

The transformation of management control in the digital age: changes in practices, tools and the role of the controller

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Abstract

Digitalisation is gradually transforming the way organisations operate and is having a direct impact on management control practices. Automation, ERP systems, Business Intelligence, Big Data and data analysis tools are changing the way information is produced, reported, forecast and used to support decision-making. However, this evolution goes beyond the purely technological dimension and is leading to a re-evaluation of the roles and skills required of management controllers.

This article provides a review of the literature on the transformations in management control in the age of digitalisation. The analysis highlights a shift towards more automated, integrated and data-analytical practices, accompanied by a gradual repositioning of the management controller towards advisory and decision-support activities. It also highlights several limitations relating to data quality, digital skills, organisational changes and the adoption of technologies. Digitalisation thus appears to be a catalyst for the renewal of management accounting, the effects of which remain closely linked to the organisational and human conditions under which it is implemented.

Keywords: Management accounting; Digitalisation; Digital transformation; Digital technologies; Management accountant; Performance management.

1. Introduction

Digitalisation is playing an increasingly significant role in the transformations organisations are undergoing. The rapid development of digital technologies is altering internal processes, the ways in which information flows and decision-making mechanisms. This evolution is no longer simply a matter of computerising certain tasks. It entails more profound changes in the way organisations mobilise their resources, structure their activities and create value (Bharadwaj et al., 2013; Vial, 2019). The use of an increasing volume of data, combined with the development of processing and analytical capabilities, plays a particularly significant role in this transformation.

Finance functions are directly affected by these developments. The widespread adoption of integrated management software packages, *business intelligence*, big data, analytical tools and automation technologies is transforming the conditions under which financial and managerial information is produced and used. In this regard, Bhimani and Willcocks (2014) emphasise that digitalisation and the development of Big Data are challenging certain traditional conceptions of accounting information. Data is becoming more abundant, more diverse and more readily accessible, which opens up new possibilities for analysis whilst also giving rise to new challenges relating to its selection, reliability and interpretation.

Management accounting lies at the heart of these transformations. Traditionally associated with planning, budgeting, costing, reporting and performance monitoring, it

relies heavily on the organisation's ability to produce and utilise relevant information. The increasing integration of digital technologies is therefore directly changing its tools and practices. In particular, information systems enable the automation of part of the data collection and processing, whilst analytical tools offer new possibilities in terms of visualisation, forecasting and decision support (Appelbaum et al., 2017). The development of these technologies thus calls for a rethinking of the role of management accounting within management processes.

However, this development does not mean that traditional tools are disappearing. Budgets, performance indicators, dashboards and reporting systems continue to play an important role. It is rather the context in which they are used that is changing. Information can be produced more quickly, financial data can be reconciled with operational data, and analyses can be carried out at a level of detail that was previously difficult to achieve. Quattrone (2016) points out, however, that the availability of a greater volume of data does not necessarily lead to better understanding. The ability to select, contextualise and interpret information therefore remains crucial.

Digitalisation also raises questions about the role of the management accountant. When certain tasks relating to data collection, consolidation or the production of reports are automated, part of their work may gradually shift towards analysis, interpretation and supporting operational managers. This development is in line with the changes already observed in the literature concerning the positioning of management accounting professionals. Goretzki et al. (2013) highlight, in particular, the evolution of their professional role and their growing involvement in managerial activities. Digital technologies can reinforce this dynamic by reducing the burden of certain routine tasks and increasing the possibilities for utilising information.

However, the digital transformation of management control cannot be reduced to a mechanical relationship between the introduction of new technologies and the improvement of management practices. The effects observed also depend on the organisation of work, the skills available, the quality of data and the way in which users adopt the tools. Technologies can alter the distribution of responsibilities and the boundaries between different stakeholders within the organisation, without necessarily leading to a uniform transformation of the controller's role (Andreassen, 2020). The human and organisational dimensions therefore remain essential to understanding the changes associated with digitalisation.

The literature on this issue has gradually expanded, but it approaches the transformation of management control from

various angles. Some studies focus on information systems and digital technologies, others examine their effects on accounting practices, whilst several pieces of research look at the evolution of professional skills and roles. Knudsen (2020), in his review of the digitalisation of accounting, highlights in particular the diversity of issues raised by this transformation and the need to better understand the relationships between technologies, knowledge and professional practices.

In this context, it seems appropriate to bring these various studies together in order to offer a structured analysis of the transformations affecting management control. The central question identified is therefore as follows: How is digitalisation transforming the tools, practices and role of management control within organisations?

This article aims to analyse the main digital technologies used in management control, to examine their effects on management practices, and to understand the transformations they bring about in the roles and skills of management controllers. Particular attention is also paid to the opportunities offered by digitalisation, as well as to the limitations and difficulties that may influence its effects.

To address this issue, the article presents a structured review of the scientific literature available up to 2022. After clarifying the conceptual foundations of digitalisation and management control, the analysis focuses on the key technologies driving the transformation of the function. Developments in the practices and profession of management controllers are then examined, before putting into perspective the main benefits, limitations and organisational challenges associated with this transformation.

2. Digitalisation and management control: conceptual foundations

The digital transformation of organisations is accompanied by an evolution in the vocabulary used to describe the integration of technologies into management activities. Terms such as digitisation, digitalisation and digital transformation are frequently used, sometimes interchangeably, even though they refer to different levels of change. This clarification is particularly important in the field of management control, where digital technologies can play a role not only in the conversion and processing of information but also in the transformation of management practices and the responsibilities of those involved. This section therefore reviews the main concepts associated with digitalisation before examining how they relate to management control.

2.1. From digitisation to digital transformation

The growing prevalence of digital technologies within organisations has given rise to several concepts, the boundaries between which are sometimes unclear. The terms '*digitisation*', '*digitalisation*' and '*digital transformation*' are thus regularly used to describe digital-related changes. However, they do not correspond to the same degree of transformation. Distinguishing between them provides a better understanding of the shift from a simple technical conversion of information to a more profound change in the way an organisation operates.

