict and modify human behavior with real-time adjustments of service offerings to increase revenues (Lycett, 2013).

The final research gap centers on the evolving role of Management Accountants in this context. Some potential research questions might include: will their roles become more decentralized? What new competencies will they need to navigate and manage the continuous flow of Big Data? Addressing these gaps is essential for a comprehensive understanding of how Big Data is reshaping the landscape of MA.

### 2.4.4. Use and satisfaction with Business Intelligence & Analytics in Management Accounting contexts

As Popovič (2012) highlighted in his work, it does not suffice to adopt a new system including BI&A; rather, organizations need to ensure that the system is used effectively and that they are integrated into decision-making processes.

At times, Business Intelligence and Analytics (BI&A) systems find limited utilization, and scant research has been conducted to pinpoint the factors that positively influence their use, particularly within accounting functions in organizations.

Numerous factors have been recognized as impacting the use of BI&A systems in organizational and MA contexts. These include usersì expertise levels (Lee et al., 2008), satisfaction levels (Hou, 2012), system flexibility (Isik et al., 2013), and technical challenges related to reporting, data, workflow, role authorization, user knowledge, system errors, and user-system interaction (Deng and Chi, 2012).

The degree of expertise impacts also the use and satisfaction dimensions. Lee et al. (2008) pointed out that expert users perform task differently than novice ones and this should be taken into account when designing the BI&A system. Novice users tend to abandon the system more often than expert ones if they encounter difficulties in performing their tasks

and for this reason the system should be as intuitive and reliable as possible to decrease the chances that novice users will stop using it.

Noteworthy findings suggest that involving non-accountants in the design and implementation of BI&A systems can enhance their attention to the system itself when making financial decisions. In essence, the participation of non-accounting end-users emerges as a positive factor, instilling confidence in the system and thereby promoting its usage (Shields, 1995; Eldenburg et al., 2010). This highlights the importance of considering a diverse range of perspectives and expertise in the development and implementation of BI&A systems for optimal engagement and effectiveness.

A determinant aspect of BI&A systems that seem to influence usage rates is system flexibility. Organizational and decision-making processes are most of the time non-routine and ill-structured and the more BI&A systems can be flexible and adapt to the present scenario and the more the users will use them because they will trust them and they will find the information reliable (Isik et al., 2013).

Deng and Chi (2012) added important details specifying that there could be several implementation issues that could affect the consequent usage rates, such as reporting, data, workflow, role authorization, usersì lack of knowledge, system error, and user-system interaction. The authors identified reporting and data problems as the most relevant among them because they highly impact the initial and continued usage phases and they suggested that becoming familiar with the functionalities of the system positively influences the future usage of it. Also, Popovič et al. (2012) highlighted how important is the effectiveness of the use of the system in supporting the decision-making processes because adopting a new BI&A system does not automatically mean effectively using it (Popovič et al., 2012).

Vahidov and He (2010) then pointed out that BI&A systems should be more active as possible because the more passive they are and the less the users will want to use them (Vahidov and He, 2010).

Several future avenues of research are available within this theme.

The most significant gaps in the utilization and satisfaction with BI&A systems in MA contexts are related to factors influencing the improvement of behavioral intentions to use these systems among Management Accountants. It is recognized that Management Accountants must be satisfied with new systems for effective utilization, a factor particularly crucial for BI&A systems given their inherent complexity. While numerous articles have been published on user satisfaction in Information Systems, there is a dearth of research specifically delving into the understanding of Management Accountantsì satisfaction with BI&A systems and how it influences their usage. Furthermore, it is clear that technological and analytical aspects of BI&A systems will be more and more articulated and will imply strong technical competences. For this reason, Management Accountants will be obliged to acquire new technical skills if they want to become real business partners. The question is how to achieve this and how this will affect the role of Management Accountants (Kavanagh and Drennan, 2008; Pathways and Commission, 2012).

Another intricate area that has not received adequate scrutiny pertains to the security risks associated with BI&A systems, especially in the context of Big Data (Isik et al., 2013; Popovič et al., 2012; Delen and Demirkan, 2013).

Finally, the cloud-computing infrastructures are now the grounds in which BI&A systems are implemented and data are stored but this relation has never been too much studied (Collins et al., 2010; Delen and Demirkan, 2013; Isik et al., 2013).

### 2.4.5. Business Intelligence & Analytics and data quality

The last stream of research concerns the theme of data quality and BI&A. Neely and Cook (2011) identified what are the main categories of data quality in literature:

- governance, in terms of plans, policies and procedures;
- operations, in terms of production, distribution and assurance of data;
- technology, in terms of measurement, system design, information products and decision-making.

With the expansion of data size and the inclusion of ever more varied data types, there is a growing need for new methods to assess and enhance data quality, which is crucial for effective decision-making. Challenges are indeed connected to accuracy, reliability, consistency, completeness, and verifiability of data in this context (Rikhardsson and Yigitbasioglu, 2018).

There are also challenges related to accuracy, reliability, consistency, completeness, and verifiability as data volumes increase (Clarke, 2015). An aspect that requires more attention is if and how the Management Accountants will need to gain the competences required to properly clean vast amounts of data. Another aspect that deserves additional attention is if and how Management Accountants will design models to quantify the costs of low data quality (Woodall et al., 2013).

In this topic the main gaps are connected to the evolution of the role of the Management Accountants. Potential research questions might include: how will they be affected by these new responsibilities? Will they be able to manage them? Will they lose power over data scientists? How will this affect the role of the MA department within the organization?

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# CHAPTER 3

## *ENABLERS AND BARRIERS TO THE USE OF BI&A SYSTEMS WITHIN MANAGEMENT ACCOUNTING CONTEXTS: A GROUNDED-THEORY LITERATURE REVIEW*

### 3.1 INTRODUCTION

Business Intelligence and Analytics (BI&A hereafter) can be defined as an information system consisting of a set of technologies and methodologies that allows to collect, organize, analyze structured and unstructured data from internal and external sources to produce and deliver information with the aim of supporting the decision-making process (Davenport T. , 2006).

Since BI&A was created with the purpose of supporting the decision-making process, this information system is acquiring an increasingly important role within Management Accounting (MA) (Knudsen, 2020), intended as a set of tools and approaches that managers can use to support planning, controlling and decision-making activities (Ferreira and Otley, 2009). In view of this close connection, research has started to investigate the relationships between BI&A and MA. In particular, (Rikhardsson and Yigitbasioglu, 2018) have recently reviewed literature on this topic showing that the relationship between BI&A and MA has been explored up to date along four distinct but interconnected research streams: limitations and potentialities, from a technical standpoint, of BI&A solutions for MA purposes; influence of BI&A technologies on MA tasks and techniques; challenges connected with data quality, governance and security; enabling and hindering factors for the use of BI&A solutions for MA purposes.

Concerning the last stream of research, little is known about the levers and barriers that might enable or hinder the use of BI&A solutions within MA contexts (Burton-Jones et al., 2006; Burton-Jones and Grange, 2013; Corte-Real et al., 2014). Research has indeed shown that such BI&A systems have too often failed when it comes to support the managerial decision-making process (Elbashir et al., 2013; Visinescu et al., 2016; Audzeyeva and Hudson, 2015; Yeoh and Popovič, 2015). This means that companies might invest a significant amount of time, money and resources to design and implement BI&A systems, but these systems often end up not being used, partially or totally, within MA contexts. Thus, acceptance and use are one of the greatest challenges when it comes to explore the intersection between BI&A systems and MA (Popovič et al., 2014; Ain et al., 2019). Consequently, there has been a call made by (Rikhardsson and Yigitbasioglu, 2018) to analyze what could hinder or enable the use of BI&A systems for MA purposes. Following along these lines, exploring these aspects seems to be particularly relevant since it opens the gates for investigating also other research streams on the relationship between BI&A and MA, e.g. impacts of BI&A on MA tasks, techniques, or the potentialities and the limitations from a technical perspective of BI&A solutions for MA purposes.

Moving from these premises, the purpose of this paper is to critically review the current state of the art on the levers and barriers to the use of BI&A systems within MA contexts to delineate how research is evolving and identify future research avenues. To achieve this aim the study adopts the Grounded Theory Literature Review method (Wolfswinkel et al., 2013)

The remainder of this paper is organized as follows. Section 2 presents grounded-theory literature review methodology and outlines the five steps of the review. Section 3 provides an overview of the three main research themes uncovered in accounting and IS literature pertinent to our aims. Section 4 outlines potential avenues for future research, while section 5 concludes the paper by presenting its main contributions.

## 3.2 RESEARCH METHOD

To achieve the aim of the paper, the research has been conducted with the adoption of the Grounded Theory Literature Review (GLTR) method (Wolfswinkel et al., 2013). With its inductive nature, the above-mentioned method allows researchers to cover a wide range of the literature, with a higher degree of flexibility than that of systematic literature reviews.

GTLR combines the systematic literature review guidelines by (Webster and Watson, 2002) with the grounded theory approach introduced by (Corbin and Strauss, 2014) and (Glaser and Strauss, 1967). Grounded theory has previously been utilized in accounting research to develop theories based on documentary evidence, such as interviews and ethnographic notes, and explore emerging phenomena (von Alberti-Alhtaybat and Al-Htaybat, 2010; Sutton and David, 2011). In the context of a literature review, GTLR treats published papers as valuable data sources and employs open, axial, and selective coding to extract relevant concepts (Wolfswinkel et al., 2013). By adopting this approach, GTLR offers a comprehensive coverage of the literature and enables a rigorous and systematic analysis. Simultaneously, rooted in grounded theory, GTLR allows for the inductive emergence of concepts from the literature, uncovering hidden or implicit ideas present in the texts (Wolfswinkel et al., 2013).

Compared to traditional methods like narrative reviews, GTLR employs an iterative and transparent process aimed at minimizing bias and subjectivity often associated with such methods. While structured literature reviews adhere to rigid rules and phases that must be followed, GTLR offers greater flexibility, allowing for deviations from the suggested steps if well-justified. Furthermore, GTLR enables both forward and backward citation tracking, which enhances the overall quality of the sample by incorporating additional relevant sources (Wolfswinkel et al., 2013).

This method was first used within the Information Systems field (Montazemi and Qahri-Saremi, 2015; Senyo et al., 2019; Surherland and Jarrahi, 2018) and later applied to other topics such as knowledge management (Balle et al., 2020) or sustainability research (Macke and Genari, 2018; Shaflee et al., 2019).

Despite the growing attention on the levers and the barriers to the use of BI&A within MA contexts, the number of publications on such a topic is relatively low. In such a context, GTLR appears to be an appropriate method since, being rooted in grounded theory, allows to develop new knowledge about a phenomenon that is still under researched (Matteucci and Gnoth, 2017)

Following the GTLR guidelines, the five-stage flexible process described (Wolfswinkel et al., 2013) has been adopted. The phases of the process, used iteratively are:

1.  defining fields of research and criteria: this step involves clearly defining the specific fields of research to be explored and establishing criteria for inclusion and exclusion of relevant literature. It also entails determining appropriate sources, such as scholarly databases, and identifying relevant search terms to retrieve relevant publications;

2.  carrying out literature search: in this step, a comprehensive literature search is conducted using the identified sources and search terms. The goal is to gather a wide range of relevant publications that pertain to the research fields under investigation;

3.  refining the sample: after the initial literature search, the sample is refined by applying inclusion and exclusion criteria established earlier. This process involves screening the retrieved publications based on their relevance and alignment with the research objectives;

4.  analysis using open, axial, and selective coding: once the sample has been finalized, the analysis begins. GTLR employs open, axial, and selective coding techniques to extract meaningful concepts from the literature. Open coding involves identifying initial themes and categories, axial coding involves exploring relationships between these themes and group them in higher level themes, and selective coding involves grouping the higher level themes identified through axial coding into major conceptual categories;

5.  presenting and structuring the content: the final step involves presenting and structuring the content of the review. This includes organizing the identified concepts

and themes in a coherent manner, synthesizing the findings, and providing an overview of the literature reviewed.

### 3.2.1 Define

The first step was to identify an appropriate research database. Scopus was selected since it is one of the most used ones and covers a wide range of journals in line with the aim of the research.

We then defined the search string as a combination of management accounting and any of the terms referring to business intelligence and analytics and its use or non-use: ["manag* account*" AND "business intelligence" OR "business analytics" OR "analytics" AND "us*" OR "util" OR "barrier*" OR "lever*"].

The search included not only peer-reviewed journal articles, but also conference papers, books, and book chapters in order to cover topics and perspectives that might not have been published in peer-reviewed journals and to access early insights and latest findings in the research stream that lies at the intersection between BI&A systems and MA.

The search was conducted among articles published in English language and included in the "Business, Management and Accounting" area in order to restrict the search to a reasonable number of publications and exclude the paper with a too narrow focus on other subject areas.

### 3.2.2 Search

The research with the selected string was conducted within "article titles, abstracts, and keywords". This stage was iterative as we have run several search queries and adjusted keyword combination based on search output (Wolfswinkel et al., 2013)

The search was carried out in October 2022 and, after filtering out duplicate articles, it resulted in 62 papers.

### 3.2.3 Select

The initial sample underwent a refinement process consisting of two stages. Firstly, we conducted a thorough assessment of paper abstracts to distinguish between relevant and non-relevant articles. This involved establishing specific criteria for inclusion and exclusion, wherein we considered publications that focused on both MA and BI&A. Consequently, we excluded articles that only briefly mentioned these topics or solely focused on either MA or BI&A solutions. After analyzing the abstracts, a total of 38 papers were deemed irrelevant to the subject matter of our study.

In the second stage, to enhance the comprehensiveness and quality of our sample, we performed backward and forward citation searches. This enabled us to include 41 original and relevant references cited in the articles within our sample.

Consequently, the final sample for analysis consisted of 65 papers, all of which were downloaded and read in their entirety by the author. Figure 1 shows the steps of the process that has led to the final sample.

Figure 1 – The process that has led to the final sample.

| | |
|---|---|
| 62 | • Database search |
| -38 | • Exclusions based on title, abstract and text analysis |
| +41 | • Backward and forward search |
| **65** | • Selected articles |
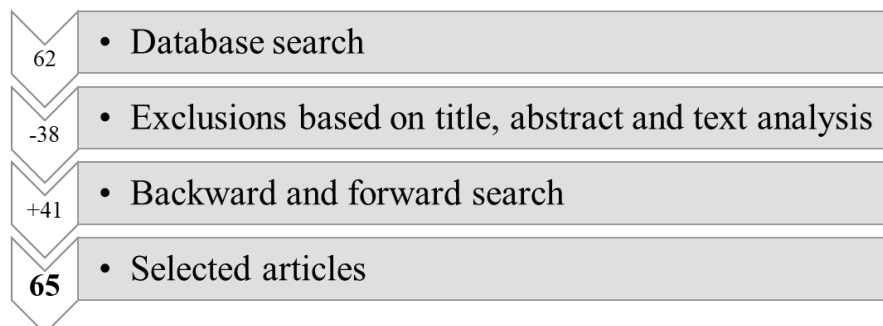
*3.2.4 Analyse*

To analyze the final sample, we initially gathered the pertinent information from the chosen articles and organized it in an Excel spreadsheet. The spreadsheet highlighted key details such as journal information, publication year, research method, theoretical lens, as well as the main results and theoretical contributions.

Following the GTLR approach, we employed principles of constant comparison, theoretical sampling, and iterative coding (Corbin and Strauss, 2014). We began with open coding, aiming to identify the main concepts and insights from excerpts of each paper included in the sample. In cases where a study explored various aspects of the relationship between the MA and BI&A, different codes were assigned. This approach aligns with GTLR's recommendation of examining literature thematically rather than on a per-study basis (Wolfswinkel et al., 2013).

Next, through axial coding, we established patterns and connections between the open codes to identify sub-themes. Finally, we conducted selective coding to group these sub-themes into three major conceptual categories: organizational-related factors, technical-related factors, human-related factors. Table 1 below reports an example of the coding process.

Table 1 – An example of the coding process

| AXIAL CODING | SELECTIVE CODING |
|---|---|
| Adequate IT architecture | TECHNICAL |
| Integration of sources | |
| Loss of Power | HUMAN |
| Perceived usefulness of the BI&A system by management accountants | |
| Understanding of company processes | ORGANIZATIONAL |
| Mixed teams composed by technical and functional employees | |
| Support of Top Management team | |

### *3.2.5 Present*

The findings are presented in accordance with the three themes identified during the Analyze stage.

### 3.3 DESCRIPTIVE ANALYSIS

This sub-section provides an overview of the selected articles, describing their characteristics in detail. The analysis highlights three relevant dimensions from a descriptive point of view: distribution of articles over time, research methods adopted and publication outlet.

As shown in figure 2, the consistent increase in the distribution of papers over the years indicates a positive trend and confirms a continuous and growing interest in literature.

Figure 2 – Distribution of articles over time


Trend over time
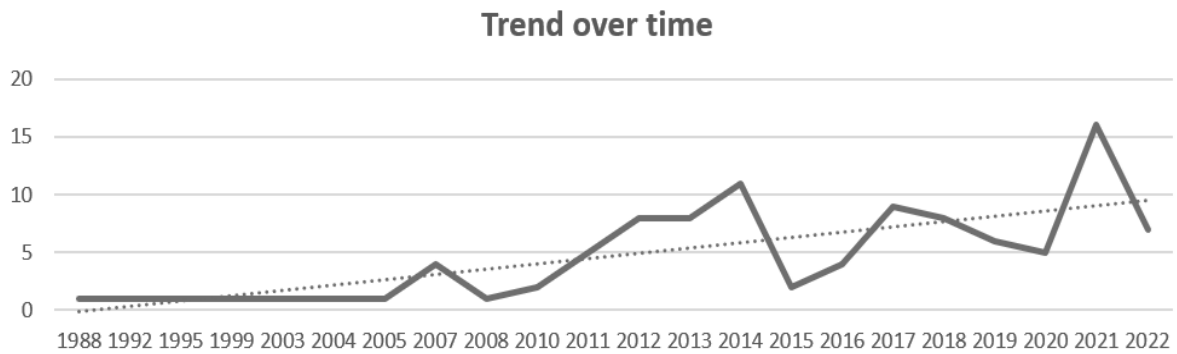
In order to analyse the research method adopted, the papers were categorized into seven different categories: literature review; survey; experimental; conceptual/theoretical; single or multiple case studies or interview-based studies; mixed methods; other. The composition of the selected articles by method is represented in Table 2 below.

Table 2 – Research methods adopted by the selected papers.
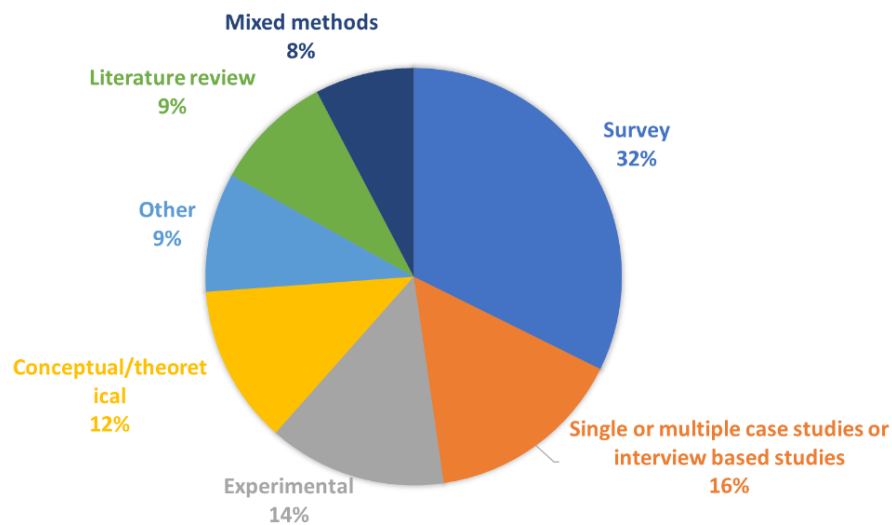


The research method results show that most of the studies are empirical with 45 articles out of 65. The research method most commonly used is the survey with 21 articles, followed

by qualitative-type articles. Surprisingly, only 8 studies out of 65 are conceptual or theoretical in nature.

Concerning the publication outlet of the selected articles, table 3 below shows the list of the journals with more than one publication.

Table 3 - Source title with more than one articles

| Journal | Count |
| --- | --- |
| International Journal of Accounting Information Systems | 4 |
| European Journal of Information Systems | 3 |
| Journal of Management Information Systems | 3 |
| Information & Management | 3 |
| Journal of Accounting and Organizational Change | 2 |
| Accounting, Organizations and Society | 2 |
| Journal of Information Systems | 2 |
| International Journal of Information Management | 2 |
| Mis Quarterly | 2 |
| Qualitative Research in Accounting and Management | 2 |

The analysis reveals a highly fragmented and balanced situation: many journals have addressed the topic under analysis, but none of them has taken the lead over the others in investigating the levers and the barriers to the use of BI&A systems in MA contexts.

## 3.4 THEMATIC ANALYSIS

The analysis of the selected papers allowed to identify three main research themes on the levers and barriers to the use of BI&A systems within MA contexts: organizational-related factors, technical-related factors, and human-related factors.

### 3.4.1 Organizational-related factors

Concerning organizational-related factors, research has shown that, broadly speaking, the level of use of the BI&A systems in MA contexts is affected by the perceived facilitating conditions, i.e. the degree to which an individual believes that an organizational infrastructure

exists to support the use of the system (Venkatesh et al., 2003; Hart et al., 2007; Grublijesic and Jaklic, 2014; Hou, 2014).

Among these facilitating conditions, the **size of the company** could be a relevant factor; users in large firms are generally more likely to use the BI&A system within MA contexts than users of smaller firms since large companies tend to have more capital to invest in activities that support the actual adoption of the system in daily activities and processes (Hou, 2012; ŠPIČÁK and ŠIŠKA , 2016).

In addition, **training** is another enabling factor at an organization level since providing support to future users of the new system is crucial to leverage the advantages of BI&A system and, as a consequence, to increase the likelihood that the system itself ends up being used (Spraakman et al., 2021). Borrowing from Nofal and Yusof (2016, p. 186) "If the employees do not have the knowledge of the way the model functions, they will consequently create their own processes with the use of those components of the model that they are capable of modifying". Thus, the sooner the Management Accountants comprehend the features of the system and the more the level of use is likely to increase, thus avoiding potential misuse or partial use of the BI&A system. Following along these lines, research has shown that training might affect in a positive way the motivation to use the BI&A system, since users feel ready and trained to use the system itself to perform tasks that are even challenging and complex (Borthwick and Hansen, 2017). However, the training process should be implemented taking into consideration the differences among participants since a specific and suitable training is crucial to achieve the desired training purpose (Yingjie, 2005).