Digitisation constitutes the first stage of this process. It primarily refers to the conversion of information available in analogue form into digital data that can be stored, processed and transmitted by IT systems. In the field of management accounting, this development may, for example, involve the digitisation of documents, the digital recording of accounting data or the replacement of certain physical media with databases. Digitisation thus primarily alters the medium in which information is stored, without necessarily leading to a fundamental transformation of organisational processes.

Digitalisation refers to a broader development. It involves the use of digital technologies to modify, automate or improve an organisation's processes and activities. The challenge is therefore no longer merely to convert information, but to harness the possibilities offered by technology to transform the way in which activities are carried out. This distinction is important, as digitalisation involves an interaction between technology, processes and stakeholders. In management accounting, this is reflected in particular through the automation of reporting, data integration via ERP systems, the development of interactive dashboards and the use of analytical tools to support decision-making.

This development is taking place in an environment where data is playing an increasingly important role. Bhimani and Willcocks (2014) show that digitalisation and the development of Big Data are altering the characteristics of the information used by organisations. The proliferation of data sources and the acceleration of data processing are expanding the possibilities available to accounting and control functions, whilst raising new questions regarding the relevance and interpretation of information. Digitalisation is therefore not merely a technical improvement to existing tools; it can also alter the way in which information is produced and utilised in management processes.

Digital transformation represents an even more profound level of change. It occurs when the use of digital technologies leads to significant changes in the organisation, its processes, its resources or its value-creation mechanisms. Bharadwaj et al.

(2013) demonstrate, in particular, that digital technologies tend to become inseparable from corporate strategy, gradually challenging the traditional distinction between corporate strategy and information systems strategy. Digital technology is thus no longer regarded as a mere enabler of business activities, but as a component of their transformation.

Vial (2019) expands on this concept by defining digital transformation as a process in which digital technologies cause disruptions that lead organisations to develop strategic responses and modify their value creation processes. These changes may relate to organisational structure, skills, working practices or even the relationships between different stakeholders. Digital transformation thus has a broader scope than the digitisation of a specific process.

In the case of management control, this distinction helps to identify a progression in the depth of the changes. Scanning essentially involves the conversion of information; digitisation focuses more on the transformation of processes and tools; whilst digital transformation can lead to a more comprehensive reconfiguration of practices, skills and the role of management control. For example, using a digital system to replace a paper document is primarily a matter of scanning. Automating the generation of a management dashboard from multiple databases is more in line with the concept of digitalisation. Conversely, when these technologies lead to changes in management processes, the development of new analytical capabilities and a repositioning of the management controller within decision-making processes, they contribute to a genuine digital transformation of the function.

This distinction should not, however, lead us to view these three concepts as necessarily successive or entirely separate stages. In practice, their boundaries may overlap and how they manifest depends on the organisational context. Nevertheless, they enable us to distinguish between different levels of change and to avoid labelling every adoption of a new IT tool as 'digital transformation'. This clarification is particularly useful for analysing management accounting, since the key issue is precisely to determine the extent to which technologies are changing not only its tools, but also its practices and its role within the organisation.

Table 1: Distinction between digitisation, digitalisation and digital transformation

Concept	Main meaning	Level of change	Illustration in management accounting
Digitisation	Conversion of analogue information into digital data	Technical	Dematerialisation and digital storage of data
Digitalisation	The use of digital technology to improve or transform processes	Process-oriented	ERP, automated reporting, digital dashboards
Digital Transformation	A more comprehensive transformation of business activities, practices and ways of creating value driven by digital technology	Organisational and strategic	Transformation of management, new skills and the evolving role of the controller

Source: Compiled by the authors based on Bharadwaj et al. (2013), Bhimani and Willcocks (2014) and Vial (2019).

2.2. Management accounting: definition, functions and evolution

Management accounting plays a central role in organisational management mechanisms. Its role is not limited to monitoring financial results, but more broadly consists of providing managers with the information and tools necessary to steer organisational activities. In its traditional conception, Anthony (1965) defines management control as the process by which managers ensure that resources are obtained and used effectively and efficiently to achieve the organisation's objectives. This conception highlights the close link between resource allocation, the achievement of objectives and the evaluation of results.

As organisations and their environments have evolved, management control has gradually moved beyond this conception, which was primarily centred on the use of resources. Simons (1995) places it within a broader perspective by demonstrating that control systems can be used by senior managers to support the implementation of strategy and guide organisational behaviour. For their part, Otley (1999) and Ferreira and Otley (2009) demonstrate that the analysis of control systems must incorporate a broader set of

dimensions relating to objectives, strategies, performance indicators, responsibilities and feedback mechanisms. Management control thus emerges as a mechanism linking strategic directions to operational activities and the results achieved.

In this context, a key fundamental function relates to planning. This involves translating the organisation's strategic direction into objectives and action plans. It enables the determination of expected outcomes, the organisation of resource allocation and the provision of benchmarks for future action. Management control therefore intervenes prior to action by helping to break down general objectives into operational and measurable objectives. Planning thus acts as a link between strategy and the decisions taken at different levels of the organisation (Anthony & Govindarajan, 2007).

Budgeting has traditionally been one of the main tools of this planning process. The budget makes it possible to translate objectives into figures, allocate resources and coordinate the activities of the various units. It also serves as a benchmark against which actual results can be compared with forecasts. Despite criticism of traditional budgetary systems, particularly regarding their rigidity in unstable environments, the budget remains a widely used tool for planning, coordinating and evaluating activities (Hansen et al., 2003). Its use, however, tends to be supplemented by updated forecasts, simulations and other more flexible management mechanisms.

Control, strictly speaking, involves monitoring the implementation of plans and identifying discrepancies between planned targets and actual results. It is not merely a matter of noting these discrepancies, but also of investigating their causes and, where necessary, facilitating the implementation of corrective actions. Management control thus establishes a feedback loop linking objectives, actions, results and adjustments. This function helps to ensure consistency between the behaviour of the various units and the organisation's strategic direction.

Reporting complements this system by organising the production and circulation of the information required for management. It enables managers to receive regular updates on results, variances and trends in key indicators. Historically centred on financial data, reporting has gradually been expanded to include operational and non-financial information. This development reflects a broader conception of performance and addresses the limitations of management based exclusively on accounting and financial results (Kaplan & Norton, 1992).

Performance measurement is, in fact, another key function of management accounting. It involves defining indicators that

enable an assessment of the extent to which objectives have been achieved. Performance cannot, however, be reduced to its financial dimension alone. The development of tools such as the *Balanced Scorecard* has helped to broaden this assessment by incorporating dimensions relating to customers, internal processes, and organisational learning and development (Kaplan & Norton, 1992). The management controller is therefore involved in developing the indicators, monitoring them and, above all, interpreting them.

Finally, management accounting plays an increasingly important role in decision-making. Information derived from budgets, cost systems, dashboards and performance analyses provides managers with the necessary insights to understand results and evaluate different courses of action. This aspect is gradually bringing the management accountant closer to operational managers. Their role no longer consists solely of producing figures, but also of explaining them, putting them into context and contributing to their use in managerial decision-making.

The evolution of these various roles thus demonstrates a gradual broadening of the scope of management accounting. In addition to its traditional functions of planning, budgeting and control, greater emphasis has been placed on strategic steering, performance analysis and decision support. This transformation had therefore begun even before the current acceleration in digitalisation. Digital technologies, however, are reinforcing this trend by automating certain activities, increasing the availability of data and offering new analytical possibilities. They are therefore challenging not only the tools of management accounting, but also the way in which its various functions are carried out.

Table 2 : Key functions of management accounting

Function	Main purpose	Key mechanisms
Planning	Translating strategic directions into objectives and organising action	Plans, objectives, forecasts
Budgeting	Quantifying objectives and allocating resources	Budgets, budget forecasts
Monitoring	Comparing actual results with targets and analysing variances	Variance analysis, corrective actions
Reporting	Producing and communicating management information	Reports, dashboards, indicators

Performance measurement	Assessing the achievement of objectives	Financial and non-financial indicators
Decision support	Providing and interpreting useful information for managers	Analyses, simulations, forecasts

Source: Compiled by the authors based on Anthony (1965), Kaplan and Norton (1992), Otley (1999) and Ferreira and Otley (2009).

2.3. The convergence of management accounting and digital technologies

The convergence of management accounting and digital technologies stems from the central role that information plays in management processes. Planning, budget monitoring, variance analysis, reporting and performance evaluation all rely on the availability of information that enables managers to understand results and guide their decisions. Consequently, any development affecting the production, processing, circulation or use of this information is likely to alter the conditions under which management control is exercised. Digitalisation fits precisely into this dynamic by offering new capabilities for data collection, integration and analysis.

However, this relationship is not entirely new. The computerisation of organisations had already led to a significant evolution in accounting systems and control mechanisms. In particular, the development of enterprise resource planning (ERP) software has made it possible to centralise information that was previously scattered across several departments and applications. By integrating data relating to the company's various activities into a single system, these technologies have helped to change the conditions under which management information is produced and circulated. Granlund and Malmi (2002) show, however, that the introduction of ERP systems has not necessarily brought about a radical transformation of management accounting techniques. Rather, it has altered the information infrastructure with which these practices are carried out. This observation highlights the need to distinguish between the adoption of a technology and the actual transformation of professional practices.

The advancement of digital technologies has, nevertheless, considerably expanded the possibilities available to management accounting. Integrated systems are now complemented by *business intelligence* solutions, visualisation tools, analytical platforms and systems enabling the exploitation of growing volumes of data. This development facilitates the reconciliation of financial information with operational data and allows for faster access

to indicators derived from the organisation's various activities. Appelbaum et al. (2017) emphasise in this regard that the development of enterprise systems and *business analytics* opens up new possibilities for management accounting, particularly in terms of analysis and decision support.

The rise of Big Data reinforces this trend by altering not only the volume of available information but also its nature. The data utilised by organisations no longer comes exclusively from internal accounting systems; it may incorporate operational or commercial information, or data from external sources. Bhimani and Willcocks (2014) argue that this development challenges certain traditional characteristics of accounting information and calls on professionals to reconsider how data is produced and used. For management accounting, the focus is thus gradually shifting from the availability of information to the ability to select relevant data, reconcile it and make sense of it.

This transformation particularly affects reporting. In a traditional environment, reporting generally relies on periodic cycles during which data is collected, consolidated and then communicated to managers. The integration of information systems and the automation of some of these operations can reduce the time taken to produce key performance indicators. The management controller then has faster access to information and can devote more time to analysing it. Under these circumstances, the value of the role tends to depend less on its ability to produce figures than on its ability to interpret them and explain their implications for the business.

Digital technologies are also transforming the possibilities available in terms of forecasting and decision support. Data processing capabilities make it possible to run a greater number of simulations, correlate different variables and develop scenarios more quickly. Historical data, traditionally used to explain past performance, can thus be supplemented by analyses that are more forward-looking. Management control is therefore tending to evolve from a predominantly retrospective, *re al* approach towards one that combines the explanation of past results with the preparation of future decisions. Quattrone (2016) points out, however, that increased digital capabilities do not automatically guarantee an improvement in managerial judgement: more data does not necessarily mean more relevant information.

The convergence of digital technologies and management accounting also has an organisational dimension. When information becomes directly accessible to managers via dashboards and integrated systems, the management accountant no longer necessarily holds the same monopoly over the production and dissemination of data. This

development may lead to a redefinition of the boundaries of the role. Andreassen (2020) thus demonstrates that digital technologies can transform areas of expertise and the relationships between the stakeholders involved in the production and use of information. The management controller is therefore required to develop a role that relies more heavily on interpretation, contextualisation and supporting users.

This shift also requires a corresponding adaptation of skills. A command of accounting principles and traditional control tools remains necessary, but this is increasingly being complemented by a deeper understanding of information systems, analytical tools and data. Oesterreich and Teuteberg (2019) demonstrate, in particular, that the development of *business analytics* is influencing the skill sets expected of internal auditors and management accounting professionals. Digital skills do not, therefore, replace traditional knowledge; they complement it and contribute to the evolution of the profession.