**Management support** is one of the main factors affecting BI&A system usage (Kee-Luen et al., 2018; Finnaoui et al., 2021) and, in such a context, maximum benefits are gained when top management label as "strategic" the use of BI&A (Lautenbach et al., 2017). Research has shown that this is likely to happen when the top management itself is aware about the benefits and potentialities of BI&A systems (Finnaoui et al., 2021). Therefore, the knowledge of the top management team on the advantages of the BI&A system is crucial to enhance its

sponsorship to its implementation and use in MA contexts. A high level of management support may also lead to craft a new organizational structure to support the BI&A implementation strategy (Sharma et al., 2014). Research has also revealed that such support and sponsorship become crucial not only during the implementation of the BI&A system, but overall, in the post implementation phases, i.e. when it comes to ensure a certain level of continuity of use of the BI&A system over time (Nespeca and Chiucchi, 2018).

Following along these lines, **culture** in a key aspect, also. BI&A systems are likely to be used in contexts where there is a well-developed data-driven and analytical decision-making culture (Popovič, 2017) since "knowledge workers with analytical decision styles will adopt and use the enterprise's IS and their information to a greater extent than knowledge workers with conceptual decision styles" (Popovič et al., 2012). Moreover, connected to cultural reasons, research has shown that another factor that could play a relevant role is **social influence**, i.e. the degree to which an individual perceives that important or powerful other individuals believe that he/she should use the new information system (Venkatesh et al., 2003). Therefore, if the use of the BI&A system is socially accepted, the users will probably be more prone to use it (Grublijesic and Jaklic, 2014; Hou, 2014). Research has acknowledged that the team in charge of the design and the implementation of the system should be composed by individuals who have **technical skills and others with business ones** so that a proper mix of knowledge and competences can be created (Villamarín-García and Díaz Pinzón, 2017). In particular, actors like data scientists or IT employees and Management Accountants should no longer work separately when it comes to improve the decision-making process through BI&A systems (Munir et al., 2023). On the one hand, data scientists and IT employees are technical experts, but they lack understanding of functional domains and, thus, they may struggle to find which features the BI&A system should have to enhance its level of use; on the other hand, Management Accountants lack the understanding of the true potential of data analytics (Elbashir et al., 2011). Thus, mixed teams should foster a proper level of **cooperation and knowledge sharing** between actors with technical skills and actors with business ones. In particular, the use of BI&A systems within MA contexts often leads to address IT-related issues, such as IT governance or the selection

of provider, that require managerial accountants to cooperate with in the IT field (Popovič et al., 2014). In such a context, it becomes crucial to ensure a proper level of knowledge sharing and to handle potential interprofessional frictions that may arise between managerial accountants and IT employees or data scientists and, overall, in strongly IT-based environment, those conflicts may impact on possibilities and constraints of use of the BI&A system (Becker and Heinzelmann, 2017). Moreover, mixed teams should ensure that a BI&A system is designed and implemented in a **collaborative way**, i.e. by involving the prospective users, in order to foster the actual use of the BI&A system (Eldenburg et al., 2010). More in particular, users should not just provide information on the desired features of the system, but they should actively participate in and influence the design and the implementation of the system itself since "systems that are most successful in terms of impact are those where users have a stronger influence on system design" (Lynch and Gregor, 2004, p. 298)

Finally, effective **communication to potential users** on the benefits of the BI&A system increases the likelihood that the system may end up being actually used, overall if communication activities are carried out in advance, i.e. during the design and implementation stages (Nofal and Yusof, 2016).

### *3.4.2 Technical-related factors*

Regarding technical-related factors, several barriers may arise and hinder the actual use of the system by the user, such as problems concerning reporting, role authorization, system errors, data (Deng and Chi, 2012; Burton-Jones and Grange, 2013).

**Reporting issues** arise when the user experiences problems when try to customize or navigate the report or, even worse, when the report is not available, includes mistakes or cannot be exported (Deng and Chi, 2012).

**Role authorization** problems deal with accessibility and arise when users' attempts to access the system is denied (Isik et al., 2013).

**System errors** deal with incidents that may happen when the user when the user interacts with the system, such as system malfunctioning, nonresponse, or missing a feature considered useful by the user (Deng and Chi, 2012).

**Data-related problems** concern data quality issues and arise when data are missing, inaccessible, incomplete, duplicate, or incorrect (Lautenbach et al., 2017), i.e. all factors that affect quality of the information provided by the BI&A system and that can, in turn, influence the likelihood that the system itself is actually used (Popovič et al., 2012). In other words, without a good level of data quality the BI&A systems are not likely to be used since the information they provide is perceived to be unreliable or low value for the sake of decision making (Davenport and Beers, 1995). Borrowing from (Wieder et al., 2012, p. 10) "Data quality is undoubtedly a key aspect of every information system, but considering the very nature and purpose of BI systems, maintaining and providing high quality data appears to be a relatively more important concern in BI systems than in other business information systems, in particular OLTP systems (e.g. ERPS), which typically have a very large non-managerial user base and often provide high levels of transaction automation and control".

**Workflow-related problems** occur when data integration does not work as designed, such as delayed data loading, data discrepancy across reports, data mismatching between data sources (Deng and Chi, 2012).

Thus, in this perspective it is crucial to put in place an **adequate IT architecture** since inappropriate hardware and software infrastructure tend to reduce the opportunities that the BI&A solutions end up being actually used (Peters et al., 2018; Schläfke et al., 2013). In particular, the IT infrastructure should be reliable and fast to ensure properly storing and computations of large data volumes given that, when that need is satisfied, the BI&A systems are more likely to be successfully implemented and used (Nguyen, 2011; Nofal and Yusof, 2016).

In addition, research has acknowledged that not only the quality of the IT infrastructure used to implement the BI&A system per se is relevant, but also the **degree of integration** between the BI&A system and the already existing information systems is crucial when it

comes to increase the likelihood that BI&A system ends up being actually used (Kern, 2012; Isik et al., 2013). Integration involves the consolidation and centralization of data from various sources into a unified environment. This approach enables the creation of greater value compared to extracting data individually from each source. By establishing a centralized data environment, users across organizations can access data directly whenever needed, ensuring a high level of flexibility and consistency among the different data sources and this aspect is crucial for optimizing the effectiveness of the BI&A system (Pervan and Dropulic, 2019). For businesses that rely on multiple information systems (such as CRM, ERP, MES), this centralized approach becomes even more relevant (Isik et al., 2013). For instance, studies emphasize the significance of integrating ERP systems and BI&A systems since the former generate comprehensive sets of structured data that serve as valuable inputs for the latter (Youssef and Mahama, 2021). Similarly, research recognizes the importance of integrating accounting information systems and BI&A systems to maximize the value derived from traditional accounting data for decision-making purposes and to enhance the overall quality of BI&A systems (Focacci, 2018; Wieder et al., 2012).

Research on technical-related factors has also focused on enabling factors by addressing the ability of BI&A to enhance the quality of managerial decision-making process.

In this perspective, the focus primarily is on technical aspects improved through BI&A technologies, i.e., on the **way information is delivered and presented by BI&A** (Dilla et al., 2013), on the ways the **user can interact** with the BI&A in terms of selecting, browsing or drilling down information (Peng, et al., 2007; Dilla et al., 2013) and on **feedbacks and recommendations** provided by BI&A to support decision making (Seow, 2011; Cardinaels and Van Veen-Dirks, 2010).

Concerning the first aspect, BI&A systems leverage on a wide range of visualization techniques when it comes to deliver information to the users (Dilla et al., 2013). In the context of MA, these visual approaches for communicating managerial accounting information, such as performance measures, can ease and accelerate the interpretation of those information and facilitate the identification of actions related to the results of those performance measures

(Granlund, 2011). All in all, this advantage might lead to higher rates of usage of the BI&A systems in MA contexts (Nespeca and Chiucchi, 2018).

Regarding the second aspect, BI&A systems allow the end-users to directly design the report and interact with it (Peng et al., 2007). On the one hand, BI&A systems grant the users the opportunity to decide the type and the number of visualization techniques to be used to display the information as well as to choose how to organize those information within the report in terms of sequence and position (Finnaoui et al., 2021); on the other hand, such systems allow the user to explore and navigate the information through drill down, roll up, slicing, dicing and pivoting paths (Spraakman et al., 2021). Concerning these aspects, research has shown that final users are more likely to use the system thanks to this level of interactivity and customization (Peters et al., 2018). However, research has also acknowledged that final users should be well trained to take advantage of such opportunities, otherwise they might end up abandoning the use of BI&A systems (Peng et al., 2007).

Regarding the third aspect, the possibility of obtaining additional insights thanks to feedbacks and recommendations provided by the BI&A systems is a factor that can encourage the use of the system itself (Villamarín-García and Díaz Pinzón, 2017). In particular, the systems might draw the attention of the users towards unknown patterns or correlations, thus facilitating and improving his/her decision-making process (Cokins, 2016). However, the literature has also demonstrated that feedbacks and recommendations should be incorporated with caution and should be designed according to the type of task to be performed (Mascha and Smedley, 2007) and the user knowledge (Seow, 2011). Moreover, it has been shown that when recommendations contradict what the users think the BI&A system might be perceived as a threat and not be used anymore (Elkins et al., 2013). On the contrary, research has also acknowledged that feedbacks from the system might increase overconfidence of users and might encourage risky behaviour since chances of success might end up being overestimated (Chen, 2015). Therefore, a balance should be reached when incorporating feedbacks and recommendations so that decision making should be both data-

driven and experience-driven, thus avoiding the non-use or the misuse of the BI&A system (Arnaboldi et al., 2022).

### 3.4.3 Human-related factors

Human-related factors deal with perceptual and behavioural aspects that may arise when the user interacts with the BI&A system (Rikhardsson and Yigitbasioglu, 2018). Within this set of factors, research has shown that the **perceived ease of use** may have a positive impact on the intentions to use the system (Hou, 2015). In particular, the easiness to use the system depends on various technical features, such as easy creation and consumption of reports, user-friendly interfaces, alerts and other automated information delivery processes (Brockmann et al., 2012).

Research has acknowledged that **satisfaction** is another critical factor since the more users are satisfied by those systems the more it is likely that they are going to use them (Hou, 2012). Satisfaction is connected to the **perceived usefulness** of the system (Jaklic et al., 2018); if the information produced by the system is perceived as being important and high quality, then the user is likely to use the system since he/she recognizes tangible and demonstrable benefits (Grublijesic and Jaklic, 2014; Popovič et al., 2012), thus perceiving the system as a mean to attain gains in job performance (Venkatesh et al., 2003). For example, research has shown that BI&A systems might be used to accelerate and refine decision making through scenario analysis the accurate analysis and simulations provided by the BI&A systems might be perceived as a tangible benefit from the perspective of Management Accountants, thus stimulating them to actual use the system itself within MA contexts (Fahlevi et al., 2021).

Moreover, the **nature of the user** is a relevant factor that influences if, how and how much the system is actually used (Burton-Jones and Gallivan, 2007). Users can indeed be defined into power and regular users: power users daily interact with the systems; they attend specific training and they are involved in the design and the implementation of the system.

Regular users are occasional users of the systems, and they often are not fully aware of the whole functionality of the systems. On the one hand, power users' difficulties are often technical problems, but this kind of users are usually reluctant to abandon the BI&A system; on the other hand, the causes of regular users' difficulties often depend on lack of knowledge about the system which might easily lead the to interrupt the use of the BI&A system (Deng and Chi, 2012). Thus, **users' level of expertise** may play a relevant role, also; research has indeed shown that the more users are experts and know how to use the BI&A system the more it is likely that they use it, actually and effectively (Castellano et al., 2017). More in depth, a good level of expertise negatively influences the abandon rates and positively influence the number of features of the system explored (Lee et al., 2008).

Another very relevant factor is related to the **absorptive capacity of the Management Accountants,** i.e. the ability to gather, absorb, and strategically leverage new technologies relevant to their role of supporting the management of achieving organizational goals (Elbashir et al., 2011). Research has indeed acknowledged that top management alone is not enough to ensure the use of BI&A system, but it should be matched with the ability of Management Accountants to identify, acquire, apply and adapt new technologies, such as BI&A systems, in their specific context for the sake of process optimizations, cost savings and performance improvements (Deng and Chi, 2012).

Research has also acknowledged that a sound **understanding of company processes** by the user may increase the chances of BI&A systems to be used in practice, once designed and implemented. Not being able to understand the company processes, especially the ones connected with information systems, legacy systems and hardware infrastructures will cause less BI&A maturity, less information quality and, as a consequence, less information use (Popovič et al., 2012).

In addition, **loss of power** is another human-related factor that research has identified as an important element able to affect the level of use of BI&A system (Popovič, 2017). Integrating the BI&A system in daily routines and processes is likely to give access to more information and to more people: this can potentially be perceived as a loss of power by those

ones, like Management Accountants, who were the "owner" of the information before the introduction of the BI&A system, thus discouraging or even hindering the use of the system itself (Heinzelmann, 2017). Moreover, the introduction of such a system may also influence the decision-making process of a given company and role played by individuals within this process: this can cause disappointments and frustration in actors, like Management Accountants, who perceive that their role is not central anymore after the adoption of the BI&A system which, in the new context, is the main provider of the information useful to support managerial decisions (Smith and McKeen, 1992).

Finally, human-related factors may also concern softer dimensions, such as **computer anxiety** and **personal traits**. Computer anxiety can be defined as the fear connected with the use of the computer, such as of the fear of losing data or generating other serious damages (Sievert M. et al., 1988). In particular, computer anxiety was found to have an impact on behavioural intention to use BI&A system (Hart et al., 2007). This means that reducing computer anxiety through training could increase users' intention to use BI&A systems (Hou, 2014). Regarding personal traits, research has shown that openness to experience (i.e., being imaginative and artistically sensitive), conscientiousness (being responsible, persistent and achievement oriented), extraversion (being sociable and assertive) and emotional stability (being calm and secure) are key determinants that could lead to BI&A system use in a working setting in general and in MA contexts in particular (Chang et al., 2015).

## 3.5 RESEARCH GAPS AND OPPORTUNITIES FOR FUTURE RESEARCH

Based on the thematic analysis carried out in the literature review, several potential research gaps and connected research questions can be identified. These gaps and questions may direct future studies and can therefore support with the advancement of knowledge in this growing field. There are indeed several aspects within the factors that influence the use of BI&A systems in MA contexts that require, and deserve, additional attention in order to gain a comprehensive understanding of this phenomenon.

Regarding organizational-related factors, existing research has shown that usage rates of BI&A systems in MA contexts are likely to be higher in large organizations (Hou, 2012; ŠPIČÁK and ŠIŠKA , 2016).

Thus, more research is needed to explore the factors that drive the adoption and use of BI&A systems in SMEs, as these organizations often face unique challenges and constraints compared to larger firms. More in particular, it could be interesting to investigate how SMEs can overcome barriers and leverage enablers to use BI&A systems.

While existing studies have highlighted the importance of management support in promoting BI&A system usage in MA contexts (Kee-Luen et al., 2018; Finnaoui et al., 2021), there is a lack of research on the specific factors that might positively or negatively influence the level of management support. Thus, investigating the factors that lead to robust and long-lasting management support over time and how to leverage on them could represent an interesting avenue for future research.

The thematic analysis has also revealed that when BI&A systems are socially accepted within an organization, then users are more likely such systems (Grublijesic and Jaklic, 2014) (Hou, 2014). However, the factors that contribute to social acceptance of BI&A systems within an organization need to be explored further. More in particular, investigating how to foster a culture where BI&A systems are embraced and valued by users is a future avenue of research that deserves additional attention.

The presence of a balanced blend of technical and business competences within the team responsible for implementing BI&A systems in MA contexts has been identified as another influential factor in favor of their successful adoption (Villamarín-García and Díaz Pinzón, 2017; Munir et al., 2023). However, what remains unclear is how Management Accountant should cooperate with other company actors, such as data scientists and IT professionals, in order to foster the use of BI&A systems as well as how interprofessional frictions could be limited, if not avoided. In particular, it would be fruitful to investigate effective strategies to manage power dynamics and resistance in order to unlock a smoother adoption and use of BI&A systems.

The technical-related factors in the literature have shown greater maturity, primarily due to the contributions coming from IS literature. However, there still remain some gaps in the research that present opportunities for further studies.

Among the extensively studied and frequently cited technical factors, data quality stands out as a crucial one. It has been indeed observed that inadequate data quality often leads to a decline in usage rates of BI&A systems in MA contexts (Popovič et al., 2012). Thus, conducting research on the primary data quality issues that impact the utilization of BI&A systems within MA contexts becomes particularly interesting. In a similar manner, it could be fruitful to investigate what is the role of managerial accountants in addressing data-related problems in terms of quality and how they could help designing BI&A systems that limit data quality issues. Understanding and addressing these aspects can be very relevant for designing BI&A systems that effectively mitigate data quality problems, ensuring their optimal performance and usefulness.

Another factor of nearly equal significance is the degree of integration between BI&A systems and pre-existing information systems, which has been demonstrated to strongly influence the utilization of BI&A systems by end-users (Kern, 2012; Isik et al., 2013). However, further investigation in this research domain should focus on the specific intricacies of systems integration in MA accounting contexts and, in particular, on how IT professionals and Management Accountants can collaborate seamlessly to integrate the selected data sources without encountering significant challenges.

Subsequently, the thematic analysis emphasized that the potentialities of BI&A systems in terms of information delivery and presentation play a pivotal role in motivating final users to actively engage with such systems (Dilla et al., 2013). Nevertheless, there remains significant research gaps concerning what could be the most adequate visualization techniques within MA contexts as well as which competences managerial accountants should grow in the field of visualization techniques. Investigating such aspects would be very relevant also to understand the evolution of the role of Management Accountants in supporting organizational decision-making through BI&A systems.

Another pivotal aspect to consider while studying the factors that enhance the usage of BI&A systems is the level of interaction they offer (Peng et al., 2007; Dilla et al., 2013). Further investigation could delve into how interaction mechanisms should be thoughtfully designed to encourage the adoption of BI&A systems by Management Accountants. Additionally, it would be fruitful to investigate the specific competences that managerial accountants should develop to effectively interact with BI&A systems as well as the criticalities that could arise when managerial accountants interact with BI&A systems. Exploring these aspects can contribute significantly to optimizing the utilization of BI&A systems in MA contexts.

The last technical-related factor that warrants deeper exploration is the incorporation of feedback and recommendation routines into BI&A systems for MA aims. Previous research has indicated that the ability to gain insights from BI&A systems significantly encourages their utilization in MA contexts (Villamarín-García and Díaz Pinzón, 2017). Currently, some researchers are beginning to investigate the impact of artificial intelligence and machine learning on MA, although only a limited number of studies have been published thus far (Ranta et al., 2022). A very promising area of interest could be investigating how to implement these mechanisms effectively, ensuring that Management Accountants embrace feedbacks and recommendations provided by the BI&A systems rather than feeling intimidated. Furthermore, it could be fruitful to identify which types of feedback and recommendations will prove most valuable to Management Accountants in their daily tasks as well as exploring how to design them and limit their criticalities. Finally, an area that deserves additional attention concerns ascertaining which new competences Management Accountants should gain to proficiently interpret the responses generated by algorithms as feedback or recommendations. Addressing these aspects could play a critical role in maximizing the benefits of BI&A systems in the realm of MA.

Concerning human-related factors, it has been acknowledged that the perceived ease of use depends on various features, such as the availability of user-friendly interfaces or performance alerts (Brockmann et al., 2012). However, further investigation would be

needed in the context of MA to pinpoint the features that enhance the perceived ease of use of BI&A systems for Management Accountants.

Connected to the previous factor, the satisfaction and perceived usefulness are other relevant human-related factors able to foster the use of BI&A systems (Hou, 2012; Jaklic et al., 2018). However, little research has been studied to explore which factors drive satisfaction with and perceived usefulness of BI&A systems within MA contexts and how such systems might be designed in a way that leverages those factors.

Finally, another human-related factors that requires in-depth investigation pertains to the potential loss of power of Management Accountants due to the use of BI&A (Popovič, 2017). While Management Accountants might appreciate the time-saving benefits of automating repetitive tasks, they might also fear weaken or losing their role of information provider in favour of BI&A systems. All in all, this might lead to potential resistance towards adopting these systems. Thus, it would be fruitful to investigate the determinants that can either restrict or amplify the loss of power experienced by Management Accountants when using BI&A systems and how these could be respectively limited or boosted. By exploring these factors, researchers can gain deeper insights into the complex dynamics of power and organizational change, which are pivotal for successful acceptance of BI&A systems in MA practices.

## 3.6 CONCLUDING DISCUSSION

This study analyzed 65 papers to critically review the current state of the art on the levers and barriers to the use of BI&A systems within MA contexts to delineate how research is evolving and identify future research avenues.

The main findings indicate an increasing interest in the subject across diverse research domains and journals, as evidenced by the publication trend over recent years. Furthermore, the results highlight the prevalence of empirical studies, predominantly carried out using quantitative methods.

The study reveals that existing research can be classified into three primary themes: organizational-related factors, technical-related factors, and human-related factors. As the

literature on this topic still appears to be limited, research gaps have been identified within each thematic area, which present opportunities for future investigation (see table 4 below). These gaps could serve as valuable starting points for further inquiry in the research field of the drivers and obstacles surrounding the use of BI&A systems within MA contexts. While some potential research directions were suggested by the authors of the reviewed papers, others were derived from our analysis of the literature.

Table 4 below shows, for each theme and sub-theme, the potential research questions that could be used as a starting point for future studies.

Table 4 – Research gaps and future avenues of research.

| THEME | FACTOR | POTENTIAL RESEARCH QUESTIONS |
|---|---|---|
| **Organizational-related factors** | Size of the company | How might the use of BI&A systems within MA contexts be fostered in SMEs? |
| | | What are the factors that could lead to the use of BI&A systems within MA contexts in SMEs? |
| | | How can SMEs overcome the liability of smallness to use BI&A systems? |
| | Training on BI&A systems | What training programs and techniques are more effective? |
| | | How could training program limit the misuse or avoid the non-use? |
| | | How should training programs designed to consider the needs and the features of Management Accountants? |
| | Management support of BI&A systems | What are the factors to leverage on to guarantee a long lasting management support, overall in the post implementation phase? |
| | | What are the factors that could limit management support over time and how could they be limited? |
| | Data-driven culture | How and why can BI&A systems contribute to build a data-driven decision making? |

| | | How can Management Accountants help create an<br><br>analytical decision-making culture? |
|---|---|---|
| | Social acceptance of the BI&A systems | How can social acceptance be fostered?<br><br>What are the factors that can foster or hinder social acceptance?<br><br>Which company actors might play a relevant role in fostering social acceptance? |
| | Teams with technical competences and business knowledge for the sake of the design and use of the BI&A systems | How should Management Accountant and data scientist cooperate to foster the use of BI&A systems?<br><br>How should Management Accountants and IT staff cooperate to foster the use of BI&A systems?<br><br>What are the reasons that lead to interprofessional frictions and how could they be limited or avoided? |
| | Involvement of Management Accountants in the design of BI&A systems | On which aspects of the BI&A system design should the Management Accountants be involved in?<br><br>What are the factors that lead to fruitful involvement of Management Accountants in the design of the BI&A systems? |
| | Communication to Management Accountants of the benefits of the BI&A systems | What are the most effective communication channels and techniques to enable the use of BI&A systems within MA contexts?<br><br>How communication strategies should be designed and on which aspects should they focus?<br><br>In which steps of the project should communication be more intensive? |
| **Technical-related factors** | Reporting issues | What are the main reporting issues that lead to abandon the BI&A systems within MA contexts? |

| | | How could reporting issues be limited or overcome? |
| --- | --- | --- |
| | | What is the role of managerial accountants in the process of limiting or overcoming these reporting issues? |
| | Data-related problems | What are the main data quality issues that affect the use of the BI&A systems within MA contexts? |
| | | How could BI&A systems be designed to limit data quality issues? |
| | | How data quality issues should be addressed to avoid the non-use of the BI&A system and what could be the role of managerial accountants? |
| | Workflow-related problems | How can the daily systems routines of the Management Accountants be protected by potential workflow-related problems? |
| | | How should the data workflow be implemented to avoid possible issues? |
| | | How can workflow-related problems be limited or overcome and what could be the role of managerial accountants? |
| | Adequate IT architecture to implement BI&A systems | What should be the right HW and SW components to build an adequate IT architecture within MA contexts? |
| | | What are the factors to be considered when assessing the suitability of an IT infrastructure within MA contexts? |
| | Integration of BI&A systems with pre-existing information systems | Which information systems should be integrated with each other to meet the needs of the Management Accountants and to ensure the use of BI&A system? |
| | | How can integration issues be limited or overcome? |
| | | How should the IT function and the MA function cooperate to integrate the selected sources of data? |

| | Information delivery | What are the most adequate visualization techniques within MA contexts? |
|---|---|---|
| | | What should be the future role of the management |
| | | accountant in terms of supporting information delivery in organizations? |
| | | Which competences should Management Accountants build in this area? |
| | Interaction between the BI&A systems and the Management Accountants | How could interaction mechanisms be designed to ensure the use of BI&A systems within MA contexts? |
| | | Which competences should Management Accountants build to properly interact with the BI&A system? |
| | | Which criticalities could arise when interacting with the BI&A system and how could they be limited or overcome? |
| | Feedbacks and recommendations provided by the BI&A systems | What is the role of Management Accountants in interpreting feedbacks and recommendations provided by the BI&A systems? |
| | | Which kind of feedback and recommendations are effective within MA contexts? |
| | | Which competences should Management Accountants build in this area? |
| | | How should feedback and recommendations be designed in MA contexts? |
| | | Which criticalities could arise when the BI&A system provides feedback and recommendations and how could they be limited or overcome? |
| **Human-related factors** | Perceived ease of use of the BI&A systems | Which features of BI&A systems might enhance the perceived ease of use within MA contexts? |
| | Satisfaction with and perceived usefulness of the BI&A systems | Which factors drive satisfaction with and perceived usefulness of BI&A systems within MA contexts? |

| | | How can BI&A systems be designed and implemented in a way that leverages those factors? |
| --- | --- | --- |
| | Management Accountants' level of expertise | How can the BI&A system be designed and implemented in a way that favors the use also by novices? |
| | | Which factors favor the use of the BI&A system by novices? |
| | | To what extent should BI&A tools take into account the |
| | | expertise of the managerial accountants? |
| | Absorptive capacity of the managerial accountants | How could the absorptive capacity of managerial accountants be enhanced? |
| | Potential loss of power of Management Accountants due to the use of BI&A systems | Which factors increase the fear of loss of power of the Management Accountants when using BI&A systems and how they could be limited? |
| | | Which factors could limit the fear of loss of power of Management Accountants when using BI&A systems and how could they be boosted? |
| | Computer anxiety and personal traits | How could computer anxiety be limited or overcome by managerial accountants? |
| | | How could personal traits that foster the use of BI&A systems be improved? |

Furthermore, some general future research avenues have been identified. First, this research showed that studies explicitly adopting a theoretical lens are few in number, thus different theoretical approaches such as institutional theory (Dimaggio and Powell, 1983), absorptive capacity theory (Cohen and Levinthal, 1990) or innovation diffusion theory (Rogers, 1983) can be adopted to develop empirical work and further examine the topic. Second, the literature review revealed that extant research has focused on the technical-related and organizational-related factors, while the human-related factors remain relatively underexplored. This theme may be further examined in order to gain a more thorough

understanding of how motivation, perceptions, behaviors, concerns and expertise of Management Accountants might influence the use of BI&A systems in MA contexts.

Third, the analysis underscored that levers and barriers within and across the three themes are usually treated in isolation, while the way and the intensity they interact among each other, also over time, have been given little attention. On the one hand, BI&A systems are not stand-alone but are they integrated into specific organizational contexts, including technical infrastructures and human behaviors (Rikhardsson and Yigitbasioglu, 2018). These factors interact among each other, meaning that changes in one factor may have ripple effects on others. For example, the effectiveness of a BI&A system's technical capabilities (e.g., data quality and reporting) may be hindered if the organizational culture does not support data-driven decision-making or if the Management Accountants lack the necessary expertise to leverage the system's capabilities. On the other hand, BI&A systems are not static, but they need to evolve and adapt to keep pace with the dynamic business environment, technological advancements, changing user needs (Peters et al., 2018). Therefore, the role played by different hindering or enabling factors and the way they reinforce or weaken each other is likely to change over time. Thus, investigating these factors holistically and over time through longitudinal case studies would allow for a comprehensive understanding of the barriers and levers that affect BI&A system usage in MA contexts.

In conclusion, this study answers the call made by Rikhardsson and Yigitbasioglu (2018) and contributes to the literature on the levers and the barriers that might enable or hinder the use of BI&A systems within MA contexts (Burton-Jones and Straub, 2006; Burton-Jones and Grange, 2013; Corte-Real et al., 2014; Popovič et al., 2014; Ain et al., 2019) by systematizing prior research, clustering results into three different research themes and providing an agenda for future research. In so doing, the paper brings together insights from the accounting literature and IS literature. By integrating these diverse perspectives, it provides a comprehensive understanding of how MA and BI&A systems intersect and impact each other.

Finally, the findings may be relevant also for Management Accountants and companies that are in the process of designing, implementing and using BI&A systems to gain knowledge on the obstacles that might arise during the process as well as on the potential solutions to overcome those obstacles.

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# CHAPTER 4

## *EXPLORING ENABLERS AND BARRIERS IN UTILIZING BUSINESS INTELLIGENCE & ANALYTICS SYSTEMS FOR MANAGEMENT ACCOUNTING PURPOSES:*
## *A CROSS-SECTIONAL FIELD STUDY*

### 4.1 INTRODUCTION

In the rapidly evolving landscape, the role of Business Intelligence and Analytics (BI&A) has become pivotal within companies (Knudsen, 2020). BI&A systems are designed to aggregate, organize, and analyze diverse datasets from both internal and external sources, the overarching objective being to furnish decision-makers with timely and relevant information to inform and enhance the decision-making process (Davenport T. , 2006).

Recognizing the growing importance of BI&A in aiding decision-making processes, researchers have embarked on exploring the intricate relationships between BI&A and MA, a discipline that employs an array of tools and approaches to bolster planning, controlling, and decision-making activities (Ferreira and Otley, 2009). Rikhardsson and Yigitbasioglu (2018), in a recent literature review, delineate four distinct but interconnected research streams on the intersection between BI&A and MA: technical limitations and potentials of BI&A solutions for MA, influence of BI&A technologies on MA tasks and techniques, challenges related to data quality, governance, and security, and enabling and hindering factors for the use of BI&A solutions in MA contexts.

Concerning the last stream of research, the literature review conducted in the previous chapter revealed that studies on the enablers and the barriers to the usage of BI&A systems

within MA contexts can be categorized within three main research themes: organizational-related factors, technical-related factors, and human-related factors.

Despite the escalating interest and multifaceted exploration of BI&A systems, a persistent challenge continues to plague organizations that still struggle to extract meaningful value from implementation of BI&A systems (Davenport et al., 2010). The implications of this underutilization are profound, given that the success of BI&A projects is intrinsically linked to the extent, manner, and degree to which these systems are actively employed to bolster the decision-making process. Paradoxically, this crucial stage has received scant attention in extant literature (Popovič et al., 2012; Burton-Jones and Straub, 2006; Burton-Jones and Grange, 2013; Corte-Real et al., 2014). This gap is particularly pronounced in the intersection of BI&A systems and MA, where user acceptance and adoption pose serious challenges (Popovič et al., 2014; Ain et al., 2019). Following along these lines, Knudsen (2020) has recently called for more qualitative studies to provide insights on what works and does not work, on the levers and the barriers that can enable or hinder the use of BI&A systems within MA contexts, as well as on the reasons for negative and positive experiences.

In light of this research gap, the aim of this paper is to investigate the following research question: How and why may BI&A systems end up being used or not used for MA purposes? Through a cross-sectional field study, the paper aims to provide a comprehensive exploration of the factors influencing BI&A system utilization within organizational, technical, and human dimensions.

The remainder of this paper is organized as follows. Section 2 presents the literature review and the research question, and section 3 describes the method chose to answer the research question. Section 4 provides and overview of the case studies. Finally, Section 5 discusses the case findings and Section 6 concludes the paper by presenting its main contributions.

## 4.2 LITERATURE REVIEW

BI&A systems encompass information systems comprising a set of technologies and methodologies to gather, organize, and analyze structured and unstructured data from internal and external sources (Chen et al., 2012). The main objective of BI&A is to generate and deliver information to support the decision-making process (Davenport T. , 2006). Specifically, BI allows to achieve the following actions: data gathering and integration, transformation and cleaning, analysis and report creation (Watson and Wixom, 2007).

Given its purpose in aiding decision-making, BI&A has gained increasing significance in the realm of MA (Knudsen, 2020). MA involves a collection of tools and approaches that managers utilize to support planning, controlling, and decision-making activities (Ferreira and Otley, 2009). Consequently, researchers have begun exploring the relationships between BI&A and MA, with Rikhardsson and Yigitbasioglu (2018) conducting a recent literature review, highlighting four distinct yet interconnected research streams: 1) technical limitations and potentials of BI&A solutions for MA, 2) influence of BI&A technologies on MA tasks and techniques, 3) challenges related to data quality, governance, and security, and 4) enabling and hindering factors for the use of BI&A solutions in MA contexts.

Concerning the last stream of research, the literature review conducted in the previous chapter revealed that studies on the enablers and the barriers to the usage of BI&A systems within MA contexts can be categorized within three main research themes: organizational-related factors, technical-related factors, and human-related factors.

Organizational-related factors play a significant role in determining the level of BI&A system usage within MA contexts. The **perceived facilitating conditions**, which refer to the extent to which an organizational infrastructure supports the use of the system, have been identified as a key driver of adoption. Research studies have highlighted that a well-established infrastructure that fosters the integration and implementation of BI&A systems facilitates their usage by Management Accountants (Venkatesh et al., 2003; Hart et al., 2007; Grublijesic and Jaklic, 2014; Hou, 2014). **Larger firms** tend to adopt BI&A systems more extensively compared to smaller companies, primarily due to greater financial resources

available for investing in activities that promote system (Hou, 2012; ŠPIČÁK and ŠIŠKA , 2016). **Training** also emerges as a crucial enabling factor at the organizational level. Providing adequate training to users of BI&A systems is essential in leveraging the advantages of these systems and increasing the likelihood of their effective usage (Spraakman et al.,  2021). The sooner Management Accountants comprehend the features and capabilities of the BI&A system, the higher the chances of increased usage and avoidance of potential misuse (Nofal and Yusof, 2016). Additionally, research has shown that training positively influences the motivation of users to utilize the BI&A system for complex tasks (Borthwick and Hansen, 2017). However, it is crucial to customize the training process to cater to the specific needs and characteristics of participants (Yingjie, 2005). **Management support** is identified as one of the most influential factors affecting the usage of BI&A systems (Kee-Luen et al., 2018; Finnaoui et al., 2021). When top management views the adoption of BI&A systems as strategic and understands its potential benefits, it fosters a favorable environment for successful implementation and usage (Lautenbach et al., 2017). Furthermore, research indicates that management support extends beyond the implementation phase and is vital for ensuring the sustained usage of the BI&A system over time (Nespeca and Chiucchi, 2018). **Cultural factors** also play a crucial role in determining the usage of BI&A systems. A well-developed data-driven and analytical decision-making culture is likely to promote the adoption of BI&A systems (Popovič, 2017). Organizations that embrace data-driven decision-making are more receptive to the integration and utilization of BI&A systems to enhance their MA practices (Popovič et al., 2012). Moreover, **social influence**, which refers to the extent to which an individual perceives that influential others believe they should use the new information system, can impact BI&A system adoption. When the usage of the BI&A system is socially accepted, users are more likely to adopt it (Venkatesh et al., 2003; Grublijesic and Jaklic, 2014; Hou, 2014). A critical organizational factor that has been highlighted in research is the **composition of the team** responsible for designing and implementing the BI&A system. A **mix** of individuals with technical and business skills is deemed essential (Villamarín-García and Díaz Pinzón, 2017). In particular, **cooperation** and **knowledge-sharing** between data scientists or IT employees

and Management Accountants are crucial for addressing IT-related issues and achieving successful BI&A system usage (Munir et al., 2023). The involvement of prospective users in the design and implementation of the system is also crucial for fostering actual system usage (Eldenburg et al., 2010; Lynch and Gregor, 2004). Finally, **effective communication** on the benefits of the BI&A system is essential for increasing its usage, particularly if communication efforts are implemented during the design and implementation stages (Nofal and Yusof, 2016).

Technical-related factors encompass barriers that may hinder the effective usage of BI&A systems by Management Accountants. Research has identified several challenges, including reporting issues, role authorization problems, system errors, data-related problems, and workflow-related problems (Deng and Chi, 2012; Burton-Jones and Grange, 2013). **Reporting issues** arise when users encounter difficulties in customizing or navigating reports or when the reports contain errors or are unavailable. **Role authorization problems** occur when users' access to the system is denied or restricted. **System errors** refer to incidents where the BI&A system malfunctions or lacks necessary features, impacting user experience. **Data-related problems** arise due to data quality issues, such as missing, inaccessible, incomplete, or duplicate data, which affect the reliability and value of information provided by the BI&A system (Lautenbach et al., 2017; Popovič et al., 2012). To ensure successful BI&A system adoption, organizations need to invest in an appropriate **IT infrastructure**. A reliable and fast IT infrastructure Is vital for handling and computing large volumes of data, leading to successful BI&A system implementation and usage (Peters et al., 2018; Schläfke et al., 2013). Moreover, **integration** between the BI&A system and existing information systems is critical for enhancing system usage. By consolidating and centralizing data from various sources, organizations can achieve a unified data environment that supports data access, flexibility, and consistency (Pervan and Dropulic, 2019). From an enabling perspective, BI&A technologies' technical aspects can enhance the quality of the managerial decision-making process. Visualization techniques and interactivity features, such as selecting, browsing, and drilling down information, positively impact system adoption (Dilla et al., 2013; Peng et al., 2007; Seow, 2011). The system's ability to provide valuable

**feedback** and **recommendations** to support decision-making is also an encouraging factor (Villamarín-García and Díaz Pinzón, 2017).

Human-related factors encompass perceptual and behavioral aspects that influence the BI&A system's usage by Management Accountants (Rikhardsson and Yigitbasioglu, 2018). **Perceived ease of use** is a significant factor influencing the intention to use the system (Hou, 2015). **User-friendly interfaces**, easy report creation, and automated information delivery processes are crucial in determining the perceived ease of use (Brockmann et al., 2012). **Satisfaction** with the BI&A system is a critical factor in driving its adoption (Hou, 2012). The **perceived usefulness of the system**, especially in terms of delivering high-quality and valuable information for decision-making, significantly influences users' willingness to adopt the system (Jaklic et al., 2018; Popovič et al., 2012). For instance, BI&A systems can accelerate decision-making through scenario analysis, providing tangible benefits to Management Accountants and encouraging system usage (Fahlevi et al., 2021). **The level of user expertise** and **absorptive capacity** plays a crucial role in the BI&A system's adoption and usage. Expert users are more likely to explore the system's features and avoid system abandonment (Lee et al., 2008; Castellano et al., 2017). Management Accountants' **understanding of company processes**, especially those related to information systems and hardware infrastructures, enhances BI&A system usage (Popovič et al., 2012; Munir et al., 2023). The potential **loss of power** for certain users when BI&A systems are introduced can impact system usage. Integration of the system into daily routines may lead to access to more information and stakeholders, potentially causing power struggles (Popovič, 2017). Additionally, changes in decision-making processes due to BI&A system adoption may cause role-related frustrations among users (Smith and McKeen, 1992). Lastly, softer dimensions such as computer anxiety and personal traits can influence the intention to use BI&A systems. Reducing **computer anxiety** through training can enhance users' intention to use the systems (Hou, 2014). Moreover, **personal traits** like openness to experience, conscientiousness, extraversion, and emotional stability are determinants that may lead to BI&A system usage (Chang, Hsu et al., 2015).

Despite this growing and multifaceted interest, research has shown that companies are in a continuous struggle to leverage and capture value from the implementation of BI&A systems (Davenport et al., 2010) and such systems have too often failed when it came to support the managerial decision-making process (Elbashir et al., 2013; Visinescu et al., 2016; Audzeyeva and Hudson, 2015; Yeoh and Popovič, 2015). In other words, companies invest a significant amount of time, money and resources to design and implement BI&A systems, but these systems often end up not being used, partially or totally. Despite business benefits from BI&A projects highly relies on if, how and how much BI&A systems are used to support the decision-making process, the stage of use has been given little attention (Popovič et al., 2012; Burton-Jones and Straub, 2006; Burton-Jones and Grange, 2013; Corte-Real et al., 2014). Borrowing from Hou (2015, p. 1) "even though a great deal of attention has been paid to the practical decision-making benefits of BI system adoption, there's still a lack of research to investigate factors that affect users' intention to continue using BI systems after they had already adopted the systems". In other words, user acceptance and adoption present significant challenges in exploring the intersection between BI&A systems and MA (Popovič et al., 2014; Ain et al., 2019). Therefore, a fruitful avenue of research that requires, and deserves, additional attention concerns what actually drives the use or non-use of BI&A systems for MA purposes. Following along these lines, Knudsen (2020) has recently called for more qualitative studies to provide insights on what works and does not work, on the levers and the barriers that can enable or hinder the use of BI&A systems within MA contexts, as well as on the reasons for negative and positive experiences.

In view of this research gap, the aim of the paper is to investigate the following research question: How and why may BI&A systems end up being used or not used for MA purposes?


## 4.3 RESEARCH METHOD

In order to answer the research question, the authors propose a cross-sectional field study (Granlund and Malmi, 2002) involving eight case companies.

Cross-sectional field study is a qualitative method that allows to collect and analyze empirical data from a limited number of cases, each of which is explored with limited depth (Roslender and Hart, 2003). Thus, this method is suitable when it comes to provide a wide representation of a phenomenon (Granlund and Malmi, 2002) through the identification of cross-case patterns, i.e., common aspects across the cases analyzed (Lillis and Mundy, 2005).

Based on the characteristics indicated, the cross-sectional field study falls midway between the case study and the survey (Roslender and Hart, 2003). Although it shares similarities with the survey and case study, it is characterized by a less structured data collection compared to the survey and a lower level of depth than the case study (Lillis and Mundy, 2005).

The cross-sectional field study has been chosen to answer the research question given its consistency with the peculiar nature of the phenomenon to be investigated. The implementation and the integration of BI&A systems are highly context-dependent, and the method of cross-sectional field study can capture the unique organizational and technical factors that might influence the adoption and usage of BI&A systems within MA contexts in different company settings. Moreover, cross-sectional field study enables researchers to explore the human perspectives and experiences related to BI&A systems, thus permitting to explore how employees interact with the system, their attitudes toward it, and the challenges they face in using it effectively. All in all, a cross-sectional field study is a suitable research method to provide a snapshot of the levers and the barriers to the use of BI&A systems within MA contexts across multiple organizations and to provide insights the similarities and differences in usage or non-usage patterns as well as on the reasons and the ways in which these patterns manifest themselves.

The eight cases were chosen purposefully (Patton, 1990) since, during the time period that is being focused on in this paper (2022 and 2023), the companies had already designed, implemented and adopted a BI&A system for MA purposes.

The data presented in this paper are collected through semi-structured interviews (Qu and Dumay, 2011) with the Management Accountants or the CFOs who were in charge for the

use of the BI&A systems within the case companies. This data collection method ensures a high degree of flexibility (Rubin and Rubin, 2011) and allows, during the interview stage, to address issues not originally contemplated in the interview guide (Wengraf, 2001). This feature is particularly relevant to collect data on the factors that enable or hinder the use of BI&A systems for MA purposes since these factors cannot be completely predicted when the interview guide is prepared.

The interview guide (appendix 2) included questions that revolve around factors affecting BI&A system use for MA purposes. In particular, the researcher identified a set of relevant themes, which also represented the main sections of the interview guide:

- general questions about the BI&A system (aims and implementation process);
- questions on organizational-related factors;
- questions on technical-related factors;
- questions on human-related factors;
- final open-ended questions aimed at:
    o exploring other influential factors in the use of the BI&A system;
    o investigating the interactions among the factors emerging during the interview;
    o identifying and ranking the most important factors.

All the interviewees have been submitted the same interview guide to ensure the validity of the study (Yin, 2014).