Nevertheless, a deterministic interpretation of this transformation should be avoided. Technology does not automatically alter management control practices simply by its presence. Its effects depend on how it is adopted, the quality of the available data, users' skills, the organisation of the function and the needs of managers. Two companies using similar technologies may thus experience very different transformations in their management control practices. Digitalisation must therefore be viewed as a process combining technological, informational, organisational and human dimensions.

The convergence of management control and digital technologies can ultimately be understood as a gradual evolution of the information value chain. Technologies facilitate the collection and integration of data; automation transforms how data is processed; analytical tools enhance its interpretation; whilst their use helps to renew management and decision-making processes. This interplay constitutes the starting point for the contemporary transformation of management accounting. It also helps to explain why analysing the technologies utilised by the function is a necessary step before examining their effects on practices and on the role of the management accountant.

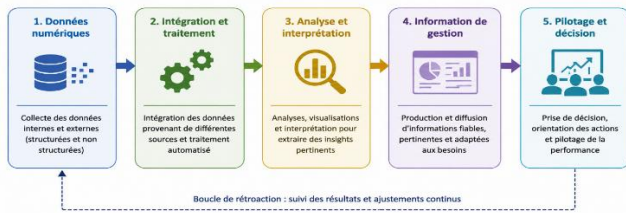


Figure 1: From digital data to management: the process of transforming information in management accounting

Source: Author's own work based on Bhimani and Willcocks (2014), Quattrone (2016) and Appelbaum et al. (2017).

3. Digital technologies in the service of management accounting

The digital transformation of management accounting relies largely on advances in the technologies used to produce, process and utilise information. Digital systems are no longer merely tools designed to facilitate the execution of existing tasks. Their gradual integration is changing the way in which data is collected, shared and analysed, thereby opening up new possibilities for the management of organisations. ERP systems, business intelligence, big data, analytical tools and automation are therefore playing an increasingly significant role in accounting and control functions (Bhimani & Willcocks, 2014; Appelbaum et al., 2017).

Among these technologies, ERP systems have played a pioneering role by enabling the integration of data that was previously scattered across different departments and applications. They thus represent a significant step in the digitalisation of management control and in the evolution of its information environment.

3.1. ERP and data integration

Integrated management software packages, generally referred to by the acronym ERP (*Enterprise Resource Planning*), have profoundly altered the architecture of organisations' information systems. Their principle is based on the integration of various business functions with to a single system using a shared database. Information relating to accounting, procurement, sales, production, stock and human resources can thus be brought together within a single information environment (Davenport, 1998). This integration is of particular importance for management accounting, whose activities rely precisely on the collection and cross-referencing of information from different organisational units.

➤ The centralisation of information

One of the key benefits of ERP systems lies in the centralisation of information. Prior to their widespread adoption, the data required for management control might have been scattered across multiple systems, files or departments, forcing controllers to carry out numerous reconciliations before they could produce their analyses. ERP systems help to reduce this fragmentation by providing a common information infrastructure.

In particular, this centralisation facilitates the reconciliation of accounting information with operational data. Controllers can thus access information relating to sales, purchases, costs, stock or production without having to rely systematically on separate systems. Scapens and Jazayeri (2003), drawing on a study of the implementation of SAP, show that ERP can promote better integration of information and gradually change management accounting practices. The smoother flow of data then helps to bring the organisation's various functions closer together.

However, centralisation does not mean that information automatically becomes relevant for management control. The availability of data must be accompanied by a process of selection, structuring and interpretation. The value provided by ERP therefore also depends on the quality of the recorded data and the way in which the system is configured and used.

➤ Process automation

ERP systems also help to automate some of the information processes. Information recorded in one part of the business can automatically feed into other modules of the system, thereby minimising the need for re-entry and reducing the need for manual processing. This feature can speed up the production of information and reduce certain repetitive tasks previously carried out by the accounting and control departments.

For the management controller, this automation may relate to data collection, certain consolidation tasks, the calculation of key performance indicators or the preparation of reports. It potentially frees u 's time for activities requiring greater analysis and interpretation. Granlund and Malmi (2002) note, however, that ERP systems have not brought about as radical a transformation of management accounting techniques as might have been anticipated. Their influence is more evident in the integration and organisation of information than in the immediate replacement of traditional control tools.

This observation is important for understanding the digitalisation of management control. New technology can transform the way work is carried out without necessarily leading to the disappearance of existing practices. Budgets,

variance analyses and dashboards can thus continue to be used, whilst being fed by more automated processes.

➤ **The standardisation of processes and information**

The integration offered by ERP systems is generally accompanied by a standardisation of processes. To enable different functions to share the same infrastructure, the organisation must define common rules regarding the recording, processing and classification of information. Davenport (1998) specifically highlights that the adoption of an integrated system often leads companies to review their processes in order to make them compatible with a common information architecture.

This standardisation offers several advantages for management accounting. It improves the comparability of data across units, minimises certain discrepancies in processing methods and facilitates the consolidation of information. When entities use common definitions for costs, responsibility centres or performance indicators, the controller has a more consistent basis on which to carry out their analyses.

It may, however, give rise to certain constraints. The pursuit of uniformity may reduce the flexibility needed to cater for the specific characteristics of certain activities or units. The challenge, therefore, lies in striking a balance between the standardisation required for integration and the system's ability to provide information tailored to local management needs.

➤ **Enhanced coordination between functions**

Finally, data integration helps to strengthen coordination between the various parts of the organisation. By providing access to shared information, the ERP system breaks down certain information barriers between departments. An operation carried out in one function can have immediately visible effects in other parts of the system, which promotes a more cross-functional understanding of activities.

This development may also alter the position of the management controller. Scapens and Jazayeri (2003) show that systems integration can help to transform the role of management accounting professionals, notably by reducing certain routine tasks and encouraging their involvement in activities more focused on analysis and supporting managers. Access to integrated information does indeed facilitate communication between management accounting and operational managers.

However, these changes should not be attributed solely to technology. Granlund and Malmi (2002) highlight the relatively modest nature of certain effects of ERP systems on

management accounting practices. Transformation also depends on the organisational structure, existing practices, the system's configuration and how users adopt it. ERP should therefore be regarded as an infrastructure that facilitates transformation, rather than as a factor that automatically generates new control practices.

The contribution of ERP systems to management control can be summarised in terms of four closely interlinked dimensions: centralisation of information, automation of processing, standardisation of processes and organisational coordination. These developments have paved the way for more advanced data utilisation. Whilst ERP systems primarily enable the integration and structuring of data, Business Intelligence technologies complement this infrastructure by enhancing the possibilities for visualising, analysing and utilising information in decision-making processes.

3.2. Business Intelligence and digital dashboards

Following the integration of data—made possible in particular by ERP systems—Business Intelligence represents a new stage in the evolution of the information systems used in management control. Whilst integrated systems are primarily designed to centralise and structure data from the company's various functions, Business Intelligence focuses more on utilising this data for analysis and management purposes. It encompasses a range of technologies and methods for collecting, organising, analysing and presenting data in order to produce information that is useful to decision-makers (Chen et al., 2012).

This development directly addresses the needs of management accounting. Indeed, the increasing volume of available data is only of value if it can be transformed into information that is comprehensible and can be utilised in decision-making processes. In this regard, Business Intelligence tools make it possible to consolidate data from multiple sources, develop indicators and present them via visual interfaces tailored to managers' needs. They thus establish a link between the organisation's information infrastructure and its performance management systems.

➤ **From static reporting to dynamic reporting**

One of the primary effects of Business Intelligence concerns the transformation of reporting. In its traditional form, reporting generally relies on reports produced at fixed intervals, presenting results observed over a past period. Whilst this approach remains useful, it can prove insufficient in environments where managers need access to up-to-date information quickly.

Digital tools are gradually making it possible to move beyond this exclusively static approach. Metrics can be updated more

frequently, and users can navigate between different levels of information. An overall metric can, for example, be broken down to identify the products, activities or units responsible for a variation. Reporting thus becomes more interactive and facilitates the analysis of the causes underlying observed performance.

For management accounting, this development can reduce the time spent on the technical preparation of reports and increase the time devoted to their interpretation. Appelbaum et al. (2017) show that the integration of enterprise systems and analytical tools specifically opens up new possibilities for management accounting by improving the ability to utilise information.

➤ **Data visualisation**

Visualisation is another important aspect of Business Intelligence tools. Digital dashboards enable data to be presented through charts, indicators, alerts and other visual elements that make the data easier to interpret. The aim is not merely aesthetic: it is to make complex datasets more readily understandable.

This function ties in directly with the long-standing focus of management accounting on dashboards. These aim to select a limited set of indicators that enable managers to monitor the key dimensions of performance. Digital technologies enhance this function by enabling a more interactive presentation and faster updating of information.

Visualisation also makes it easier to identify trends, variations or anomalies that might be less immediately apparent in tables consisting solely of numerical data. It can thus promote a quicker understanding of performance, provided that the selected indicators remain relevant and that their presentation does not lead to an excessive simplification of complex phenomena.

➤ **Faster access to performance indicators**

Business Intelligence also helps to improve access to information. When data is properly integrated, indicators can be made available to managers without having to wait for a report to be produced manually by the management control department. Digital dashboards can thus provide an up-to-date view of certain aspects of performance.

This accessibility is gradually changing the relationship between the controller and the users of the information. Managers can consult certain indicators directly, whilst the controller plays a greater role in their construction, interpretation and contextualisation. Their expertise therefore tends to shift from simply holding the information to the ability to explain what it means for the organisation.

However, rapid access alone does not guarantee the quality of management. Quattrone (2016) points out that increased digital capabilities and the proliferation of data do not necessarily lead to more relevant decisions. The selection of indicators, their contextualisation and the judgement of those involved remain essential.

➤ **Enhanced decision-making support**

Ultimately, the value of Business Intelligence lies in its ability to enhance decision-making support. By bringing together data from different activities, analytical tools enable users to identify relationships, compare scenarios and provide a more in-depth explanation of observed performance. The dashboard is therefore no longer merely a monitoring tool, but also serves as a basis for discussion and analysis.

Business Intelligence thus supports a broader evolution in management control: the function is moving beyond the mere periodic production of figures to play a greater role in their interpretation. This transformation also paves the way for the development of more advanced forms of analysis based on larger volumes and greater varieties of data, notably through Big Data and Data Analytics.

3.3. Big Data and Data Analytics

The development of Big Data marks a new stage in the transformation of the information environment of management accounting. Whilst traditional systems rely mainly on internal, structured and often financial data, digital technologies enable organisations to access considerably larger volumes of information from multiple sources. The challenge is therefore no longer simply to collect data, but to determine how to utilise it to improve understanding of business activities and the decision-making process (Bhimani & Willcocks, 2014).

The concept of Big Data generally refers to datasets whose volume, variety and speed of generation make them difficult to process using conventional tools. Chen et al. (2012) show that the evolution of Business Intelligence towards more advanced analytical capabilities is closely linked to this proliferation of data and the technologies enabling its exploitation. Data analytics, for its part, refers to the methods used to examine this data in order to extract useful information, identify relationships and support decision-making.

➤ **The expansion of data sources**

The first change concerns the diversification of the information sources available for management control. Accounting systems and ERP systems remain essential, but they are no longer the only usable sources. Organisations may

also have access to data relating to customers, operations, purchasing behaviour, supply chains or digital interactions.

This diversification has the potential to change the way performance is analysed. A variation in turnover, for example, can be linked to commercial, operational or behavioural information. The controller therefore has a richer information environment in which to investigate the factors underlying the observed results.

Bhimani and Willcocks (2014) argue specifically that digitalisation and Big Data are challenging the traditional boundaries of accounting information. The value of information no longer depends solely on its accounting origin, but also on its ability to contribute to an understanding of the business.

➤ **More in-depth analyses**

Data analytics also makes it possible to go beyond a simple description of results. Several levels of analysis can gradually be distinguished: descriptive analysis, which seeks to understand what has happened; diagnostic analysis, which seeks to explain why it happened; and predictive analysis, which uses available data to anticipate certain future developments.

This progression is particularly important for management accounting. Historically, a significant part of its work has relied on explaining past results through the analysis of variances and performance. Analytical capabilities offer the opportunity to complement this retrospective approach with a more forward-looking focus. Appelbaum et al. (2017) thus highlight the potential of *Business Analytics* to enrich management accounting practices and strengthen their contribution to decision-making.