During the interviews the interviewer made him sure to ask reflexive questions and to ask for examples along the lines suggested by (Kreiner and Mouritsen, 2005). Asking for examples, storytelling and anecdotes forced the interviewees to explain what really happened, stimulating them to provide detailed information and triggering, in turn, other stories and thoughts. Through story and language, in fact, individuals gave meaning to events that occurred and to their actions and they organized more effectively their experience. In this way, it was possible to discover which hindering or enabling factors come "into action" in the companies under analysis.

The interviews were conducted online through MS Teams within the period July-November 2022 and had a duration ranging from a minimum of 60 minutes to a maximum of 120 minutes.

Table 1 provides an overview of the interviews carried out for the sake of this paper.

| N. | Data | Firm | Actor | Length | Support |
|---|---|---|---|---|---|
| 1 | July 22, 2022 | Alfa | Head of the Management Accounting Department | 70 mins. | Audio + Note |
| 2 | November 15, 2022 | Beta | Management Accountant | 60 mins. | Audio + Note |
| 3 | July 25, 2022 | Gamma | Management Accountant | 80 mins. | Audio + Note |
| 4 | September 13, 2022 | Delta | CFO | 60 mins. | Audio + Note |
| 5 | July 28, 2022 | Epsilon | Head of the Management Accounting Department | 60 mins | Audio + Note |
| 6 | October 10, 2022 | Zeta | Management Accountant | 80 mins. | Audio + Note |
| 7 | September 28, 2022 | Eta | CFO | 70 mins. | Audio + Note |
| 8 | August 28, 2022 | Theta | Head of the Management Accounting Department | 70 mins. | Audio + Note |

Concerning data analysis, all the interviews were transcribed in their full length, and the researcher applied a structural coding approach in the analysis of them, through a coding tree (appendix 3) reflecting the sections included in the interview guide. Thus, a qualitative data analysis was applied to the interview data as this made it possible to focus on the meanings the respondents attributed to the hindering or enabling factors as well as to maintain sensitivity to the context (Denzin and Lincoln, 2000; Patton,1990). All in all, the analysis was centered on the factors that led the BI&A systems being used or not used for MA

purposes. In line with the qualitative approach adopted in the paper, subjects' verbatim quotes will be provided throughout the analysis section (in italics and quotation marks).

## 4.4 AN OVERVIEW OF THE CASE COMPANIES

As mentioned above, the study explored eight cases gathered within the Marche Region, Italy. The selected SMEs are heterogeneous in terms of background, capabilities, and the industrial sector since they operate in shoemaking, industrial constructions, production, and distribution of machineries and automotive. Table 2 below provides a showcase of all the SMEs involved in the study by focusing on their profile, on their size and on their industry.

Table 2 – Showcase of the companies involved in the study.

|  | **Case profile** | **Industry** |
|---|---|---|
| Alfa | Alfa designs and sells a wide range of software for either companies or customers B2C. | Software |
| Beta | Beta sells electronic devices in the B2C market. It is a medium-sized company with 4 branches in the same region. | Consumer electronics |
| Gamma | Gamma is an Italian food company specialized in the production of white and red meats. | Agri-food |
| Delta | Delta commercializes music instruments. | Music instruments |
| Epsilon | Epsilon is an historic Italian company that produces and sells toys for children. | Toys |
| Zeta | Zeta is an Italian company that produces measurement and quality control systems for companies operating in various industries. | Manufacturing of industrial machines |
| Eta | Eta produces and commercializes architectural lighting products. | Architectural lighting |
| Theta | Theta produces and sells dairy products. | Dairy products |

The initial insight drawn from the interviews revolves around the motivation that prompted the companies to embark on the implementation process of a BI&A system. All the companies under consideration initiated the implementation of a BI&A system primarily

for technical reasons, such as integrating data sources, improving data quality, and automating the reporting workflow, as highlighted in the quotes below:

*"the first reason that led us to the decision of implementing a structured BI&A system was advantages we would have obtained thanks to the integration of all the data sources. The new strategy of the company consists in the acquisition of different specialized companies all around Italy and we decided to integrate all the data sources with a big, unified Data Warehouse rather than the unification of all the ERP systems". (Alfa)*

*"the integration factor was the one that drove the Top Management Team to start a BI&A system implementation project because they were struggling having a whole view of the performance of all the companies of the group". (Theta)*

*"we implemented a BI&A system to reduce data quality errors and to certificate the production and transmission data flow so that within all the companies of the group the information would have been homogeneous". (Epsilon)*

The analysis of the empirical material also revealed that within the case companies the BI&A systems have been successfully implemented and regularly used for MA purposes:

*"..after the successful implementation of the BI&A system we now use it regularly each day and with that we're able to send reports each week". (Alfa)*

*"..we are now able to manage daily needs of information at different hierarchic levels. We have three different reports that are daily diffused among warehouses workers, middle managers and top managers". (Beta)*

*"..the BI&A system is our main information hub. We daily use the system to check information about warehouses and availability of products. We've also implemented automation for reporting: each week and each month the system sends us those reports and we use those ones during meetings with managers and top management". (Delta)*

*"we implemented the first BI&A system twenty years ago to analyze the profitability of products and customers. Since then we have never stopped exploring data with such systems and we have refined the system in relation to the continuous changing information needs of the company" (Theta)*

## 4.5 ANALYSIS OF CASES

The empirical material gathered, and its corresponding data analysis allowed the construction of table 3 below that identifies, for each case company, the present factors (grey cells) and the absent factors (white cells).

Table 3 – Present factors (grey cells) and absent factors (white cells) in each case company

| Category | Factors | Alfa | Beta | Gamma | Delta | Epsilon | Zeta | Eta | Theta |
|---|---|---|---|---|---|---|---|---|---|
| HUMAN | Absorptive capacity of management accountants | | | | | | | | |
| HUMAN | Loss of power of management accountants | | | | | | | | |
| HUMAN | Perceived ease of use of the BI&A system | | | | | | | | |
| HUMAN | Perceived usefulness of the BI&A system | | | | | | | | |
| HUMAN | Understanding of company processes by management accountants | | | | | | | | |
| HUMAN | Management accountants' expertise on BI&A system | | | | | | | | |
| ORGANIZATIONAL | Collaborative implementation of the BI&A system | | | | | | | | |
| ORGANIZATIONAL | Communication of benefits of the BI&A system to management accountants | | | | | | | | |
| ORGANIZATIONAL | Data driven culture | | | | | | | | |
| ORGANIZATIONAL | Management support to the BI&A project | | | | | | | | |
| ORGANIZATIONAL | Mixed teams of implementation of the BI&A system | | | | | | | | |
| ORGANIZATIONAL | Training on BI&A system | | | | | | | | |
| TECHNICAL | Data-related problems | | | | | | | | |
| TECHNICAL | Integration between BI&A system and existing information systems | | | | | | | | |
| TECHNICAL | Use of visualization techniques to deliver information | | | | | | | | |
| TECHNICAL | Use of feedbacks and recommendations provided by the BI&A system | | | | | | | | |
| TECHNICAL | Use of interactive features provided by the BI&A system | | | | | | | | |
| TECHNICAL | IT architecture issues | | | | | | | | |
| TECHNICAL | Reporting issues | | | | | | | | |
| TECHNICAL | Role authorization issues | | | | | | | | |
| TECHNICAL | System errors | | | | | | | | |
| TECHNICAL | Workflow-related problems | | | | | | | | |

### 4.5.1 Exploring a core group of human and organizational enabling factors

The first focal point of the empirical analysis revolves around the existence of a set of factors that positively influenced the utilization of BI&A systems in MA contexts within the

analyzed cases. More in particular, the analysis revealed that there was a bundle of organizational and human factors consistently present in all cases that form the backbone for continued usage of the BI&A system for MA purposes. In every instance, these factors remained constant and included **management support**, **mixed teams** for the implementation of the BI&A system, **collaborative implementation** of the BI&A system, **perceived usefulness** of the BI&A system, sound **knowledge of business processes**.

Management support was consistently cited by all eight respondents as the primary determinant influencing not only the implementation of the BI&A system, but also its successful use. Throughout the interviews, participants from Alfa, Beta and Theta companies emphasized this factor more prominently than those from other organizations:

*"The management team has always supported the whole implementation process during each step of it and this was the most important determinant to gain a successful implementation and to make the BI&A system used by the final users". (Alfa)*

"*The management team was the actor that started asking about a system that could integrate and visualize the data of all the branches of the group. Consequently, when we moved on with the implementation phase, it was the main sponsor of the system". (Beta)*

*"We started exploring the functionalities of the BI&A system more than twenty years ago thanks to the foresight of the top management team, that continued to be the main sponsor. I can affirm that without it we would never have achieved the actual degree of use of the system for management accounting activities". (Theta)*

Another factor consistently present in all eight cases under analysis concerns the composition of team in charge of the design and the implementation of the BI&A system. Regarding this aspect, the respondents underscored the relevance of creating a team composed by individuals with technical skills and others with business ones in order to create a proper mix of knowledge and competences:

*"The mix of competences within the implementation team is crucial for the implementation and adoption phases of such a system. Our team is composed by management accountants, data scientists and data integration specialists, externally supported by IT architecture. Mixing technical and business competences is fundamental to project a BI&A system that can actually support the informative needs of the managers."*
*(Alfa)*

*"During the implementation phase the mix of competences of the implementation team was one of the main success factors from my point of view. It allowed to create a BI&A system perfectly related to our business needs and with the adequate IT infrastructure."*
*(Gamma)*

*"In our case the implementation team was composed of different professionals, both internal and external, and the main benefit was the mix of competences of them. We would not have been able obtain a successful implementation without this factor. It definitely was one of the main relevant for us." (Zeta)*

All respondents also emphasized the importance of designing and implementing BI&A systems collaboratively, particularly involving the final users of the BI&A system and of the information produced by the system itself:

*"The approach we chose to follow for the concrete implementation of the system was the collaborative one. We organized several meetings with all the final users involved and during some brainstorming and feedback meeting we went on developing the system until it was clear to the final users and ready for the final release. This process helped us increase confidence on the system even before the release so that the final users could immediately start to use it as soon as it would have been possible." (Beta)*

*"Of course, the implementation must be collaborative. If not, the process fails from my point of view. In our case we followed the collaborative approach and we benefited for sure*

*from it. This was a determinant factor to make the implementation successful and the system used". (Eta)*

*"In our company the implementation of the system is always collaborative, and we think that this is one of the main reasons why our system is used and understood by the final users. Our approach of collaborative implementation is an iterative approach between the implementation team and the final users that allows us to constantly obtain feedback by them and answer to their specific needs". (Delta)*

A factor of paramount importance for all the interviewed companies was the perceived utility of the BI&A system. In each case, the more the new system was considered beneficial for the company and the specific tasks of the identified end users, the higher the likelihood of its usage, as underlined by the following quotes:

*"I think that without a good perception of the usefulness of the system it will never be used in a decent way because the use will be only driven by top-down duties. Throughout an adequate process the final users perfectly understand all the advantages that they will gain with the new BI&A system and the usage rate will increase for sure. That is what happened in our case" (Beta)*

*"The perceived usefulness of the BI&A system is crucial to make it used by the users of the firm. Like with other software, it is important that all the users understand the usefulness of the new system so that they will be the first ones to have the desire to use it. (Gamma)*

*"When the final users understand the importance of the BI&A system, they are much more interested in utilizing it. We knew that this would have been an important boost for the project, and we organized several meetings to explain to everyone the project we were implementing and why it would have been relevant for the company, and I can definitely say that it was crucial in terms of system usage". (Delta)*

The final factor consistently deemed crucial in achieving a high level of system usage was a sound understanding of business processes. Even when the other four factors were

appropriately addressed, without a tailored implementation concerning business processes, there was a high risk of not attaining a satisfactory level of system usage:

*"The knowledge of the business processes involved in the data sources that will be integrated with the BI&A system is crucial. The new system must perfectly fit and represent the business processes as they are, and it must be able to adapt whenever they will change. We worked so hard to make this happen, and I can affirm that this was determinant for the usage of the BI&A system." (Beta)*

*"It is very important to well know the business processes to implement a BI&A system capable of answering the business needs. We are always working on this factor because it is one of the most relevant in terms of system usage. We are also supported by external consultants to gain a perfect view of the processes because if we proceed alone, we may end up being confused by our subjectivity. This is important for both the implementation team and for the end-users of the system." (Delta)*

*"The implementation of the BI&A system should absolutely be managed by people who know perfectly all the business processes. This is so relevant to make the system used by the final users" (Alfa)*

Therefore, the empirical analysis underscores the critical importance of a core set human and organizational factors in driving a sustained usage of BI&A systems in MA contexts, as highlighted by the insights gleaned from the cases examined.

### 4.5.2 The relevance of entry point and bottom-up requests

Moreover, the analysis of the empirical data highlighted additional enabling factors not directly addressed in the literature review but able to foster the use of BI&A system for MA purposes, i.e. entry point for the BI&A system and bottom-up requests.

The factor related to the entry point emerged during the examination of interview data concerning the deployment of BI&A systems. It became apparent that, in most instances, the

BI&A system was initially developed to scrutinize sales data, encompassing metrics such as customer numbers, sales across business units, and individual salesperson performance. Additional inquiries were made to delve deeper into this specific aspect, unveiling that the deliberate decision to commence with sales data was intentional:

*"We chose sales data to start with for the implementation of the BI&A system for two main reasons. In the first place they are the fundamental data we should be analyzed with such a system. The other ones can be integrated only after the sales information. The second reason is that they are the easiest data we could have started with, and we decided to proceed with them to make the system as easy as possible because we have never used BI&A models before" (Zeta)*

*"Monitoring sales data is fundamental for our company, as the seasonality of the business implies a whole series of operational activities to anticipate the procurement and production processes, therefore from the sales data it is possible to observe the priorities to be addressed in operational terms and the critical issues that emerge on the market. Sales forecasts are updated monthly and based on them decisions are made in terms of labor requirements, purchase orders in Asia, medium-term production plans, material purchasing strategies. These were therefore the primary data we needed to integrate within the BI&A system" (Epsilon)*

*"Sales data are the most easily verifiable ones and least subject to free interpretation, so starting from these can be useful for developing "trust" in these systems." (Gamma)*

All respondents unanimously indicated that initiating the BI&A system with a focus on sales data was not only deemed advantageous due to its inherent simplicity, but also because sales data holds significant importance. The ease of handling sales data plays a pivotal role in promoting utilization, especially during the initial phase where a high level of user-friendliness and trust is essential. This preference is justified by the fact that sales data, being database-centric and lacking intricate cost or value details, aligns seamlessly with the requirement for an easily navigable starting point. Moreover, empirical data emphasized that sales data was fundamental for operations and strategic decisions, thus underscoring that

using the BI&A system to analyze sales data was perceived as valuable in influencing and guiding key business activities. As a consequence, adopting sales data as the starting point for BI&A systems contributed to the perceived usefulness of the system, especially during the initial adoption phases.

The factor associated with the bottom-up approach became evident when respondents clarified that their endeavors in constructing reports were not solely dictated by their proficiency as Management Accountants. Instead, they underscored that the way they built reports was influenced by the demand from users:

*"The organization of our management accounting activities is a bit fragmented and not standardized. We always worked so much to implement tailor made solutions for the people asking information to us and we went on with this approach even when we decided to implement a BI&A system. We know that it is not the best way but at least we are creating a system that's being used regularly by all the final users and it is good for us." (Epsilon)*

*"I believe that when the final user proposes the development of a report, he will use it more intensely as it was requested to facilitate his work and make sense of it... processing data that is not looked at is not very stimulating." (Gamma)*

Thus, the effectiveness of the BI&A system in these instances can be credited to its adaptability to requests originating from end-users. Instead of imposing predetermined analytical frameworks, the Management Accountants actively collaborated with user needs, incorporating in reports features and contents that directly catered to the specific information requirements of users. This routine heightened the relevance and perceived usefulness of the BI&A system by ensuring a close alignment with the practical needs of individuals utilizing the system for daily decision-making.

### *4.5.3 Delving into the relationships among factors*

In addition, the empirical data revealed a noteworthy pattern since the interviewees consistently linked one factor to another, recognizing the interconnected nature of the determinants:

*"In our experience the most important factor was the support by the Top Management Team. From day one it sponsored the project and the whole implementation process so that each one involved in it would have taken it as seriously as possible. The CEO is also the head of the IT department and thanks to this it accurately managed the creation of the team in charge of the implementation of the BI&A system. Without a doubt the support by the Top Management team is the main factor without which the others would not count at all, even if they were present. Secondly, the collaborative implementation and the implementation team composed by employees with mixed competencies are the second factors that should be considered from my point of view. Given the support by the Top Management Team the implementation should be handled in the best way possible and to achieve that we should be sure the team in charge is a mixed one and the implementation process is collaborative with the final users. Finally, the third factor that is the knowledge of business processes. Given the previous ones, the system should be implemented following the specific business needs and that purpose can be well obtained with a great knowledge of all the involved business processes. (Epsilon)*

*"I would say that the support by the Top Management Team and the data-driven culture are crucial at the first stage of the process, the collaborative implementation, the mixed team of implementation, the perceived usefulness, and the preventive communication are important during the following phases after the initial ones. Technical problems, training, collaborative implementation are factors that emerge in the central phase." (Gamma)*

*"Certainly, the support from top management and an organizational culture predisposed to the use of BI systems (knowing the benefits and advantages of these tools, therefore there being a certain perceived usefulness) has allowed a fairly massive use of the systems (obviously also together to adequate training provided especially by the*

*planning team towards end users). From the initial stages, support from the management and organizational culture certainly manifested itself; the training was instead prepared once the system was ready and at that point the perceived usefulness obviously also increased. In my opinion the most important enabling or hindering factors are: 1) Support from management (without this support the project would never get off the ground) 2) Adequate IT architecture (it is essential that there is an adequate IT architecture before starting with a BI&A project) 3) Organizational culture (if there is not a widespread predisposition to use the tool, given the perceived usefulness, it is difficult to promote the use of a new system) 4) Technical problems (if technical problems constantly occur, users abandon the use of the tool and perhaps alternative tools are created, personal Excel in each user's PC, etc.). In our case there was certainly support from management, but there were also several technical problems in the implementation which slowed down the go-live of the various applications. (Zeta)*

The interview data highlights the complexity of factors influencing the effective implementation and usage of BI&A systems in the context of MA. A recurring theme is that these factors do not act in isolation but interact with each other and come into play at different stages of the process. More in particular, a temporal aspect is emphasized in the impact of different factors since factors like top management support and a data-driven culture are crucial in the initial stages, while factors such as collaborative implementation, mixed teams, perceived usefulness, and preventive communication gain importance in subsequent phases. Factors like organizational culture, including a predisposition to BI systems, and the perceived usefulness of the tools not only enable the initial stages but also contribute to the widespread use of BI systems over time.

### 4.5.4 Downplaying the importance of power shifts and advanced technical features

Opposite to the factors discussed in the previous section, some factors resulted in being not as important as it emerges from the literature and of course not always present and important in each studied case. Specifically, loss of power and feedback and recommendations ones were the less present among all cases.

Alfa was the only company in which the loss of power factor resulted as relevant.

*"Yes, it had an important impact. Now all analysts have the means to conduct their analyzes and are no longer totally dependent on Management Accountants. Sometimes you have the impression that the Management Accountants are starting to no longer count because in every area there are analysts capable of independently conducting their own analyzes with the new BI&A systems" (Alfa)*

The respondents of the other companies all agreed that loss of power could have been a serious risk but fortunately no one experienced that situation.

*"There was a fear that the control area would lose power. We worked to make it clear that data analysis was a more difficult and important phase, which is why it was important to implement such a system. In practice, controller support has always been necessary." (Zeta)*

*"Obviously there was fear that the system could affect the activities and responsibilities of the controllers and that it could somehow decrease their relevance for management. Luckily this was not the case, on the contrary, the controller was important at every moment of development and became even more so at the end of the implementation." (Eta)*

*"We didn't have this problem. The controller has always been important, and BI has only helped accentuate its role." (Delta)*

The feedback and recommendations factor was never present in the cases we studied. No one has so far invested time and money to implement such solutions because of other priorities even though in the majority of the cases they all recognized the importance of them.

*"Yes, and this makes you want to use the system if you understand how to do it. However, there are no feedback and recommendation options yet because we preferred to try to introduce it only when everyone was ready to do so." (Zeta)*

*"Yes, I am able to interact with the system, an interaction that is greatly appreciated and nurtured thanks to continuous training. However, we do not have any feedback or recommendations yet, we preferred to invest in something else, but this did not lead to a lowering of the level of use of the system." (Delta)*

*"Initially difficult to understand the various functions, but then with use they gradually understood. The report is used the same even if not all the features are used well, especially the feedback and recommendation ones, so I wouldn't say it's a determining factor." (Beta)*

*"Yes, and this makes you want to use the system if you understand how to do it. However, we do not have large feedback and recommendation systems, it is not essential for now." (Theta)*

## 4.6 DISCUSSION AND CONCLUSIONS

The aim of this paper was to investigate how and why BI&A systems may end up being used or not used for MA purposes, thus contributing to the call for more qualitative research studies to provide insights on what works and does not work, on the enablers and the barriers that can foster or hinder the use of BI&A systems within MA contexts, as well as on the reasons for negative and positive experiences (Knudsen, 2020). In order to reach its aim, through a cross-sectional field study, the paper provides a comprehensive analysis of the factors influencing the implementation and utilization of BI&A systems for MA purposes.

First, the analysis uncovers a cohesive set of organizational and human factors, consistently observed across all cases, which collectively serve as the foundational elements supporting the sustained utilization of BI&A systems. These enduring factors encompass pivotal aspects such as unwavering **management support**, the **composition of teams** with a blend of technical and business expertise for BI&A system implementation, **collaborative**

**approaches** to system implementation, the **perceived usefulness** of the BI&A system, and a robust **understanding of business processes**.

More in particular, in line with Kee-Luen et al. (2018), Chiucchi and Nespeca (2018) and Finnaoui et al. (2021), **management support** resulted fundamental to achieve a high degree of use of BI&A systems for MA purposes. This was obviously reinforced when the Top Management Team was also very aware of the potential of such systems and followed the implementation in first person, like in the Epsilon case.

Consistently with Villamarín-García and Díaz Pinzón (2017), the **composition of the team** was consistently emphasized across all cases studied. Each organization underscored the importance of having a diverse range of competencies within the team responsible for implementing the BI&A system and this diversity was deemed crucial for ensuring the utilization of the system for MA purposes.