➤ **Linking financial and non-financial data**

One of the major contributions of Big Data also lies in the ability to integrate financial and non-financial data more extensively. Performance measurement has long since ceased to rely exclusively on accounting indicators. Kaplan and Norton (1992) had already emphasised the importance of incorporating dimensions relating to customers, internal processes and organisational capabilities into performance measurement systems.

Digital technologies enhance this capability by facilitating the collection and reconciliation of different types of data. Financial information relating to revenue, costs or margins can thus be reconciled with indicators concerning lead times, quality, volumes, customers or operations. This integration offers a potentially more comprehensive understanding of the determinants of performance.

However, it raises a fundamental question: having more data does not necessarily mean having better information. Management accounting must therefore continue to play a role in selecting and prioritising data to prevent the accumulation of data from leading to information overload.

➤ **From explanation to forecasting**

Finally, data processing and analysis capabilities open up new prospects for **forecasting**. Analytical methods make it possible to utilise historical data, identify certain patterns and build models designed to anticipate changes in variables that are important to the organisation. Forecasts of sales, costs, cash flow or demand can thus be enhanced through the use of more extensive and diverse data.

For management accounting, this development may alter the timing of management control. It is no longer simply a matter of comparing actual results with forecasts, but also of revising forecasts more frequently based on available information. The function can then strengthen its contribution to the simulations and scenarios required for decision-making.

However, this development does not mean that analytical tools replace the judgement of the controller or managers. The results produced by the models remain dependent on the quality of the data, the assumptions made and the context in which they are interpreted. Quattrone (2016) rightly emphasises the need to maintain the capacity for judgement in the face of increasing digital possibilities.

Big Data and Data Analytics thus broaden the informational scope of management control through a two-fold dynamic: more data can be utilised and more advanced analyses can be carried out. Their contribution, however, does not lie in the quantity of information produced, but in the ability of the organisation and the controller to transform this data into knowledge relevant to management. This development also paves the way for the development of technologies capable of further automating certain operations and analyses, notably RPA and artificial intelligence.

3.4. Automation, RPA and artificial intelligence

Automation is a key stage in the digital transformation of management accounting. It mainly concerns repetitive, standardised tasks based on explicit rules, such as data extraction, certain reconciliations, file consolidation or the preparation of reports. In this context, *Robotic Process Automation* (RPA) enables software to replicate certain actions carried out manually within information systems. Its benefit lies in reducing the time spent on routine operations and in allowing management controllers to refocus on activities more oriented towards analysis and interpretation (Kokina & Blanchette, 2019).

However, RPA should not be equated with artificial intelligence. It relies primarily on the automated execution of predefined procedures, whereas AI utilises more advanced capabilities such as recognition, learning and prediction. Until 2022, the most relevant applications for management accounting will mainly concern *machine learning*, predictive analytics and the improvement of forecasting processes. These tools can, in particular, support planning and *forecasting* activities, but they do not replace the controller's judgement, which remains necessary to interpret the results and place them in their organisational context (Wasserbacher & Spindler, 2022).

These technologies are thus helping to reshape the distribution of tasks within the function. As certain technical operations are automated, the controller's added value shifts towards understanding data, identifying root causes, formulating recommendations and supporting managers. Andreassen (2020) demonstrates in this regard that digital technologies can alter the boundaries of expertise and lead management accounting professionals to redefine their role within the organisation.

Automation, RPA and artificial intelligence therefore appear to be drivers of transformation rather than substitutes for management control. Their effectiveness depends on data quality, the level of process standardisation, the skills available and how well users adopt them. They are gradually driving a shift in management control from manual execution towards augmented analysis and decision support, whilst still leaving a vital role for human judgement.

4. Transformation of management control practices

The spread of digital technologies is not only transforming the tools used in management accounting; it is also changing the day-to-day practices of the function. Automation, the integration of information systems and the increasing use of data are influencing the way in which information is produced, analysed and communicated to managers. Management control is thus tending to evolve from an approach heavily centred on the periodic production of data towards practices that are more integrated, responsive and geared towards anticipation and decision support.

4.1. Automation of traditional tasks

Digitalisation is gradually reducing the burden of certain tasks traditionally carried out manually by management controllers. Data collection, consolidation, report preparation and certain consistency checks can now be partially automated using ERP systems, RPA and analytical tools. This development helps to minimise repetitive tasks and reduce the time required to produce information (Kokina & Blanchette, 2019). It can also

improve the reliability of data processing when processes are sufficiently standardised.

This automation is changing the distribution of working time within the function. Technical data preparation tasks tend to play a less significant role, whilst activities involving analysis, interpretation and communication are becoming increasingly important. Digitalisation therefore does not eliminate the traditional tasks of management accounting, but it transforms the conditions under which they are carried out and gradually shifts the controller's added value towards activities requiring greater judgement.

4.2. Transformation of reporting

Reporting is one of the practices most directly affected by digitalisation. In a traditional set-up, it is generally based on monthly or quarterly cycles during which data is collected, verified and then consolidated before being distributed to managers. The integration of information systems and the development of Business Intelligence now make it possible to automate some of these operations and to access performance indicators more quickly (Appelbaum et al., 2017).

Reporting is thus becoming more dynamic and interactive. Digital dashboards allow users to view up-to-date information, explore data at different levels of detail and identify discrepancies or significant changes more quickly. This transformation is gradually shifting reporting from a primarily retrospective approach towards a more reactive one, where information serves as a basis for analysis and discussion rather than a mere record of past results.

4.3. Transformation of budgeting and forecasting processes

Digital technologies are also having an impact on budgeting and forecasting processes. The budget remains a key tool for planning and coordination, but it is increasingly being supplemented by more flexible methods, such as *forecasting*, simulations and scenario analysis. Data processing capabilities make it possible to update assumptions more frequently and to quickly test the consequences of different decisions.

This development encourages a more forward-looking approach to management. Rather than simply comparing actual results with budgets set at the start of the period, controllers can incorporate more recent information into forecasts and propose alternative scenarios. Analytical tools and *machine learning* methods also enhance forecasting capabilities, although their use requires a critical eye to be kept on the quality of the data and the relevance of the models employed (Wasserbacher & Spindler, 2022).

4.4. Towards a more data-driven approach to management

Overall, digitalisation helps to foster a more data-driven approach to management. Controllers have access to greater volumes of information, drawn from both financial systems and operational activities. This availability makes it possible to broaden performance analysis, reconcile financial and non-financial indicators, and better identify certain factors that explain results (Bhimani & Willcocks, 2014).

However, data-driven management does not mean that decision-making becomes entirely automated. The relevance of information still depends on its quality, its interpretation and its contextualisation. The role of the management controller therefore increasingly involves transforming data into knowledge that is useful to managers, by selecting relevant indicators, explaining variances and contributing to the decision-making process. This development directly paves the way for the transformation of the management controller's role, which will be examined in the following section.

5. Transformation of the management controller's role

The digitalisation of management accounting is not limited to changes in tools and processes. It also affects the nature of the role and the management accountant's position within the organisation. The automation of certain tasks, faster access to data and the development of analytical capabilities are gradually reducing the emphasis on activities centred on the production of information. At the same time, expectations are shifting towards analysis, interpretation and support for operational managers. However, this transformation varies from organisation to organisation: technologies can broaden certain functions whilst, in other situations, leading to greater specialisation of roles (Andreassen, 2020).

5.1. From information producer to analyst

For a long time, management accountants devoted a significant proportion of their work to collecting, verifying and consolidating the data required to produce budgets, dashboards and reports. The integration of information systems and the gradual automation of certain operations are changing this landscape. When data is directly available within integrated systems and repetitive tasks can be automated, the production of information potentially requires fewer human resources.

However, this development does not diminish the importance of the management accountant. Rather, it shifts their focus towards utilising the information produced. The focus is increasingly on understanding results, identifying the causes of variances, correlating various indicators and extracting relevant information for managers. The management

accountant is thus gradually evolving from a role centred on producing figures to one focused on analysing and interpreting data.

Digitalisation is reinforcing this shift by significantly expanding the scope for analysis. Controllers must now be able to work with larger and more diverse datasets and use tools to explore them. Oesterreich and Teuteberg (2019) note that the rise of Big Data is changing the skill set expected of controllers, with skills in business analytics and information technology becoming increasingly important.

5.2. Greater involvement in decision-making

The faster availability of information also enables management accountants to play a greater role in decision-making processes. As the time spent on the technical preparation of data decreases, their involvement can focus more on explaining results, making forecasts, conducting simulations and evaluating different courses of action. The role thus tends to align more closely with the operational and strategic concerns of managers.

This development also alters the relationship between the controller and operational managers. It is no longer simply a matter of periodically providing key performance indicators, but of participating in their interpretation and helping to understand the factors that influence performance. The controller can thus contribute their expertise during the decision-making process by offering analyses, comparing different scenarios or drawing attention to the financial and operational consequences of certain courses of action.

However, this involvement is neither automatic nor uniform. Andreassen (2020) shows that digital technology can lead to different developments depending on the organisational level: some controllers find their tasks becoming more specialised, whilst those in more business-oriented roles see their responsibilities expand. Digitalisation therefore creates opportunities for repositioning, but realising these opportunities depends on the organisation, the skills available and the expectations placed on management accounting.

5.3. The emergence of the Business Partner role

This development is in line with the growth of the Business Partner model for management controllers. It should be noted, however, that this role did not arise solely as a result of digitalisation. The literature on the evolution of the profession had already highlighted a shift in the controller's role towards a position closer to operational managers and decision-making processes. Digitalisation acts instead as a factor that can accelerate or facilitate this transformation.

The Business Partner differs from a traditional view of the controller, which is primarily focused on the production and control of information. They are more closely involved in managers' activities, participate in discussions regarding performance, and provide an economic and financial perspective on decisions. Goretzki et al. (2013) analyse in detail the process of institutionalising this role within a German industrial company and demonstrate that its development also depends on the stakeholders involved, organisational practices and the work undertaken to legitimise this new positioning. The transition to the Business Partner role is therefore not solely the result of a technical evolution of the profession.

In the context of digitalisation, however, this role becomes particularly relevant. Whilst systems handle part of the information production, the controller can devote more attention to its use in decision-making. -technology can thus facilitate the shift from a role as an information provider to that of a partner to managers. This evolution remains, however, contingent on the management accountant's ability to understand operational activities, communicate with managers and transform the available data into relevant recommendations.

5.4. The new skills required of the management controller

The transformation of the profession necessarily goes hand in hand with a shift in the skills required. Traditional technical skills remain essential: cost control, budgeting, accounting, variance analysis and performance measurement remain the cornerstones of the profession. Digitalisation does not, therefore, render these obsolete, but rather complements them with new requirements.

Digital skills are becoming particularly important. Management controllers must be more familiar with information systems, ERP systems, business intelligence solutions and tools for processing and visualising data. Added to these are analytical skills, which are necessary for selecting relevant information, identifying relationships between different variables, constructing analyses and interpreting the results. The study by Oesterreich and Teuteberg (2019), based on 2,331 German professional profiles, confirms in particular the growing importance of skills in business analytics and information technology within the controller's role.

The development of a role that is more focused on supporting managers reinforces interpersonal skills. Communication, the ability to explain complex results, an understanding of operational activities, dialogue with managers and the ability to formulate recommendations are becoming essential. Digital transformation is therefore leading not so much to the

replacement of traditional skills as to the development of a broader profile in which several dimensions complement one another:



Figure 2 : The skills of the management controller in the age of digitalisation

Source: Author's own work based on Goretzki et al. (2013), Oesterreich and Teuteberg (2019) and Andreassen (2020).

This complementarity is a key element in the repositioning of the management controller. Proficiency in technology enables them to access information, analytical skills enable them to make sense of it, and interpersonal skills enable them to transform this analysis into an effective contribution to decision-making. The transition to a business partner role therefore depends as much on interpersonal and organisational skills as on proficiency in new digital tools.