Additionally, the analysis of cases further supports the perspective of authors, such as Munir et al. (2023), who argue that a **collaborative approach** involving technical professionals and end-users is crucial to promote the use of BI&A systems for MA purposes.

The **perceived usefulness** of the system was another factor consistently relevant in the cases studied, and this aligns with the contributions of authors like Jaklic et al. (2018) and Popovič et al. (2012) who affirmed that the more such systems are perceived as useful by end-users, the more willing they are to use or learn how to use them.

Finally, the last factor that proved crucial for achieving satisfactory usage levels is a thorough understanding of business processes by both the implementation team and end-users. Popovič et al. (2012) and Munir et al. (2023) emphasized the importance of comprehending company processes, particularly for Management Accountants. However, the case analysis revealed that it is not only Management Accountants who should possess deep knowledge of company processes; rather, this understanding is essential for the entire implementation team and end-users. The more individuals involved in the BI&A flow are

acquainted with business processes, the better equipped they are to develop an appropriate system and, consequently, the greater the likelihood that the system will be used.

Thus, the paper aligns with previous literature concerning the relevance of the abovementioned human and organizational factors. Moreover, beyond confirming the relevance of these factors individually, the paper adds to the existing literature by showing that the abovementioned factors, taken together, form the backbone for the usage of BI&A systems within MA contexts.

Differently from Heinzelmann (2018) and Popovič (2017), the cases examined in this paper show a different outcome since the implementation and the use of BI&A system do not entail a perceived **loss of power** for Management Accountants, thus not causing role-related frustration. As emerged in almost each interview, loss of power was never a real issue for the Management Accountants, apart for Alfa case, whose respondent revealed that in some situations Management Accountants felt like losing ground in supporting the decision-making processes because the massive diffusion of the information throughout the company made the operational managers able to interpret information and take decisions autonomously. However, within the majority of the organizations Management Accountants did not lose power, instead they gained importance. In addition, and differently from Garcia et al. (2017), the cases under analysis reveal that the BI&A system's ability to provide valuable **feedback and recommendations** to support decision-making was never a crucial factor to encourage the use of the system itself. Up to this point, those organizations have not invested in feedback and recommendation algorithms or features. This could be due to reasons such as prioritizing other improvements in the systems or waiting for the organization to become confident with the basic features before introducing new ones.

Thus, the findings do not align with previous literature concerning the relevance of these factors. In addition, on a more general level, the paper adds to previous literature by revealing varying levels of significance among factors, with some proving more important and consistently present than others.

Following along these lines, and differently from previous literature, the analysis underscores that factors do not work in isolation, but the way they **interact** and the sequence in which they come into play shape the effective implementation and utilization of BI&A systems. A recurring theme throughout the data is indeed the interdependence of these factors, revealing that they do not operate in isolation but rather interact dynamically. Furthermore, a temporal dimension emerges, highlighting that certain factors, such as top management support and a data-driven culture, play a pivotal role in the initial stages. In contrast, factors like collaborative implementation, diverse teams, perceived system usefulness, and proactive communication become increasingly significant in subsequent phases. Additionally, organizational culture and the perceived utility of the tools not only facilitate the early stages but also contribute significantly to the sustained and widespread adoption of BI systems over time.

Furthermore, the study uncovers additional enabling factors not extensively addressed in the literature, such as the entry point for BI&A systems and the bottom-up approach for reporting requests.

Starting BI&A implementation with a focus on sales data is identified as a strategic choice, providing an easily navigable starting point that enhances the perceived relevance of the BI&A system. The case analysis revealed that sales data appeared to be the most known and important ones, and the easiest ones to collect and manage in technical terms. By reading these considerations with academic lens, it is possible to identify links with some of the factors found in the literature.

The fact that sales data are considered the easiest to collect and manage, the most important and most known data and therefore the data with which organizations should start their BI&A system implementation to gain trust has connections with perceived usefulness and ease of use of the system as well as with technical aspects connected to data-related problems. By using sales data first, information produced by BI&A systems are likely be easier to be interpreted and understood than information produced by elaborating other types of data since sales data are considered the most important and the most known within

organization as well as the easiest to collect and manage given that they are usually not affected by data quality issues. This situation clearly improves the perceived usefulness and ease of use of the system and, consequently, the user satisfaction.

Thus, the paper confirms and refines the findings of Jaklic et al. (2018) and Popovič et al. (2012) by shedding light on the reasons why the BI&A systems may be perceived useful and easy to use. In addition, the paper adds to Lautenbach et al. (2017) by showing how data-related problems and the issues connected to the reliability of the information might be addressed by using sales data as entry point for the BI&A system.

The bottom-up approach, driven by user requests and tailoring reports to meet specific needs, enhances the adaptability and relevance of BI&A systems. This has the potential to increase perceived usefulness, leading to higher satisfaction levels and, consequently, higher usage degree. The paper confirms and refines the findings of Jaklic et al. (2018), Popovič et al. (2012) and Fahlevi et al. (2022) by shedding light on the reasons why the BI&A systems may be perceived as relevant and useful.

All in all, the complexity of factors influencing BI&A usage in the context of MA is evident, and the study contributes to a nuanced understanding of these dynamics. The findings emphasize the need for a multifaceted approach, considering technical, organizational and human factors, and recognizing the interconnectedness of these dimensions.

In closing, it is important to acknowledge the limitations of this paper. Notwithstanding its utility, the cross-sectional field study design is accompanied by inherent constraints. One notable limitation lies in its inability to explore in depth the temporal dynamics of factors or relationships among identified factors and subsequent outcomes. To achieve a more comprehensive and longitudinal understanding of those aspects, it would be useful to investigate enablers and barriers to the use of BI&A systems for MA purposes through single in-depth case studies.

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# CHAPTER 5

*INVESTIGATING HOW AND WHY BUSINESS INTELLIGENCE & ANALYTICS SYSTEMS RESHAPE THE ORGANIZATIONAL RELEVANCE OF MANAGEMENT ACCOUNTANTS:*
*A SINGLE IN-DEPTH CASE STUDY*

## 5.1 INTRODUCTION

Management Accountants (MAs) play a pivotal role in business organizations, performing diverse tasks, taking on different types of responsibilities, and establishing a wide range of relationships with other actors operating within companies. Traditionally, MAs have been associated with scorekeeping, involving the collection and dissemination of data for performance assessment, and providing decision-making support through precise information (Simon et al., 1954; Hopper, 1980; Sathe, 1983).

In the contemporary business environment, MAs are increasingly viewed as crucial business partners, contributing value by aiding management in informed decision-making across operational and strategic domains (Järvenpää, 2007; Ahid and Augustin, 2012). This expanded role demands a profound understanding of the business beyond conventional accounting practices, necessitating collaboration across various organizational functions (Granlund and Lukka, 1998; Byrne and Pierce, 2007). The integration of digital technologies, specifically Business Intelligence & Analytics (BI&A) systems, further transforms the dynamics of information processing, posing both opportunities and challenges for MAs and raising questions about the future relevance and role of MAs within organizations.

The ongoing academic debate centers around the impact of BI&A systems on the role of MAs, with two clearly divergent perspectives emerging (Nielsen, 2015; Moll and Yigitbasioglu, 2019; AlAnsari et al., 2022). One perspective envisions MAs as central

protagonists and the management accounting function as the company's data and information hub, intensifying interactions across organizational functions (Wadan and Teuteberg, 2019; Esswein and Chamoni, 2018; Peters et al., 2018). The alternative perspective suggests a potential loss of importance for MAs, with their tasks being delegated to other functions, leading to conflicts and competition, particularly with IT and data scientists (Cavélius et al., 2020; Arnaboldi et al., 2017; Richards et al., 2019; Rowbottom et al., 2021).

However, previous contributions on how the MA's role might be affected by the introduction of new Information Systems seem to be depict a much more nuanced and complex picture, thus, not presenting a sharp dichotomy like the one that the literature spots for MAs and BI&A.

For example, when exploring the relationship between MA and ERP systems, Caglio (2003) affirmed that the consequences for Management Accountants might be "hybrid", leading MAs to perform new tasks such as the update of the information system. Carlsson-Wall et al. (2022) and Morales and Lambert (2013), pointed out that within the MA team each Management Accountant might be affected in different ways by the introduction of an ERP, both in terms of reception of the information and in terms of tasks, techniques and competences. In addition, authors like Moles and Lambert (2013) coined the term "deviant management accountant" referring to the phenomenon on the basis of which there could be some Management Accountants who do not want to evolve into "business partners" but instead they appreciate new "dirty work" (es. data collection, data cleaning) produced by the introduction of an ERP.

Against this backdrop, it still remains uncertain whether the introduction of BI&A systems will lead MAs to play a "protagonist" role, becoming the central information "hub" for the entire company, or to face the risk of diminishing importance or to hybrid, more complex and multifaceted effects. Therefore, more empirical evidence is needed to investigate how the introduction of BI&A systems is reshaping the interactions with and the organizational power between MAs and other companies' actors, such as operational managers, top managers and other support functions like the IT department.

Therefore, this paper aims to contribute to filling this research gap by investigating the following research question: *if and how do BI&A systems reshape the organizational relevance of management accountants within companies?*

To answer the research question the authors conducted a case study-based research about a company which implemented a BI&A system for management accounting purposes and its use substantially reshaped the organizational relevance of the management accountants.

The structure of the remainder of the paper is as follows: Section 2 presents the literature review and the research question, and Section 3 describes the method chosen to answer the research question. Section 4 illustrates the case study. Finally, Section 5 discusses the case findings and Section 6 concludes the paper by presenting its main contributions.

## 5.2 LITERATURE REVIEW

Management Accountants (referred to as MAs henceforth) are organizational actors belonging to the management accounting function that engage in diverse tasks, responsibilities, and relationships within business organizations. Their multifaceted roles have been a subject of extensive academic research for several decades, as evidenced by various scholarly works (e.g. Hopper, 1980; Sathe, 1983; Granlund and Lukka, 1998; Burns and Baldvinsdottir, 2005; Byrne and Piece, 2007; Järvenpää, 2007; Goretzki et al., 2013).

Traditionally, the role of MAs has been categorized into two primary functions, as articulated by Simon et al. (1954) and Hopper (1980). The first involves scorekeeping, encompassing activities related to the collection, preparation, and dissemination of data to assess organizational performance (Hopper, 1980. This depiction aligns with the conventional perception of MAs as mere "bean counters" (Friedman, Lyne, 2001; Järvenpää, 2001). The second function pertains to the provision of precise and pertinent information to support managerial decision-making processes (Hopper, 1980). In this regard, subsequent contributions reinforce this, indicating that MAs are expected to support and advise managers by delivering relevant information when needed (Burns and Baldvinsdottir, 2005; Morales and Lambert, 2013; Arnalboldi et al., 2021). MAs acting in this way are labelled "business

partners" (e.g., Järvenpää, 2007; Goretzki et al., 2013). Contrary to "bean counters", business partners have "the willingness and ability […] to provide more added value to the management (decision-making and control) of the companies" (Järvenpää, 2007, p. 100).

In this scenario, beyond processing and providing information, the customized communication of data becomes paramount for MAs. Weber et al. (2011) emphasize that information must be tailored to individual user needs, explained clearly, and interpreted understandably.

Acting as "business partners", MAs contribute value to companies by helping management make informed decisions in both operational and strategic domains (Järvenpää, 2007; Ahid and Augustin, 2012). This MAs' role as decision-making facilitators necessitates a profound understanding of the business beyond traditional accounting tools and data (Granlund and Lukka, 1998; Byrne and Pierce, 2007). A comprehensive knowledge of the organization, including other business functions, industry dynamics, competitors, and the market, is crucial for MAs to pose relevant questions, meet diverse managerial information needs, and tailor information accordingly (Pierce and O'Dea, 2003; Spraakman et al., 2020).

Recognizing the contemporary use of digital technologies such as Business Intelligence & Analytics (BI&A) within organizations, it is noteworthy that tasks involving information collection, creation, and communication can now be facilitated through these technologies (Appelbaum, 2017; Bhimani and Willcocks, 2014; Moll and Yigitbasioglu, 2019; Quattrone, 2016). BI&A systems, defined as a combination of technical and organizational elements, serve to present information for effective decision-making and management support (Işik et al., 2013; Alter, 2004; Moss and Atre, 2007). The ongoing debate in academia centers on the impact of BI&A systems on the role of MAs, with contrasting perspectives emerging in recent literature (Nielsen, 2015; Moll and Yigitbasioglu, 2019; AlAnsari et al., 2022). One perspective envisions MAs as central "protagonists" and the management accounting function becoming the company's data and information "hub". Conversely, the other perspective suggests MAs may risk losing importance, ceding control over some activities to other functions, and possibly facing dissolution.

According to the first research perspective, interactions between MAs and other operational areas will intensify due to increased data input from various departments (Wadan and Teuteberg, 2019). Consequently, data will no longer be confined to individuals from specific areas, enhancing collaboration across functions (Esswein and Chamoni, 2018; Nespeca A. and Chiucchi M.S., 2018a, 2018b; Ruggeri et al., 2022). MAs are expected to develop a holistic view of the company to support decision-makers by analyzing diverse datasets and scenarios from various functions such as supply chain, human resources, or marketing (Nielsen, 2018). This expanded role may involve supporting planning, controlling, and decision-making operations for a broader set of organizational functions.

To fulfill this extended role, MAs will need to cooperate more intensively with certain organizational functions, particularly IT. Three new areas where MAs are expected to collaborate and share responsibilities with IT are: (1) data governance, (2) data access. Data governance involves plans, policies, and procedures to ensure legal and ethical compliance and mitigate data quality risks, necessitating employee training on these issues (Bai et al., 2012; Neely and Cook, 2011). As more functions require access to accounting data, MAs may play a role as data "curators", requiring competence in data access and supporting other functions in integrating accounting data with data from other sources (Vasarhelyi et al., 2015; Rikhardsson and Yigitbasioglu, 2018).

Interactions between MAs and managerial decision-makers are also expected to transform, with faster real-time data processing shifting managers' focus from descriptive analysis to diagnostic, predictive, and prescriptive analysis (Wiedemann and Wiegmann, 2017; Nielsen, 2018; Wadan and Teuteberg, 2019). As managers gain direct access to data through user-friendly BI&A tools, MAs may adopt a consultative role, advising managers in interpreting and utilizing the outputs of these tools for decision-making (Elbashir et al., 2011; Fehrenbacher et al., 2022; Peters et al., 2018; Rikhardsson and Yigitbasioglu, 2018). In particular, MAs' "feel for the numbers" becomes essential in translating information provided by BI&A systems into decision-relevant business information (Al-Htaybat and von Alberti-Alhtaybat, 2017; Becker and Heinzelmann, 2017). This renewed interaction with

managers is expected to strengthen MAs' role as business partners (Bhimani and Bromwich, 2009; Möller et al., 2020; Samanthi and Gooneratne, 2022; Yigitbasioglu et al., 2023).

Thus, the increasing need for MAs to develop technological and analytical competencies due to the introduction of BI&A systems complements and amplifies the importance of their traditional management accounting skills. This combination of knowledge benefits organizations, as the integration of accounting expertise with cutting-edge technological tools enhances efficiency and optimization in achieving objectives (AlAnsari et al., 2022).

On the contrary, an alternative research perspective suggests that MAs are at risk of losing their distinct identity within the organization and becoming absorbed into other functions. This viewpoint highlights three key threats to the management accounting function: (1) the quality of tasks performed, (2) the quantity of tasks performed, and (3) potential competition and conflicts with other professions, particularly IT and data scientists.

Firstly, there are doubts about the notion that BI&A systems automatically lead to more time for value-added activities, as it often involves replacing traditional nonvalue-added activities with new ones. While certain low-value tasks may be eliminated (Guthrie and Parker, 2016; Wadan and Teuteberg, 2019), the implementation of BI&A systems may introduce additional "dirty" work (Hughes, 1951 in: Brown, 2015), such as data collection and cleaning, reducing the time available for advisory roles (Cavélius et al., 2020; Oesterreich and Teuteberg, 2019).

Secondly, the use of BI&A systems can potentially marginalize the role of MAs within the company by reducing their power in decision-making processes. Traditionally, MAs have been responsible for designing the content and presentation format of managerial reports, influencing the accuracy and quality of decisions. However, BI&A systems now allow managers to customize presentations, possibly diminishing MAs' influence (Dunne et al., 2013; Mertins and White, 2014). Consequently, MAs may find themselves in a more marginal role than before.

Thirdly, the introduction of BI&A systems may lead to conflicts over functional jurisdiction and responsibilities, particularly between MAs and IT. The adoption of BI&A systems in management accounting may necessitate MAs to acquire IT competencies to address IT-related issues (Oesterreich and Teuteberg, 2019). Additionally, traditional responsibilities of MAs, such as creating and maintaining reliable and secure databases, might be increasingly challenged by IT. The use of Big Data and analytics further intensifies the clash between MAs and IT staff, as it remains unclear which function owns Big Data and how MAs, IT staff, and data scientists collaborate to extract information from it (Arnaboldi, Busco, et al., 2017). This could lead to potential conflicts regarding the reliability and timeliness of information gathered from Big Data analysis (Al-Htaybat and von Alberti-Alhtaybat, 2017).

Therefore, the changing organizational power dynamics may lead to the assimilation of MAs' tasks by managers, IT staff, and data scientists. On the one hand, BI&A systems empower managers to take more control over management accounting processes (Richards et al., 2019; Rowbottom et al., 2021); on the other hand, managers themselves may prefer to rely on IT and data science expertise for the design and implementation of such systems (Inghirami, 2014, 2017; Möller et al., 2020; Twyford and Abbas, 2023). Consequently, MAs face the risk of being marginalized in their traditional roles, possibly leading to a downsizing of the management accounting function (Lee and Widener, 2016).

Overall, the literature review highlights that current research on the impacts of BI&A systems on MAs' role proposes a clear dichotomy about the future of the MA profession. However, previous studies on the influence of information systems on MAs' role suggests that the interplay between BI&A and MAs' role can be more blurred and complex than presented. More precisely, this rich stream literature illustrates that the use of information systems, such as Enterprise Resource Planning (ERP) systems, often produces multifaceted, nuanced and sometimes unexpected outcomes on MAs' role within organizations (e.g. Caglio, 2003; Carlsson-Wall et al., 2022; Dechow, Mouritsen, 2005; Heinzelmann, 2018; Jack, Kholeif, 2008; Sánchez-Rodríguez, Spraakman, 2012).

For example, Caglio (2003) shows the phenomenon of "hybridization" of occupational roles as a consequence of an ERP system implementation and use. In particular, the Author reports a case in which the use of the system broke down functional barriers, thus allowed managers to directly access accounting data. Although MAs lost their power over information, thanks to the ERP use, they could broaden their competencies towards the IT field and "hybridize" their role within the organization.

Another interesting aspect that emerges from previous literature relates to the different ways in which the use of an information system can influence the role of MAs employed in the same organization. In this regard, it is not said that all MAs perceive the use of an information system in a similar way but depends on how they perceive that the technology can improve their tasks and their relationships with other organizational actors (Carlsson-Wall *et al.*, 2022; Morales and Lambert, 2013).

For instance, Carlsson-Wall *et al.* (2022) illustrate that central management accountants perceived that the use of a cloud-based ERP improved their role as it cleared their work of errors and redundant activities. By contrast, local management accountants found that the use of standard formats required more manual work to them. More importantly, they were no longer able to provide local managers with tailored information; therefore, they perceived that the cloud-based ERP did not allow them to act as "business partners".

Implications for MAs' role can be different also for MAs working within the same department and one case is that of the "deviant management accountant" analyzed by Morales and Lambert (2013). Contrary to his colleagues who aimed at acting as business partners and felt frustrated by performing "dirty work" produced by the system, the "deviant management accountant" liked performing it and, more interestingly, he exploited it to gain power within the organization.

Against this backdrop, it appears that the two opposite perspectives about the nexus between BI&A systems and MAs' role do not sufficiently describe the multifaceted implications deriving from the use of information systems on the role of MAs. As previous literature on information systems shows, MAs can be differently influenced by the use of a

technology even when they work within the same department. This seems to be related to if and how they perceive opportunities for improving their role deriving from the use of the technology of not. Yet, to date our knowledge about if and how the use of BI&A influence MAs' role within organizations appears still scant and more empirical evidence is needed. Therefore, this paper aims to contribute to filling this research gap by investigating the following research question: *if and how do BI&A systems reshape the role of MAs within companies?*

As Lukka (2007, p. 95) states, providing an answer to the how questions can help to explain why something happens. Thus, the paper will focus on the way the introduction of the BI&A systems influences the role and the responsibilities of MAs towards other company's stakeholder. The interactions among subjects while they are engaging with BI&A systems will represent the core of the investigation.

## 5.3 RESEARCH METHOD

To address the research question, the authors employ a single in-depth case study of an Italian medium-sized company that has been designing and implementing a BI&A system for managerial accounting purposes since 2020.

The case study method was chosen to investigate the research question, as it allows for a comprehensive and in-depth examination of a complex phenomenon within its real-life setting (Yin, 2003; Scapens, 2004; Lukka, 2005). Additionally, opting for a single case enhances the depth of the analysis by providing a more profound and comprehensive understanding of the phenomenon and its contextual factors. This approach allows researchers to gather "richer" information on the analyzed phenomenon, both in terms of breadth and depth of data collected (Ferreira and Merchant, 1992), as well as understanding the underlying reasons behind specific actions taken by individuals and the interactions among them (Ahrens and Dent, 1998). This approach is particularly suitable for exploring the influence of BI&A systems on the organizational relevance of MAs, which is not only

inherently complex and context-dependent, but also depends on the way actors interact with each other and with the BI&A system.

The case was chosen purposefully (Patton, 1990) due to the occurrence of several instances where the implementation and the use of the BI&A system for management accounting purposes led to reshape the power, the responsibilities, the tasks of the MA as well as his interactions with other company actors, thus influencing his relevance within the organization.

To collect data, semi-structured interviews were used (Kreiner and Mouritsen, 2005, Qu and Dumay, 2011). This method was considered particularly relevant to explore the topic under scrutiny, since the way BI&A systems might reshape the organizational relevance of MAs cannot be completely predicted in advance before entering the field. Therefore, semi-structured interviews can ensure, during the interview stage, the emergence (and subsequent analysis) of other relevant issues not originally contemplated (Wengraf, 2001) because of their high degree of flexibility (Qu and Dumay, 2011; Rubin and Rubin, 2011).

Questions were prepared by the authors after having reviewed extant academic literature on the influence of the BI&A systems on the organizational relevance of management accountants, and they were provided to subjects involved in the research project before interviewing them. Interviews were carried out with the MAs as well as with the final users of the information provided by MAs through the BI&A system, i.e. the actors with whom the interactions with the MA changed after the introduction of the BI&A system. Every participant answered the questions through face-to-face or online interviews, and each interview lasted from 45 minutes to one hour and a half. If it was considered necessary by the researchers, follow-up interviews were requested. All interviews were tape-recorded and then transcribed to make the analysis possible.

In order to explore the influence of the BI&A system on the organizational relevance of the management accountants from different perspectives, two different interview protocols were prepared: one for the management accountants and one for the operational managers.

The structure of the interview protocol for the Management Accountants (appendix 4) was composed of five main sections, with some sub-sections where necessary. The initial section focused on the characteristics of the Management Accounting team, delving into inquiries aimed at grasping the team's composition, operational dynamics, and its interplay with other departments within the organization. Additionally, we sought insights into the tools commonly employed, the team's routine, and the core competencies of the Management Accountants. The second section explored the motives behind implementing the BI&A system and the associated procedural aspects. This involved probing into the rationale for implementation, the role played by the Management Accounting department in the implementation, adoption, and post-adoption phases, as well as the primary positive and negative factors encountered during this process. Following these, the third section analyzed three aspects from both pre-implementation and post-implementation perspectives. The first sub-section scrutinized whether and how interactions with other departments underwent changes. Participants were asked about the frequency, content, and mode of interactions both before and after the implementation of the BI&A system. In a similar manner, the sub-section delved into pre and post synergies among team members, exploring the motives behind these changes. In the second sub-section, we assessed if and how interactions with the top management team evolved following the introduction of the BI&A system. Moreover, questions investigated how the top management team perceives the role and responsibilities of management accountants post-implementation. The last section centered on the evolution of the management accountant's role after implementing the BI&A system, examining shifts in activities and competencies. Questions explored how tasks and responsibilities were handled before and after the implementation of the BI&A system, with a focus on whether the management accountant gained or lost centrality within the organization.

The second interview protocol (appendix 6) structured for operational managers comprised two sections. The initial part inquired about their roles, activities, and the impact of the BI&A system on their department or activities. The subsequent section delved into their experiences with the introduction of the BI&A system, specifically examining their relationships and interactions with the Management Accounting department. Participants

were asked to articulate changes in these relationships and identify significant positive and negative factors influencing these interactions.

Table 1 provides an overview of the interviews carried out for the sake of this paper.

| N. | Data | Actor | Length | Support |
|---|---|---|---|---|
| 1 | May 16, 2023 | Head of Management Accounting Department & Business Intelligence | 90 mins. | Audio + Note |
| 2 | May 25, 2023 | Sales & Business Intelligence | 80 mins. | Audio + Note |
| 3 | June 23, 2023 | Export Sales Director | 60 mins. | Audio + Note |
| 4 | June 23, 2023 | Manufacturing Manager | 70 mins. | Audio + Note |
| 5 | June 23, 2023 | COO | 60 mins | Audio + Note |
| 6 | July 05, 2023 | Management Accountant 1 | 70 mins. | Audio + Note |
| 7 | July 14, 2023 | Head of Accounting & Finance | 80 mins. | Audio + Note |
| 8 | January 04, 2024 | IT administrator | 70 mins. | Audio + Note |
| 9 | January 17, 2024 | Management Accountant 2 | 80 mins. | Audio + Note |
| 10 | January 23, 2024 | CEO | 65 mins. | Audio + Note |

The empirical material obtained from the interviews was enriched with the analysis of documents and reports of the company. A before and after BI&A comparison was specifically carried out to explore if and how the outputs of the Management Accounting team changed thanks to the new BI&A system.

A qualitative data analysis was applied to the interview data as this made it possible to maintain sensitivity to the context (Denzin and Lincoln, 2000; Patton, 2002). In particular, data analysis was performed by the researcher in a following stage. More specifically, the researcher read and coded the transcriptions of every interview, following the coding protocol

that was established before starting the data analysis phase. The coding protocol was organized to identify quotes related to: a) reasons behind the introduction of the BI&A system; b) design and implementation process of the BI&A system; c) tasks and responsibilities of the MAs before and after the introduction of the BI&A system, b) interactions with the operational managers before and after the introduction of the BI&A system in terms of intensity, content, frequency, synergies, frictions, power balance; c) interactions with the top managers before and after the introduction of the BI&A system in terms of intensity, content, frequency, synergies, frictions, power balance. All in all, the analysis was centered on the factors that led to changes in the organizational relevance of MA due to the introduction of the BI&A system. In line with the qualitative approach adopted in the paper, subjects' verbatim quotes will be provided throughout the analysis section (in italics and quotation marks).

## 5.4 CASE DESCRIPTION

Alfa is a medium-sized Italian company operating in the toy industry with revenues of approximately 200 million euros, a workforce of around 600 employees, and a global market presence. Established as a family-owned business in the 1960s, it remains a family-managed organization without external equity investments.

Alfa sells its products both through General Distribution Outlets (GDO) and its online store. Technologically advanced in the design and production of its products, the company is also investing in enhancing its internal management tools. Consequently, the family leadership has hired different managers to initiate innovative internal projects, one of which involves the introduction of a BI&A system to integrate company data sources, certify data flows, centralize information, and automate the production and transmission of reports to all company users.

Before the introduction of the BI&A, whenever the Top Management needed some aggregated information, the Management Accountants and the other managers involved in producing always had several difficulties in meeting that need in a timely and homogeneous

way. The first need was therefore the integration of all the data sources of the company and the creation of a unique central data warehouse of all information.

Another relevant goal the organization wanted to achieve was the possibility to widen and deepen the analysis of managerial information. The international environment in which the firm operates in recent years has become so complex as to force the organization to equip itself with a complex monitoring system. They therefore decided to build a BI&A system also for this reason.

Thus, the reasons that led the organization to implement a BI&A system were related to management accounting purposes and mainly technical and managerial in nature.

The entire process of implementation of the BI&A, which took place in 2020, was overseen by the head of the management accounting department, engaging a specific consulting company and forming a dedicated internal team for implementation. A seasoned sales manager joined the internal team, contributing with his analytical expertise and experience to create suitable dashboards for end-users. From that point onward, the implementation gained momentum, earning increased trust from the top management team, which augmented the budget for the project each year.

The key phases of the implementation comprised three stages:

•    technical and business analysis: the implementation team gathered technical and business requirements, investing several months to analyze data flows and collect requests from identified end-users;

•    definition of the IT architecture: in this step the head of the management accounting department provided advice, but the majority of the work was carried out by the IT employees who crafted the IT architecture;

•    iterative collaborative process between designers and end-users: led by the head of the management accounting department, this phase involved connecting and integrating data,

implementing dashboards, and organizing meetings with end-users to validate the content and the structure of the dashboards and gather feedback.

Over the course of several months, this process resulted in the creation of effective dashboards that end-users began using on a daily basis, transitioning from the old analysis and reporting methods to the new BI&A system-based approach.

The following section presents the case analysis, partitioned into various subsections corresponding to the salient points identified during the analysis of the empirical material. Each subsection delves into specific elements, dissecting their implications and interconnections within the broader context. This methodical segmentation allows for a focused analysis, enabling a detailed exploration of the pivotal issues at hand. Through this dissection, the analysis aims to provide an insightful and thorough understanding of the case, laying a solid foundation for subsequent discussions and conclusions.

## 5.5 CASE ANALYSIS

The analysis of the empirical material has revealed clear changes in the role of the management accountant following the introduction of the BI&A system. Upon conducting a comprehensive examination of the empirical material, we can delineate key considerations concerning what has changed and how these changes have manifested. These considerations encompass themes such as the interactions between Management Accountants and the company's top management team, and alterations in the type and volume of requests from other departments to the management accounting department, or the role adopted by them in the implementation process and the organizational significance of the management accounting department once the system was rolled out across the entire organization. Additionally, considerations extend to changes in the skills of management accountants and the redistribution of responsibilities within the management accounting department,

### 5.5.1 The pivotal role of Management Accountants in the BI&A implementation process

The analysis of the empirical data underscored the **pivotal role** played by management accountants throughout the implementation process of the BI&A system, spanning from the early stages of technical and business analysis to the design and deployment phases for end-users. Each respondent emphasized the consistent presence of management accountants at all stages of the implementation process and underscored their critical importance. In this regard, the head of management accounting function revealed:

*"Management Accountant had to be the central role in the whole implementation process because they know our procedures like everyone else and because their main activities are the elaboration of data and interpretation of it and the BI&A system is a vertical mix of procedures and technologies that helps improving that kind of activities for decision-making purposes" (CEO)*

*"The management accounting team was the main sponsor together with the CEO because he also is head of the IT department. Suddenly, the sales and marketing departments accepted the project because they knew the importance of it and one of their most experienced managers joined the implementation team and since then he never stopped with BI&A activities and responsibilities. Apart from some technical difficulties, the management accountants were central in the implementation because they had the greatest holistic view of the whole process of the firm and they perfectly knew what and how should be built as BI&A system for the moment" (Head of Management Accounting)*

*"I did not participate in the designing of the IT architecture of the system and in the implementation of the data model. Those activities were carried out by Management Accountants and the IT employees. I supported the designing phases managed by the Management Accountants by trying to clarify what were the main information needs by the end-users working with sales and marketing data. We worked so well that we created a central BI&A team and now I'm daily working for BI&A activities in relation to sales and marketing data". (Sales Manager)*

*"During the implementation phases my role was to participate in some check point meetings to give feedbacks and/or other recommendations to the implementation team. In doing so, the presence of the Management Accountants was determinant because they could mediate and translate our requests in technical terms for the IT employees, and vice versa."*

*(Manufacturing Manager)*

*"The process was led by the head of our department, but we supported him during each phase of the implementation." (Management Accountant 1)*

Hence, the central role of Management Accountants emerges during the implementation phases. It is important to note that this situation was a deliberate decision made by the company's top management team. One of the primary reasons for this decision was undoubtedly the advocacy for the system's introduction by the head of the management accounting department.

Furthermore, another reason behind the involvement of the Management Accountants in the implementation process was the recognition of the Management Accounting department's ideal position as an intermediary between more technically and business-oriented roles. It is noteworthy that the management of Business Intelligence activities has been entrusted to the head of the Management Accounting department, in collaboration with a former sales manager and the IT department.

The insights into why and how Management Accountants participated in the implementation process immediately led to a key observation: Management Accountants were selected as the primary actors in the implementation process due to their comprehensive knowledge of processes, people, and information systems. In connection with the previous aspect, there are the Management Accountants' competencies, activities, and interactions with other business areas and the company's leadership.

The active involvement of Management Accountants in the entire implementation process elevated their already central role within the organization. Having gained valuable experience

throughout the phases, they became the primary point of contact for any issues related to data flows, encompassing both technical and organizational/business aspects. As the perception of the individual roles of Management Accountants matured, the organizational significance of the department has significantly expanded. What was once a support function has evolved into the right-arm of the Top Management team. Management Accounting became the primary source of information that the Top Management team relied on for support in the decision-making process.

### 5.5.2 The evolution of the interactions between the Management Accountants and the other actors

The considerations included in the empirical material pertain to the changes in **interactions** between the Management Accounting department and other business areas, as well as between the Management Accounting department and the company's top management.

Before the implementation of the BI&A system, as mentioned by all interviewees, interactions were already at a satisfactory level, managed without significant difficulties, and involved regular data analysis meetings. However, the introduction of the BI&A system significantly intensified these interactions, fostering stronger personal relationships among employees that have had positive consequences throughout the work environment.

The volume of requests to the management accounting department from the other departments notably increased and covered a wide range of aspects, from specific technical issues to assistance in interpreting and analyzing data. When data is unclear, end-users promptly reached out to the Management Accountant for collaborative interpretation of ambiguous data.

*"I was already in constant contact with the Management Accounting team but as soon as the BI&A implementation process began we've united in a unique big implementation team and we're now directly connected to insure data certification. I am responsible for the*

*architectural side of the BI&A system and they work to design the best reports for the final users of them, but we are always connected also thanks to their improving technical competencies in managing databases and integrations of data sources" (IT administrator)*

*"With the introduction of the BI&A system the relationship between me and the Management Accounting team increased. We were already highly connected but now we contact each other every day and given my new BI&A responsibilities I must organize our schedule with them for the release of the new reports or the modifications of the existing ones. However, I can speak for all the sales team when I say that their interactions have grown. The meetings are not sporadic and do not last hours like in the past, they now happen every day in a much faster way in relation to the past". (Sales Manager)*

The same perspective was confirmed by the members of the other departments of the company.

*"Before the introduction of the BI&A system the main duty of the Management Accountants was the analysis of balance sheet data and we always have been contacting them for those issues. Now, we are always connected to the Management Accounting department for a least three main reasons. The first one concerns the fact that the technical complexities have increased and we need the support by someone who also knows the business procedures. The second one concerns the fact that now the Management Accounting department have a greater holistic view and they really support us in the multidimensional analysis of the performance of the firm. The last one is related to the fact that the complexity of the analysis has increased as well and we need their support in the interpretation of the information coming from the BI&A system. I can therefore say that the interactions have not only increased but we are all connected as one big analysis team whose main purpose is to understand the performance and make it improve." (Export Sales Director)*

*"Before the BI&A system we used to meet with the Management Accountants or call them whenever we had issues connected to the reliability of operational data. There were several problems in connecting the sources and certificate the data across the firm. It could*

*happen that someone had some numbers different from ours; in that case we used to*
*connect to the Management Accounting department so that we could solve the problem*
*together. Now the flow of data is almost totally certified and to do so we are constantly*
*connected to the Management Accounting department. We do not meet just to solve issues,*
*but to build new architectures and procedures always in the direction of the creation of a*
*single unified information hub of the firm." (COO)*

Finally, interactions between the Management Accounting department and the company's top management team have evolved in a similar manner. Historically, these interactions consisted of regular touchpoints to reflect on data and gather specific needs from the top management team to be explored by the management accounting department. With the implementation of the new BI&A system and the top management team's acceptance of its regular use, the relationship between the two has significantly intensified, yielding positive results.

*"We have always been often in contact with the company's leadership. The CEO is the*
*head of IT department and to demonstrate how close we were, as I said, before we were*
*together the main sponsors of the BI&A system. However, I must say that the relationship*
*between our department and the whole leadership team grew again and it is still growing*
*day after day. They have totally acknowledged our role as main information hub of the firm"*
*(Head of Management Accounting)*

*"In our case the Management Accountants were fundamental in the implementation*
*process of the BI&A system because they were the ones with the best knowledge of all the*
*processes of our organization and thanks to this, they became great business partners for*
*me and the other Top Managers. Furthermore, since we live in a very competitive and*
*changing environment their abilities to manage non routine activities and support us in this*
*non routinary environment was crucial for us. We are in fact much more in contact than*
*ever before" (CEO)*

A positive consequence of this process is the growth of the connection between Management Accountants and IT employees. They became constantly aligned to manage the

entire data flows and architectures and their relationship increased so well they were almost seen as a big unique team.

*"The system is well designed and managed and if some specific technical need emerges, we immediately contact the IT department for supporting us in completing the task. However, it is not always clear who should be responsible for the issues and we are therefore obliged to acquire a minimum set of technical competencies to be able to manage simple technical issues" (Management Accounting 2)*

However, the technical competences the Management Accountants was obliged to acquire made them less dependent from the IT department. They were indeed able to manage several technical issues for which that they would have asked for support to the IT department before the implementation of the BI&A system. This situation not only did not created any particular frictions with the IT team, but it was the key to the improvement of the relationship between the two teams.

### 5.5.3 The evolution of competencies of Management Accountants

Regarding the **competencies** of Management Accountants, it was observed that they had to adapt to new technical responsibilities, although this adaptation did not occur uniformly among all Management Accountants. Some continued to excel in traditional activities, while others became more proficient in technical matters.

The challenge lied in the requirement for additional competencies to complement those already possessed by Management Accountants. There were indeed significant gaps in competences, particularly among employees in the Management Accounting department, who were grappling with the challenge of staying updated and competent in a much broader range of skills than a few years before. To address this issue, specific training programs were implemented to enhance the key competencies needed to run the BI&A system throughout the entire company.

*"Speaking about competences, we had to gain new technical ones to be able to manage all the new technical aspects connected to the BI&A system. We now have to complete data*

*management, connection, quality and designing activities and our background was not sufficient at all. The training programs were fundamental to let us prepare for this. However, not everyone in our department followed the same path. Someone remained central in the management of administrative and financial control activities while others, including me, focused on those technical aspects. I have to say that it was tough but now we are capable of manage almost each step of the whole BI&A process, from the data sources to the design of the reports."*

*(Management Accountant 1)*

*"We are in a continuous training path to allow us to well perform tasks with the new BI&A system and update it in terms of new data sources, new calculations, new information to process, and new reports to design" (Management Accountant 2)*

*"There were few real difficulties, mostly technical. An important difficulty was that of data preparation and then mapping the organizational flows and business processes well. If the Management Accountants had been more capable in terms of programming languages the implementation would have gone better, but IT still provided adequate support. For this reason there are now some specific technical learning programs for the Management Accounting department" (Head of Management Accounting)*

It can be therefore noted how much the introduction of the BI&A system impacted in the competences profiles of the Management Accounting and this impact was actually not homogeneous for each employee of the department.

### 5.5.4 The change in the quantity of activities performed by the Management Accountants

Closely tied to the previously discussed topic is the change in the activities and responsibilities of Management Accountants. With the introduction of the new BI&A system, and given the central role played by the Management Accounting department throughout the implementation process, all Management Accountants found themselves tasked with

managing a significantly larger **workload** than in the past. This increased demand for responsibilities was also the driving force behind the need for acquiring new competencies.

As outlined by the head of Management Accounting and other collaborators, the department's daily activities, prior to the implementation of the BI&A system, included tasks such as generating reports, reconciling numbers for periodic financial statements, cost analysis for production and marketing, data analysis and cleansing using tools like Excel or relational database management software, as well as conducting periodic analyses and preparing summary presentations for the company's top management and managers in other business areas. Following the implementation of the BI&A system, the department also had to handle all activities related to the management of the entire data flow.

The crucial new responsibilities encompassed tasks such as gathering information needs from end-users seeking additional reports, designing and releasing reports, conducting presentation meetings, providing training to end-users on how to navigate and interact with the new reports, and collecting feedback on these reports. These additional tasks, coupled with those mentioned earlier, became so numerous, intense and time-consuming that the management accounting department faced challenges in meeting deadlines and fulfilling commitments to end-users within the organization, including the company's top management, other managers, and collaborators across various business areas.

*"The Management Accountant is not just a supplier of numbers, it now has to manage, design and communicate them. Our workload always increases and our challenge is to be able to manage it. On the other hand we have to say that in doing so our role within the organization expanded with the workload and we are now the main information hub for the whole company, even the top management team." (Head of Management Accounting)*

*"Our role elevated and augmented without a doubt: we have never been so crucial for the company in its history. However, our workload has increased exponentially and we are now struggling to manage all the requests that the other departments are sending to us."*

*(Management Accountant 1)*

*"Before the BI&A system everyone would extract their own data and conduct their own analysis. Now it is our team the responsible for the certification of the data of the whole group and to produce the reporting for all the branches of the firm. This was positive in terms of unification and certification of the information, but the major consequence was the great increase in the activities we now must handle, and it is not always easy to not miss the deadlines. In this sense it is therefore very important for us to develop time and task management skills more than ever"* (Management Accountant 2)

From outside the Management Accounting department, the managers revealed:

*"Management Accountants are now always present in all the data flows involved in the new BI&A system. From technical aspects to distribution ones we are always connected to them for requests, feedbacks and other issues. It is evident that their workload has increased a lot and they have several difficulties in trying to answer to all the information needs, especially because they did not lose any traditional responsibilities. Apart for some repetitive tasks that was automatized with the new system, their job now is to manage the traditional responsibilities and the new ones related to the BI&A system"* (Export Sales Manager)

*"The workload of the Management Accountants has increased for sure. I am not able to say how many activities they can now delegate to the system but I know for sure that they have to manage several new responsibilities and in some cases they struggle because they do not have the adequate technical skills"* (COO)

Thus, there has been a notable expansion of activities for which Management Accountants are accountable, contributing to a further elevation of the significance of the Management Accountant role.

### 5.5.5 The change in the quality of activities performed by the Management Accountants

Regarding the impact of the new BI&A system on Management Accountants' activities, it is crucial to emphasize the evident **shift** reported by a majority of the interviewees. Empirical evidence indicates that the new BI&A system, built on a robust data management and storage architecture, has facilitated the automation of numerous repetitive, low-value activities that were both time-consuming and error-prone before the implementation of the BI&A system. Consequently, new activities with higher value have been incorporated into the responsibilities of Management Accountants.

This illustrates that, despite a considerable increase in activities for Management Accountants and an influence on their daily routines, the implementation of a BI&A system in the case under analysis has resulted in a significant positive transformation in activities. This includes a reduction in low-value tasks and the creation of space for higher-value responsibilities.

*"With the new BI&A system we were able to reduce low added value operations and increase high value ones. We are now able to adequately support the other departments of the firm for the analysis and interpretation of the data in a wider and deeper way compared to the past." (Head of Management Accounting)*

*"Before the introduction of the BI&A system several tasks were carried out using autonomous spreadsheets and other tools without unifying the procedures and the outputs and this has always required a great amount of time in performing repetitive and low-value activities. Thanks to the BI&A system we have been able to automatize most of them and we have now more time to interpret the data or other higher quality tasks" (Management Accountant 2)*

### 5.5.6 Towards a departmental specialization of the Management Accountants

The last aspect that emerged from the empirical data concerns the Management Accounting team as a whole rather than the single Management Accountants or the Head of the team.

By analyzing the empirical material, it became apparent that the members of the Management Accounting team developed a departmental specialization after the introduction of the BI&A system. The members of the Management Accounting team were already not always following the same issues; thus, there was already a certain degree of specialization, but the introduction of the BI&A system led to increase the focus of the members of the Management Accounting team on specific departments.

*"Even though there were differences among Management Accountant 1 and Management Accountant 2, the new workload obliged them to focus on just some activities and develop specific set of competencies for those tasks. Management Accountant 1 operates with operation departments, while Management Accountant 2 supports logistic, sales, and administrative departments" (Head of Management Accounting)*

*"We were specialized even before, but the BI&A system has strongly accentuated this process. Me and Management Accountant 1 we are now growing in parallel: even though always in contact we follow different activities and different tasks." (Management Accountant 2)*

### 5.6 DISCUSSION AND CONCLUSIONS

Through a single in-depth case study, the aim of this paper was to investigate if and how BI&A systems reshape the organizational relevance of Management Accountants within companies. The analysis revealed that the implementation and the use of the BI&A system had profound effects on the role, competencies, activities, and other peculiarities of the Management Accounting department and Management Accountants, ultimately elevating

their significance within the organization and fostering increased collaboration with other actors. Thus, on a general level, the study aligns with the bulk of research that acknowledges that the implementation and the use of BI&A systems elevate the significance and the recognition of the Management Accounting department for the entire company, but it adds some nuances on the "costs" to be incurred by the Management Accounting department to play such a more relevant role. Those "costs" seem to be connected with the bulk of research that depict more nuanced, complex and multifaced consequences for Management Accountants due to the adoption of new information systems.

While Dunne et al. (2013) and Mertins and White (2014) state that use of BI&A systems can potentially marginalize the role of management accountants since managers might self-produce and customize reports and presentations, the case examined in this paper shows a different outcome: with the introduction of the BI&A system, the reporting process evolved towards more advanced forms and management accountants engaged in iterations with managers not only to gather feedback on how to improve the quality and relevance of the presented information, but also to train managers themselves interpret correctly the information presented in reports. Therefore, in line with Wiedemann and Wiegmann (2017) and Fehrenbacher et al. (2022), the management accountants adopted a consultative role in interpreting BI&A outputs. This has also reshaped and intensified significantly the interactions between management accountants and operational managers since the volume of requests from other departments increased, covering various aspects from technical issues to data interpretation. Moreover, also the nature and the frequency of requests from other departments changed: the case analysis revealed that there has been a shift from a pre-BI situation where interactions were sporadic and centered on operational aspects to a post-BI scenario where interactions have become intense, frequent, and focused on high-value-added tasks, like data interpretation and support to the decision-making process. In turn, this has created a trend towards departmental specialization within the Management Accounting team following the implementation of the BI&A system. Members of the Management Accounting team found themselves focusing more closely on specific departments. This shift in focus resulted in the development of specific competencies tailored to the tasks associated with

each department, ultimately leading to a more specialized Management Accounting department overall.

However, the introduction of the BI&A system impacted the competencies profile of the Management Accounting department since Management accountants had to adapt to new technical responsibilities and, as a consequence, specific training programs on data access, flow and management were implemented to address competency gaps and enhance skills related to the use of the BI&A system. Those new technical competencies acquired during the implementation made management accountants less dependent on the IT department. However, differently from Oesterreich and Teuteberg (2019) and Arnaboldi et al. (2017), the introduction of BI&A systems did not lead to conflicts over functional jurisdiction and responsibilities between MAs and IT. On the contrary, the acquisition of IT competencies by management accountants to address IT-related issues led to the growth of collaboration and alignment between with IT employees. While Arnaboldi et al. (2017) show that traditional responsibilities of MAs might be increasingly challenged by IT, the paper shows an opposite outcome: MAs might absorb some of the traditional IT responsibilities and competences. Therefore, the case analysis showed a phenomenon of "hybridization" of Management Accountants as a consequence of a BI&A system implementation and use even more intense than that of revealed by Caglio (2003) in relation to ERP systems. This seems to be a paradox since BI&A systems are information systems aimed at supporting the decision-making process, unlike ERP systems that instead keep track of business operations.

Moreover, the adoption of the BI&A system resulted in a significant increase in the workload for Management Accountants. New responsibilities included not only managing the back-end activities, like handling the entire data flow, but also managing the front-end activities, like gathering information needs, designing and releasing reports, conducting training, and collecting feedback. Thus, and differently from Cavélius et al. (2020) and in line with Guthrie and Parker (2016), the implementation of BI&A systems did not introduce additional "dirty" work and did not reduce the time available for advisory roles. On the contrary, the BI&A system reduced repetitive, time-consuming, and error-prone activities,

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creating space for more meaningful contributions of management accountants not only to the decision-making process (business-oriented activities), but also to the data flow process (IT-oriented activities).

All in all, the case examined revealed that the implementation of the BI&A system had profound effects on the role, competencies, and activities of the Management Accounting department, ultimately elevating its significance within the organization and fostering increased collaboration with other departments, but with some "costs" to be incurred connected to a heavier workload difficult to handle and to new hard IT competencies to acquire.

In closing, it is important to acknowledge the limitations of this paper. The findings could have been influenced by the peculiar process adopted by the case company in order to implement the BI&A system and, in particular, by the intense involvement of the Management Accounting department in such a process. Therefore, it would be interesting to explore the outcomes of implementation processes that involve less active participation of Management Accountants.

Moreover, the findings could have been influenced by the specific BI&A system implemented and used. Thus, it could be interesting to investigate other companies which have been using different BI&A systems. This would help to understand if and how the ones implemented and the specific interactions among subjects have influenced the findings, helping to enrich the analysis on if and how BI&A systems reshape the organizational relevance of management accountants within companies.

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# CHAPTER 6

## *FINDINGS AND CONTRIBUTIONS OF THE DOCTORAL THESIS*

### 6.1 WHAT ARE THE ENABLING AND HINDERING FACTORS TO THE USE OF BI&A SYSTEMS WITHIN MANAGEMENT ACCOUNTING CONTEXTS?

The aim of the first study was to critically review the state of the art on the levers and barriers to the use of BI&A systems within MA contexts to delineate how research is evolving and identify future research avenues. Through a Grounded-Theory Literature Review 65 articles were analyzed and three key themes were identified to classify enablers and barriers: organizational-related, technical-related, and human-related factors. Despite advancements, there are significant gaps in these areas, offering potential for future research. The study suggests various research questions for each theme, emphasizing the need for theoretical diversity in future studies, such as using institutional, absorptive capacity, or innovation diffusion theories. The paper underscores a lack of focus on human-related factors in current research, suggesting this as a critical area for understanding the impact of management accountants' motivations and behaviors on BI&A systems. Additionally, the study finds that the interaction between the factors is often overlooked, while understanding these interconnections, especially over time, might be really relevant.. Thus, the study recommends longitudinal case studies for a comprehensive understanding of the factors affecting BI&A system usage in Management Accounting contexts.

In conclusion, the study contributes to existing literature by systematizing research, identifying key themes, and setting a future research agenda. It integrates accounting and information systems literature, offering a broad perspective on the interplay between Management Accounting and BI&A systems. The findings are also valuable for Management Accountants and companies involved in designing, implementing, and using BI&A systems, providing insights into potential challenges and solutions.

## 6.2 HOW AND WHY BI&A SYSTEMS END UP BEING USED OR NOT USED FOR MANAGEMENT ACCOUNTING PURPOSES?

The aim of this paper was to investigate how and why BI&A systems may end up being used or not used for MA purposes, thus contributing to the call for more qualitative research studies to provide insights on what works and does not work, on the enablers and the barriers that can foster or hinder the use of BI&A systems within MA contexts, as well as on the reasons for negative and positive experiences (Knudsen, 2020). In order to reach its aim, through a cross-sectional field study, the paper provides a comprehensive analysis of the factors influencing the utilization of BI&A systems for MA purposes. The study identifies a set of organizational-related and human-related factors critical for the sustained use of BI&A systems. These include strong management support, team composition with technical and business expertise, collaborative implementation, system usefulness, and a deep understanding of business processes. Thus, the paper aligns with previous literature concerning the relevance of the abovementioned human and organizational factors. Moreover, beyond confirming the relevance of these factors individually, the paper adds to the existing literature by showing that the abovementioned factors, taken together, form the backbone for the usage of BI&A systems within MA contexts. Furthermore, the study uncovers additional enabling factors not extensively addressed in the literature, such as the use of a specific type of data, i.e. sales data, as the entry point for BI&A systems and the bottom-up approach for reporting requests. In so doing, the paper sheds light on the reasons why the BI&A systems may be perceived as relevant, easy to use and useful, confirming and refining earlier research by Jaklic et al. (2018), Popovič et al. (2012) and Fahlevi et al. (2022).

Moreover, it is emphasized that enabling factors operate in tandem, following a particular sequence to ensure the successful implementation and utilization of BI&A systems. The research reveals that specific elements, such as management support and fostering a data-driven culture, play a pivotal role in the initial phases, whereas collaborative implementation and the involvement of diverse teams become more significant at later stages. Throughout

both the early adoption and long-term use, organizational culture and the perceived utility of the tools remain crucial.

The research underscores the complexity of factors influencing BI&A usage in MA, advocating for a multifaceted approach that considers technical, organizational and human factors and their interconnectedness. However, the paper also acknowledges its limitations due to the cross-sectional field study design, which restricts the ability to understand the temporal dynamics or relationships among factors and outcomes. Future research could benefit from single in-depth case studies to gain a more comprehensive understanding of the enablers and barriers in the use of BI&A systems for MA purposes.

## 6.3 IF AND HOW DO BI&A SYSTEMS RESHAPE THE ORGANIZATIONAL RELEVANCE OF MANAGEMENT ACCOUNTANTS WITHIN COMPANIES?

The purpose of the third article was to explore the influence of BI&A systems on the organizational relevance of management accountants within organizations. Through a single in-depth case study, the finds that the implementation and use of BI&A systems has profound effects on the role, competences, and activities of the Management Accounting department, increasing its organizational importance and fostering greater collaboration with other departments. Thus, on a general level, the study aligns with the bulk of research that acknowledges that the implementation and the use of BI&A systems elevate the significance and the recognition of the Management Accounting department for the entire company, but it adds some nuances on the "costs" to be incurred by the Management Accounting department to play such a more relevant role.

In particular, the introduction of the BI&A system impacted the competencies profile of the Management Accounting department since Management accountants had to adapt to new technical responsibilities on data access, flow and management. Therefore, the case analysis showed a phenomenon of "hybridization" of Management Accountants as a consequence of an BI&A system implementation and use even more intense than that of revealed by Caglio (2003) in relation to ERP systems. While Arnaboldi et al. (2017) show that traditional

responsibilities of MAs might be increasingly challenged by IT, the paper shows an opposite outcome: MAs might absorb some of the traditional IT responsibilities and competences.

Moreover, the adoption of the BI&A system resulted in a significant increase in the workload for Management Accountants. New responsibilities included not only managing the back-end activities, like handling the entire data flow, but also managing the front-end activities, like gathering information needs, designing and releasing reports, conducting training, and collecting feedback. Thus, and differently from Cavélius et al. (2020) and in line with Guthrie and Parker (2016), the implementation of BI&A systems did not introduce additional "dirty" work and did not reduce the time available for advisory roles.

However, the study acknowledges its limitations. The findings could have been influenced by the peculiar process adopted by the case company in order to implement the BI&A system and, in particular, by the intense involvement of the Management Accounting department in such a process. Therefore, it would be interesting to explore the outcomes of implementation processes that involve less active participation of Management Accountants.

# APPENDIX

**Appendix 1: List of 65 papers analyzed in the contribution of Chapter 3**

1 Arnaboldi, M., de Brujin, H., Steccolini, I., & Van der Voort, H. (2022). On humans, algorithms and data. Qualitative Research in Accounting & Management, 241-254.

2 Becker, A., & Heinzelmann, R. (2017). The Role of the Management Accountant: Local Variations and Global Influences.

3 Berikol, Bilal & Killi, Mustafa. (2021). The Effects of Digital Transformation Process on Accounting Profession and Accounting Education. 10.1007/978-981-15-1928-4_13.

4 Borthwick, A., & Hansen, R. (2017). Digital Literacy in Teacher Education: Are Teacher Educators Competent? Journal of Digital Learning in Teacher Education, 46-48.

5 Brockmann, Stieglitz, Kmieciak, & Diederich. (2012). User acceptance of mobile business intelligence services. International conference on network-based information systems.

6 Burton-Jones, A., & Gallivan, M. (2007). Toward a Deeper Understanding of System Usage in Organizations: A Multilevel Perspective. MIS Quarterly, 657-679.

7 Burton-Jones, A., & Grange, C. (2013). From Use to Effective Use: A Representation Theory Perspective. Information Systems Research, 632-658.

8 Castellano, N., Presti, C., & Gobbo, R. (2017). Employing big data & analytics in decision-making: Factors affecting managers' trustworthiness.

9 Chang, Hsu, Shiau, & Wu. (2015). The effects of personality traits on business intelligence usage: a decision-making perspective. Malaysian journal of library & information science, 13-40.

10 Chen, C.-W. (2015). The impact of decision support system features on user overconfidence and risky behavior. European Journal of Information Systems, 607-623.

11 Cokins, G. (2016). The Top Seven Trends in Management Accounting.

12 Davenport, T., & Beers, M. (1995). Managing Information about Processes. Journal of Management Information Systems, 57-80.

13  Deng, X., & Chi, L. (2012). Understanding postadoptive behaviors in Information Systems Use: a longitudinal analysis of Systems use problems in the Business Intelligence context. Journal of Management Information Systems, 291-326.

14  Dilla, W., Janvrin, D., & Jeffrey, C. (2013). The Impact of Graphical Displays of Pro Forma Earnings Information on Professional and Nonprofessional Investors' Earnings Judgments. Behavioral Research in Accounting.

15  Elbashir, M., Collier, P., & Sutton, S. (2011). The Role of Organizational Absorptive Capacity in Strategic Use of Business Intelligence to Support Integrated Management Control Systems. The Accounting Review, 155-184.

16  Elbashir, Z., M., A., C. P., G., S. S., & A., D. M. (2013). Enhancing the business value of business intelligence: The role of shared knowledge and assimilation. Journal of Information System, 87-105.

17  Eldenburg, Soderstrom, Willis, & Wu. (2010). Behavioral changes following the collaborative development of an accounting information system. Accounting, Organizations and society, 222-237.

18  Elkins, A., Dunbar, N., Adame, B., & Nunamaker, J. (2013). Are Users Threatened by Credibility Assessment Systems? Journal of Management Information Systems, 249-262.

19  Fahlevi, H., Irsyadillah, I., Indriani, M., & Oktari, R. (2021). DRG-based payment system and management accounting changes in an Indonesian public hospital: exploring potential roles of big data analytics. Journal of Accounting & Organizational Change, 325-345.

20  Finnaoui, K., Megder, E., & Ouariti, O. (2021). Factors Enhancing the Use of Business Intelligence to Support Organizational Learning: A conceptual Model.

21  Focacci, A. (2018). Costs Function Assessment: An Empirical Business Analytics Approach for Decisional Purposes. International Journal of Business and Systems Research, 1-12.

22  Villamarín-García, J., & Díaz Pinzón, B. (2017). Key success factors to business intelligence solution implementation. Journal of Intelligence Studies in Business, 48-69.

23  Hunton, James E. & Gibson, Dana, 1999. "Soliciting user-input during the development of an accounting information system: investigating the efficacy of group discussion," Accounting, Organizations and Society, Elsevier, vol. 24(7), pages 597-618, October.

24 Granlund, M. (2011). Extending AIS research to management accounting and control. International Journal of Accounting Information Systems, 3-19.

25 Grublijesic, & Jaklic. (2014). The importance and impact of determinants influencing business intelligence systems embeddedness. Issues in Information Systems, 106-117.

26 Hart, Esat, Rocha, & Khatieb. (2007). Introducing students to business intelligence: acceptance and perceptions of OLAP software. Issues in informing science and information technology, 106-123.

27 Heinzelmann, R. (2017). Occupational identities of management accountants: the role of the IT system. Journal of Applied Accounting Research, 465-482.

28 Hou. (2012). Examining the effect of user satisfaction on system usage and individual performance with business intelligence systems: An empirical study of Taiwan's electronics industry. International Journal of Information Management, 560-573.

29 Hou. (2014). Exploring the user acceptance of business intelligence systems in Taiwan's electronics industry: applying the UTAUT model. International journal of internet and enterprise management, 195-226.

30 Hou. (2015). Understanding business intelligence system continuance intention: an empirical study of Taiwan's electronics industry. Information development, 1-13.

31 Inghirami, J.E. (2014), "Reshaping Strategic Management Accounting Systems", DSS 2.0–Supporting Decision Making with New Technologies, IOS Press, doi: 10.3233/978-1-61499-399-5-495.

32 Isik, Jones, & Sidorova. (2013). Business intelligence success: the roles of BI&A capabilities and decision environments. Information management, 13-23.

33 Jaklic, Grubljesic, & Popovič. (2018). The role of compatibility in predicting business intelligence and analytics use intentions. International journal of information management, 305-318.

34 Kee-Luen, W., Hong-Leong, J., Shwu-Shing, N., & Mini-Hooi, C. (2018). Insights from the CGMA Data Competencies Model: The Role of Data Culture to the Value Creation Process. Journal of Telecommunication, Electronic and Computer Engineering, 187-192.

35 Kern, J. (2012). Utilities Surge Ahaead with BI, Analytics Despite Immaturity and Integration Problems. Information Management.

36 Lautenbach, johnston, & Adeniran-Ogundipe. (2017). Factors influencing business intelligence and analytics usage extent in south african organisations. South Africa Journal of Business Management, 23-33.

37 Lee, Wagner, & Shin. (2008). The effect of decision support system expertise on system use behavior and performance. Information management, 349-358.

38 Lynch, & Gregor. (2004). User participation in decision support systems development: Influencing system outcomes. European Journal of Information Systems, 286-301.

39 Mascha, M., & Smedley, G. (2007). Can computerized decision aids do "damage"? A case for tailoring feedback and task complexity based on task experience. International Journal of Accounting Information Systems, 73-91.

40 Munir, S., Rasid, S., Jamil, F., & Ahmed, I. (2023). Big data analytics capabilities and innovation effect of dynamic capabilities, organizational culture and role of management accountants. Foresight, pp. 41-66.

41 Nespeca, A. and Chiucchi, M.S. (2018a), "The role of business intelligence in the production, transmission, and reception of performance measures: A case study", Studies in Managerial and Financial Accounting, Vol. 33, Emerald Group Publishing Ltd., pp. 121–141, doi: 10.1108/S1479-351220180000033005.

42 Nespeca, A. and Chiucchi, M.S. (2018b), "The impact of business intelligence systems on management accounting systems: The consultant's perspective", Lecture Notes in Information Systems and Organisation, Vol. 24, Springer Heidelberg, pp. 283–297, doi: 10.1007/978-3-319-62636-9_19.

43 Nguyen, H. (2011). Critical Success Factors For Erp Adoption Process.

44 Nofal, & Yusof. (2016). Conceptual model of enterprise resource planning and business intelligence systems usage. International journal of business information systems, 178-193.

45 Peng, J., Viator, R., & Buchheit, S. (2007). An Experimental Study of Multidimensional Hierarchical Accounting Data. Journal of Inormation Systems, 69-86.

46 Pervan, I., & Dropulic, I. (2019). The impact of integrated information systems on management accounting: case of Croatia. 21-38.

47 Peters, M., Wieder, B., & Sutton, S. (2018). Organizational Improvisation and the Reduced Usefulness of Performance Measurement Bi Functionalities. International Journal of Accounting, 1-15.

48  Popovič. (2017). If we implement it, will they come? User resistance in post-acceptance usage behaviour within business intelligence systems context. Ecomonic Research - Ekonomska Istraživanja, 911-921.

49  Popovič, Hackney, Coelho, & Jaklic. (2014). How information-sharing values influence the use of information systems: an investigation in the business intelligence context. Journal of strategic information systems, 270-283.

50  Popovič, R, H., P.S., C., & J, J. (2012). Towards business intelligence systems success: effects of maturity and culture on analytical decision making. Decision Support Systems, 729-739.

51  Rikhardsson, P., & Yigitbasioglu, O. (2018). Business intelligence & analytics in management accounting research: status and future focus. International Journal of Accounting Information, 37-58.

52  Schläfke, M., Silvi, R., & Möller, K. (2013). A framework for business analytics in performance management. International Journal of Productivity and Performance Management, 110-122.

53  Seow, P.-S. (2011). The Effects of Decision Aid Structural Restrictiveness on Decision-Making Outcomes. International Journal of Accounting Information Systems, 40-56.

54  Sharma, Mithas, & Kamkanhalli. (2014). Transforming decision-making processes: a research agenda for understanding the impact of business analytics on organizations. Euorpean journal of information systems, 433-441.

55  Sievert, Albritton, Roper, & Clayton. (1988). Investigating computer anxiety in an academic library. Information technology and libraries, 243-252.

56  Smith, A., & McKeen, J. (1992). Computerization and managemen. A study of conflict of change. Information & Management, 53-64.

57  Al-Zubi, Ziad & Osama, Samih & Shaban, Osama & Al-Zaytoonah,. (2014). The effect of Business Intelligence Tools on Raising the Efficiency of Modern Management Accounting NABIL ALNASER.

58  ŠPIČÁK, D., & ŠIŠKA , L. (2016). Application of Specialized ICT Tools for Measuring Strategic Performance: Empirical Evidence of Contingency Factors. Information Technology, Society and Economy Strategic Cross-Influences, 393-401.

59  Spraakman, G., Sánchez-Rodríguez, C., & A. Tuck-Riggs, C. (2021). Data analytics by management accountants. Qualitative Research in Accounting & Management.

60  Venkatesh, Morris, & Ackerman. (2003). User acceptance of information technology: toward a unified view. MIS Quarterly, 425-478.

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63  Wieder , B., Ossimitz, M.-L., & Chamoni, P. (2012). The Impact of Business Intelligence Tools on Performance: A User Satisfaction Paradox? International Journal of Business and Economic Sciences Applied Research, 7-32.

64  Yingjie, J. (2005). Critical Success Factors in ERP Implementation in Finland.

65  Youssef, M., & Mahama, H. (2021). Does business intelligence mediate the relationship between ERP and management accounting practices? Journal of Accounting & Organizational Change.

**Appendix 2: Interview guide used to collect empirical material for the contribution of Chapter 4**

**Particularities of the case**

1. Introduction of Walter Lasca and the objectives of the research

2. Introduction of the interviewee (role, years in the company, etc.)

   a. Can you define your job position in the company in more detail?

   b. Can you provide some examples of the activities you perform most frequently?

3. Company size

   a. Turnover:

   b. Number of employees:

4. Is the management control team dedicated or integrated into other areas? Administration, production timing and methods, etc..

   a. Number of team members

   b. Team competencies

   c. Main activities and duties

5. Is the BI team dedicated or integrated into IT?

   a. Number of team members

   b. Team competencies

   c. Main activities and duties

**General Questions about the BI&A System and its Use**

1. Who wanted the system?

2. How long has it been implemented?

3. What were the reasons that led to the adoption of the system for management control purposes?

4. What was the purpose of its implementation?

5. Is the system actually used? How frequently/regularly?

6. Was it implemented internally only, or also with the help of external consultants?

7. On what basis was the software selected?

8. Has the system changed the workflow and activities of management control? If yes, how? Can you provide some examples of use for management control purposes?

9. What are the pros and cons of using the system for management control purposes?


**Organizational Related Factors**

1. Has there been / is there support from the company's management? In which phase? Design and/or implementation? If yes, what kind of support? How has this support influenced the use of the system?

2. Were you already accustomed to a data-driven/analytical culture? How has this affected the level of use/non-use of the system? In the absence of a data-driven culture, has the system contributed to changing the corporate culture?

3. Is the system socially accepted in the control department? What are the factors that have favored or hindered acceptance? How and why has acceptance/non-acceptance influenced the use/non-use of the system? What have been the social dynamics?

4. Do you have separate control and BI (only technical) teams or mixed teams for data design and analysis (technical and business) when you designed and implemented the system? Do you believe this was a factor that influenced subsequent use of the system? How and why?

5. Was the implementation of the system collaborative between technical and functional experts? How did the collaboration take place? Do you believe this was a factor that influenced the use/non-use of the system? How and why?

6. Was there prior communication regarding the importance of the tool to potential users? If yes, what aspects did the communication focus on? Do you believe this is an important factor for the use of the system? How and why has it influenced?

7. Was there training regarding the use of the system? If yes, how? How and why has the presence/absence of this factor influenced the use/non-use of the system?

**Technical Related Factors**

1. Does the system have reporting problems? Navigation, data processing, etc.. How often? How does this factor affect the use/non-use of the system?

2. Does the system have access problems? If yes, how often? Do you believe this is an important factor for the use of the system?

3. Does the system have data quality issues? If yes, what kind? How does this factor affect the use/non-use of the system?

4. Does the system have workflow problems (slow data loading, different data in different reports, wrong integrations between systems, etc..)? Do you believe this is an important factor for the use of the system?

5. Does the system have system problems (malfunctions, crashes, etc..)? If yes, how often? How does this factor affect the use/non-use of the system?

6. How has the pre-existing IT architecture influenced the use/non-use of the system? Do you believe you have an adequate architecture in your organization? For example, SAP as software.

7. How integrated are the existing information systems with the new BI&A system? How has this factor influenced the use/non-use of the system?

8. How is the report presented and shared with the end users? How do the methods of "delivery" of the report affect the use/non-use of the system?

9. Are users able to interact with the system (browsing, drill-down, choosing visual objects, asking for feedback and recommendations)? How do these interactions affect the use/non-use of the system? Ask for examples.

**Human Related Factors**

1. Is the system considered easy to use (user friendly)? What factors make it user friendly or unfriendly, and how do these factors affect the use/non-use of the system? Very important.

2. How has the level of experience and skills of the final users (and the controller) regarding BI&A systems affected the use/non-use of the system? Do more experienced users use the system differently compared to less experienced ones? What are the main differences in use?

3. How important, in your opinion, is the period of time that elapses from when the system is implemented? Do you believe that the longer time passes, the more the system is used? If yes, for what reasons?

4. Are you generally satisfied with the BI&A system? What causes this satisfaction/dissatisfaction and how has this influenced the use/non-use of the system?

5. How important is perceived utility for correct and consistent use of the system?

6. Has the implementation and use of the BI&A system influenced power relations between subjects/functions? What experience have you had from this point of view? How have these changes influenced the level of use/non-use of the system?

7. Has the level of knowledge of the business and corporate processes influenced the level of use of the system? How and why?

8. Have there been problems with "computer anxiety"? If yes, how has it affected the level of use of the system?

9. How and to what extent have personal characteristics (creativity, willingness to learn, predisposition to innovation, predisposition to digitalization, sense of responsibility, etc.) influenced the level of use of the system?

**Final Open Questions**

1. Based on your experience, do you believe there may be other influencing factors, both positive and negative, on the use of the BI&A system in management control contexts?

2. In your opinion, do the factors that emerged during the interview interact with each other? Can you provide some examples of interactions in a positive or negative sense?

3. Combining those already mentioned with new ones you have cited, which do you believe are the 3 most important factors in a positive way and the 3 most important in a negative way?

**Appendix 3: Code tree used to analyze empirical data collected for the contribution included in Chapter 4**

| Section | Topic | Question | Section.CODE | Topic.CODE | Question.CODE | CODE |
|---|---|---|---|---|---|---|
| General Information | Respondent | Role | GEINF | RESP | RO | GEINF-RESP-RO |
| General Information | Respondent | Routine activities | GEINF | RESP | ACT | GEINF-RESP-ACT |
| General Information | Company | Turnover and n° of employees | GEINF | COMP | TURN | GEINF-COMP-TURN |
| General Information | Organization | Autonomous MA team? | GEINF | ORGA | AUTMA | GEINF-ORGA-AUTMA |
| General Information | Organization | N° of the components of the team | GEINF | ORGA | COMPMA | GEINF-ORGA-COMPMA |
| General Information | Organization | Team BI? | GEINF | ORGA | BI | GEINF-ORGA-BI |
| General Information | Organization | Autonomous BI team or integrated? | GEINF | ORGA | AUTBI | GEINF-ORGA-AUTBI |
| General Information | Organization | Background of the components | GEINF | ORGA | BACK | GEINF-ORGA-BACK |
| General Information | Business Intelligence System | Will to implement the system | BIS | BIS | WI | BIS-BIS-WI |
| General Information | Business Intelligence System | Time since Implementation | BIS | BIS | TI | BIS-BIS-TI |
| General Information | Business Intelligence System | Objectives of the Implementation | BIS | BIS | OBJ | BIS-BIS-OBJ |
| General Information | Business Intelligence System | Actual use of the system? | BIS | BIS | USE | BIS-BIS-USE |
| General Information | Business Intelligence System | Implementation of the system | BIS | BIS | IMPL | BIS-BIS-IMPL |
| General Information | Business Intelligence System | Software selection | BIS | BIS | SWSEL | BIS-BIS-SWSEL |
| General Information | Business Intelligence System | Did the workflow of MA change? | BIS | BIS | WFMA | BIS-BIS-WFMA |
| General Information | Business Intelligence System | Pro-cons of the usage of the BI&A systems for MA purposes? | BIS | BIS | PROCONS | BIS-BIS-PROCONS |
| Factors | Organizational | Top management support | FACT | ORG | TMT | FACT-ORG-TMT |
| Factors | Organizational | Culture | FACT | ORG | CULT | FACT-ORG-CULT |
| Factors | Organizational | Mix of competences | FACT | ORG | MIX | FACT-ORG-MIX |
| Factors | Organizational | Collaboration between IT and MA | FACT | ORG | COLLAB | FACT-ORG-COLLAB |
| Factors | Organizational | Communication before the delivery | FACT | ORG | COMM | FACT-ORG-COMM |
| Factors | Organizational | Training | FACT | ORG | TRAIN | FACT-ORG-TRAIN |
| Factors | Technical | IT architecture | FACT | TECH | ITARCH | FACT-TECH-ITARCH |
| Factors | Technical | Delivery of the report | FACT | TECH | DELIV | FACT-TECH-DELIV |
| Factors | Technical | Degree of integration | FACT | TECH | INTEGR | FACT-TECH-INTEGR |
| Factors | Human | User Interface | FACT | HUM | UX | FACT-HUM-UX |
| Factors | Human | Interaction | FACT | HUM | INTER | FACT-HUM-INTER |
| Factors | Human | Time since Implementation | FACT | HUM | TIME | FACT-HUM-TIME |
| Factors | Human | Perceived usefulness | FACT | HUM | USEF | FACT-HUM-USEF |
| Factors | Human | Relations | FACT | HUM | RELAT | FACT-HUM-RELAT |
| Factors | Human | Business processes | FACT | HUM | BUSPROC | FACT-HUM-BUSPROC |

**Appendix 4: Interview guide for Management Accountants used to collect empirical material for the contribution of Chapter 5**

**Section 1 – Characteristics of the management control team**

- How is the management control team composed? (position within the organizational chart, number of controllers, the seniority of the management control team members, educational backgrounds of the controllers)

- What activities do you regularly perform as controllers? How are the tasks divided within the team?

- What are the management control tools implemented in the company?

**Section 2 – Reasons and process for bi implementation**

- Why was BI introduced? Who sponsored its introduction? What was the need or problem to be solved? In support of what tool or activity was BI implemented?

- Did the management control team participate in the implementation of the Business Intelligence system? If yes, what role did it play?

- Besides the management control team, who else participated in the implementation process (IT, managers, etc.)? What was their role?

- What were the difficulties encountered during the implementation process? (e.g., cultural resistance, technical difficulties, etc.)

- What were the levers in the implementation process? (e.g., the role of the sponsor, etc.)

- What were the most important benefits of participating in the implementation process?

**Section 3 – Interactions with other functional areas**

Section 3.1. Relationships with other functional areas pre-bi

- Before the introduction of BI, with which functional areas did the control team interface?

- What was the content, frequency, and intensity of these interactions?

- What were the frictions/synergies with these areas? What caused them?

Section 3.2. Relationships with other functional areas post-bi

- With the introduction of BI, how has the relationship between control and other functional areas changed?

- Has the relationship intensified or relaxed? Why?

- Have the content and frequency of interactions changed? What is the process through which BI led to these changes?

- Has BI created synergies or frictions with these functional areas? Why?

- How have the power dynamics between the management control team and these functional areas changed? What is the process through which BI led to these changes?

- Has BI allowed the control team to extend control logic to other functional areas that were previously not involved? If yes, what is the process through which BI led to this change?

- Conversely, are there functional areas where your presence was stronger before the introduction of BI? If yes, what is the process through which BI led to this change?

- In your opinion, has there been a change in the perception of the controller's role by other functional areas following the introduction of BI? Has BI increased or decreased the importance of the management control team in relation to other functional areas? How and why? E.g., has the spread of data been beneficial or not from this point of view?


**Section 4 – Relationships with the executive team**

Section 4.1 – Relationships with the executive team pre-bi

- before the introduction of bi, how did the control team support the executive team?

- what was the content, frequency, and intensity of these interactions?

- what were the frictions/synergies with the executive team?


Section 4.2 – Relationships with the executive team post-bi

- with the introduction of bi, how has the relationship between control and the executive team changed?

- has the relationship intensified or relaxed? Why?

- have the content and frequency of interactions changed? What is the process through which bi led to these changes?

- has bi created synergies or frictions with the executive team? Why?

- how has bi changed the support provided to the executive team in terms of decision-making support? Also in terms of data storytelling and recommendations (ai) of the bi system

- what is the process through which bi led to these changes?

- in your opinion, has there been a change in the perception of the controller's role by the executive team following the introduction of bi? How and why? Has bi therefore increased or decreased the importance of the management control team in relation to the executive team?


**Section 5 – Activities (and skills)**

Section 5.1. – Activities and skills pre-bi

- how were the activities of data acquisition, data preparation, information production, and communication of information to recipients managed?

- in general, what were the most relevant activities and/or those that took up the most time?

- what were the skills of the management control team before the introduction of bi with reference to the four aforementioned activities?

- what was the role and what were the responsibilities of the management control team before the introduction of bi?


Section 5.2. – Activities and skills post-bi

- with the introduction of bi, has there been a change in the management of activities of data acquisition, data preparation, information production, and communication of information to recipients?

- if yes, has there been an enrichment or impoverishment of these activities?

- why did bi generate these changes and what is the process through which these changes were generated?

- are there new activities? Have some disappeared? Have some been absorbed by other company functions (e.g., reporting setup)? Have some gained more relevance, while others have seen a reduction in their relevance? Has there been a shift towards activities with more or less added value for the control team?

- why did bi generate these changes and what is the process through which these changes were generated?

- how have the skills of the management control team changed with the introduction of bi with reference to the four aforementioned activities? In general, what kind of specializations are you developing within the control team (data viz, bi analyst, data engineering, etc.)?

- have the responsibilities and role of the control team changed after the implementation of bi? If yes, how? What is the process through which bi generated these changes?

# Appendix 5: Code tree used to analyze empirical data collected from Management Accountants for the contribution included in Chapter 5

| Section | Topics | Question | Section.CODE | Topic.CODE | Question.CODE | TAILS |
|---|---|---|---|---|---|---|
| Control team | Team | Composition of MA team | TEAM | TEAM | COMP | TEAM-TEAM-COMP |
| Control team | Activity | Activities | TEAM | ATTIV | ATTIV | TEAM-ATTIV-ATTIV |
| Control team | Instruments | Tools | TEAM | STRUM | STRUM | TEAM-STRUM-STRUM |
| Implementation | Reasons for implementation | Motivation BI | IMPL | MOTIV | MOTIV | IMPL-MOTIV-MOTIV |
| Implementation | Reasons for implementation | Participation in implementation of MA | IMPL | MOTIV | PARTEC | IMPL-MOTIV-PARTEC |
| Implementation | Reasons for implementation | Participation in implementation of other areas | IMPL | MOTIV | ALTRI | IMPL-MOTIV-ALTRI |
| Implementation | Reasons for implementation | Difficulties | IMPL | MOTIV | DIFFIC | IMPL-MOTIV-DIFFIC |
| Implementation | Reasons for implementation | Drivers | IMPL | MOTIV | LEVE | IMPL-MOTIV-LEVE |
| Implementation | Reasons for implementation | Benefits | IMPL | MOTIV | BENEF | IMPL-MOTIV-BENEF |
| Relations with other areas | Pre BI reports | Interactions pre BI | RAPPAREE | PREBI | INTERAZ | RAPPAREE-PREBI-INTERAZ |
| Relations with other areas | Pre BI reports | Interactions | RAPPAREE | PREBI | INTENS | RAPPAREE-PREBI-INTENS |
| Relations with other areas | Pre BI reports | Frictions / sinergies pre BI | RAPPAREE | PREBI | SINERG | RAPPAREE-PREBI-SINERG |
| Relations with other areas | Post BI reports | Interactions between MA and other areas pre BI | RAPPAREE | POSTBI | CAMBRAPP | RAPPAREE-POSTBI-CAMBRAPP |
| Relations with other areas | Post BI reports | Intensification interactions | RAPPAREE | POSTBI | INTENSRAPP | RAPPAREE-POSTBI-INTENSRAPP |
| Relations with other areas | Post BI reports | Content and frequency of interactions | RAPPAREE | POSTBI | INTERAZ | RAPPAREE-POSTBI-INTERAZ |
| Relations with other areas | Post BI reports | Frictions / sinergies post BI | RAPPAREE | POSTBI | SINERG | RAPPAREE-POSTBI-SINERG |
| Relations with other areas | Post BI reports | Power relationships | RAPPAREE | POSTBI | RAPPPOTERE | RAPPAREE-POSTBI-RAPPPOTERE |
| Relations with other areas | Post BI reports | Diffusion of Management Accounting | RAPPAREE | POSTBI | ESTEND | RAPPAREE-POSTBI-ESTEND |
| Relations with other areas | Post BI reports | Decreasing presence post BI | RAPPAREE | POSTBI | RIDUZ | RAPPAREE-POSTBI-RIDUZ |
| Relations with other areas | Post BI reports | Management Accountant's role perception | RAPPAREE | POSTBI | PERCEZ | RAPPAREE-POSTBI-PERCEZ |
| Relationships with management | Relationships with pre-BI management | Support to Management team | RAPPDIREZ | PREBI | CONTRDIREZ | RAPPDIREZ-PREBI-CONTRDIREZ |
| Relationships with management | Relationships with pre-BI management | Interactions with Management team pre BI | RAPPDIREZ | PREBI | INTERAZ | RAPPDIREZ-PREBI-INTERAZ |
| Relationships with management | Relationships with pre-BI management | Frictions / sinergies pre BI | RAPPDIREZ | PREBI | SINERG | RAPPDIREZ-PREBI-SINERG |
| Relationships with management | Relationships with post-BI management | Change of relationships with Management team post BI | RAPPDIREZ | POSTBI | RAPPDIREZ | RAPPDIREZ-POSTBI-RAPPDIREZ |
| Relationships with management | Relationships with post-BI management | Intensification interactions with Management team | RAPPDIREZ | POSTBI | INTENS | RAPPDIREZ-POSTBI-INTENS |
| Relationships with management | Relationships with post-BI management | Content and frequency of interactions with Management team | RAPPDIREZ | POSTBI | INTERAZ | RAPPDIREZ-POSTBI-INTERAZ |
| Relationships with management | Relationships with post-BI management | Frictions / sinergies post BI with Management team | RAPPDIREZ | POSTBI | SINERG | RAPPDIREZ-POSTBI-SINERG |
| Relationships with management | Relationships with post-BI management | Support to Management team post BI | RAPPDIREZ | POSTBI | SUPPDIREZ | RAPPDIREZ-POSTBI-SUPPDIREZ |
| Relationships with management | Relationships with post-BI management | Process | RAPPDIREZ | POSTBI | PROCESS | RAPPDIREZ-POSTBI-PROCESS |
| Relationships with management | Relationships with post-BI management | Management Accountant's role perception by Management team | RAPPDIREZ | POSTBI | PERCEZDIREZ | RAPPDIREZ-POSTBI-PERCEZDIREZ |
| Activities and skills | Pre BI activities and skills | Activities pre BI | ATTCOMP | PREBI | ATTIVPREC | ATTCOMP-PREBI-ATTIVPREC |
| Activities and skills | Pre BI activities and skills | Time consuming activities post BI | ATTCOMP | PREBI | ATTIVTEMPO | ATTCOMP-PREBI-ATTIVTEMPO |
| Activities and skills | Pre BI activities and skills | Skills pre BI | ATTCOMP | PREBI | COMPET | ATTCOMP-PREBI-COMPET |
| Activities and skills | Pre BI activities and skills | Role and responsibilities pre BI | ATTCOMP | PREBI | RUOLO | ATTCOMP-PREBI-RUOLO |
| Activities and skills | Post BI activities and skills | Activities post BI | ATTCOMP | POSTBI | ATTIVPOST | ATTCOMP-POSTBI-ATTIVPOST |
| Activities and skills | Post BI activities and skills | Changing in activities post BI | ATTCOMP | POSTBI | CAMBIAM | ATTCOMP-POSTBI-CAMBIAM |
| Activities and skills | Post BI activities and skills | Process | ATTCOMP | POSTBI | PROCESSCAMB | ATTCOMP-POSTBI-PROCESSCAMB |
| Activities and skills | Post BI activities and skills | Changing in activities post BI | ATTCOMP | POSTBI | NOVIT | ATTCOMP-POSTBI-NOVIT |
| Activities and skills | Post BI activities and skills | Skills post BI | ATTCOMP | POSTBI | COMPET | ATTCOMP-POSTBI-COMPET |
| Activities and skills | Post BI activities and skills | Role and responsibilities post BI | ATTCOMP | POSTBI | RUOLO | ATTCOMP-POSTBI-RUOLO |

**Appendix 6: Interview guide for Operational Managers used to collect empirical material for the contribution of Chapter 5**


**Section 1 – General overview**

- Role in the company, years of experience, and main responsibilities.

- What role did you play in the implementation of BI?

- How has the use of BI impacted your activities? (examples...)


**Section 2 – Relationships with the management control team pre and post bi**

Section 2.1. – Relationships with the management control team pre-bi

- before the introduction of bi, what was the content, frequency, and intensity of the relationships with the management control team?

- what were the frictions/synergies with the management control team?


Section 2.1. – Relationships with the management control team post-bi

- With the introduction of BI, how has the relationship between control and your functional area changed?

- Has the relationship intensified or relaxed? Why?

- Have the content and frequency of interactions changed? Why and what is the process through which BI led to these changes?

- Are there some activities that were previously the responsibility of the control team but are now managed autonomously by your team? What are they?

- Has BI created synergies or frictions with the management control team? Why?

- How have the power dynamics between the management control team and your functional area changed?

- Has BI increased or decreased the importance of the management control team in relation to your functional area? How and why? E.g., has the dissemination of data been beneficial or not from this point of view?

**Appendix 7: Code tree used to analyze empirical data collected from Operational Managers for the contribution included in Chapter 5**

| Section | Topics | Question | Section.CODE | Topic.CODE | Question.CODE | TAILS |
|---------|--------|----------|--------------|------------|---------------|-------|
| General info | Role in the company | Role | INFO | RUOLOAZ | RUOLOAZ | INFO-RUOLOAZ-RUOLOAZ |
| General info | Implementation role | Role in implementation | INFO | RUOLOIMPL | RUOLOIMPL | INFO-RUOLOIMPL-RUOLOIMPL |
| General info | Impact | Impact of BI on other areas | INFO | IMPATTO | IMPATTO | INFO-IMPATTO-IMPATTO |
| Relationships with control tea | PREBI | Content and frequency of interactions pre BI | RAPPORTI | PREBI | RELAZ | RAPPORTI-PREBI-RELAZ |
| Relationships with control tea | PREBI | Frictions / sinergies pre BI | RAPPORTI | PREBI | SINERG | RAPPORTI-PREBI-SINERG |
| Relationships with control tea | POSTBI | Relationships post BI | RAPPORTI | POSTBI | CAMBRAPP | RAPPORTI-POSTBI-CAMBRAPP |
| Relationships with control tea | POSTBI | Intensification post BI | RAPPORTI | POSTBI | INTENS | RAPPORTI-POSTBI-INTENS |
| Relationships with control tea | POSTBI | Content and frequency of interactions post BI | RAPPORTI | POSTBI | INTERAZ | RAPPORTI-POSTBI-INTERAZ |
| Relationships with control tea | POSTBI | Changing of responsibilities | RAPPORTI | POSTBI | ATTIV | RAPPORTI-POSTBI-ATTIV |
| Relationships with control tea | POSTBI | Frictions / sinergies post BI | RAPPORTI | POSTBI | SINERG | RAPPORTI-POSTBI-SINERG |
| Relationships with control tea | POSTBI | Power relationships change | RAPPORTI | POSTBI | POTERE | RAPPORTI-POSTBI-POTERE |
| Relationships with control tea | POSTBI | Importance of Management Accoutnant's role | RAPPORTI | POSTBI | IMPORTANZA | RAPPORTI-POSTBI-IMPORTANZA |