6. The benefits and limitations of digitalisation for management accounting

Digitalisation opens up new possibilities for management accounting by improving the conditions under which information is produced, processed and utilised. However, it should not be regarded as an automatic source of performance improvement. The benefits achieved depend not only on the quality of the systems and data, but also on the skills, organisational practices and the ability of those involved to embrace the new tools. A review of the literature therefore leads us to consider the benefits of digitalisation, the risks it introduces and the organisational conditions necessary for its success in a holistic manner (Bhimani & Willcocks, 2014; Quattrone, 2016; Andreassen, 2020).

6.1. The main benefits

One of the primary benefits of digitalisation lies in the reduction of repetitive tasks. The integration of information systems and automation enable part of the operations involved in data collection, consolidation, reconciliation and preparation to be handled automatically. RPA is a prime example of this development, automating structured, rule-based processes. This transformation can reduce processing times and allow the controller to devote more time to

analysing and interpreting the results (Kokina & Blanchette, 2019).

Digitalisation also facilitates faster access to information. Integrated systems, business intelligence solutions and digital dashboards make it easier to access key performance indicators and reconcile different data sources. Management control can thus gradually move beyond an approach reliant primarily on periodic information to make use of more frequently updated data. This development improves responsiveness to variances and facilitates the monitoring of different aspects of performance (Appelbaum et al., 2017).

Another benefit relates to the strengthening of analytical and forecasting capabilities. Analysing growing volumes of data enables a more in-depth analysis of the factors influencing results, the integration of financial and non-financial information, and the development of simulations or scenarios. Management accounting can thus complement its traditionally retrospective focus with an approach that is more forward-looking (Bhimani & Willcocks, 2014). From this perspective, digital technologies help to strengthen the support provided to managers and improve steering capabilities, without, however, replacing the judgement required for decision-making.

6.2. Limitations and risks

The opportunities offered by digitalisation are, however, accompanied by several limitations. The first concerns data quality. An increase in data volume or processing speed does not guarantee its relevance. On the contrary, incomplete, incorrect or inadequately structured data can lead to misleading analyses. Bhimani and Willcocks (2014) show that the considerable expansion of the information environment is forcing accounting functions to reconsider how they assess and use data. The ability to select relevant information therefore remains essential.

The growing reliance on technology also raises issues relating to system reliability, costs and information security. The implementation of ERP systems, analytical platforms or automation solutions requires not only financial investment but also resources dedicated to their maintenance, integration and development. Furthermore, the centralisation and increasing flow of data place greater demands on data protection and system continuity. Over-reliance on digital systems can also undermine control processes when users no longer have sufficient understanding of the mechanisms behind the information produced.

Finally, the shortage of digital skills constitutes a significant constraint. The proliferation of tools only creates value when professionals possess the necessary capabilities to use them

and, above all, to interpret their results. Oesterreich and Teuteberg (2019) specifically highlight the growing importance of skills in information technology and business analytics within the profile of internal auditors. Investment in technology must therefore be accompanied by skills development; otherwise, the potential offered by the new tools risks remaining only partially realised.

6.3. Organisational and human barriers

The digital transformation of management accounting also faces obstacles that go beyond the technological dimension. Resistance to change can arise, in particular, when new tools alter working practices, call certain areas of expertise into question or redistribute responsibilities. The automation of tasks traditionally carried out by the controller may raise questions about their role and position. Andreassen (2020) also shows that digital technologies can lead to different changes in professional roles depending on organisational structures.

Organisational culture and training therefore play a decisive role. An organisation that encourages data sharing, learning and cooperation across functions makes it easier for staff to adopt new tools. Conversely, a transformation that is primarily technological, without support for users, may limit the actual changes observed in working practices. Training must therefore focus not only on mastering the tools, but also on the ability to interpret data and understand its limitations.

Finally, digitalisation can lead to a shift in responsibilities between controllers, operational managers and information systems specialists. Managers' direct access to dashboards, for example, alters the traditional relationship in which the controller played a central role in the production of information. Their contribution then shifts towards the development of indicators, analysis and supporting decision-making. Acceptance of the tools and clarification of the new responsibilities therefore become essential conditions for this evolution.

Overall, the literature thus leads us to reject a technodeterministic interpretation of digitalisation. The adoption of an ERP system, a business intelligence solution or an automation system does not automatically result in more effective management control. As Quattrone (2016) points out, having greater digital capabilities does not necessarily mean having better information on which to base decisions. Rather, the effects of digitalisation result from the interaction between technologies, data, skills and organisation. It is the coherence between these dimensions that determines management control's ability to effectively capitalise on digital transformation.

7. Discussion

The findings of this literature review show that the digitalisation of management control cannot be viewed simply as a modernisation of its tools. It forms part of a broader transformation that simultaneously affects the function's technological environment, its practices and the professional positioning of the controller. The studies examined agree on the increase in information processing and analysis capabilities, but also show that the effects of digitalisation depend on the organisational conditions in which the technologies are introduced. The discussion thus brings these various findings together to offer an integrated understanding of the transformation of management accounting.

7.1. A three-dimensional transformation

The first conclusion to emerge from the literature concerns the multidimensional nature of the transformation. The first dimension is technological. The development of ERP systems, business intelligence, big data, data analytics and automation is changing the infrastructure upon which management control relies to produce and utilise information. In particular, these technologies facilitate data integration, accelerate data processing and expand the scope for analysis (Bhimani & Willcocks, 2014; Appelbaum et al., 2017).

The second dimension concerns management control practices. Technological advances are gradually transforming data collection, reporting, forecasting and performance analysis. The change therefore does not necessarily lie in the disappearance of traditional tools. Budgets, dashboards and variance analyses remain in use, but the way they are produced and utilised is evolving. Information can be obtained more quickly, analyses can become more interactive, and forecasts can be updated more frequently. As Granlund and Malmi (2002) had already shown, the introduction of technology does not necessarily lead to an immediate transformation of management control techniques; it may first alter their information environment.

The third dimension is professional and organisational. When certain information-production tasks are automated, the activities of analysis, interpretation and communication take on greater importance. The role of the controller may then evolve towards a position closer to operational managers and decision-makers. The three transformations thus appear to be interdependent: technological transformation creates new possibilities, the transformation of practices reflects their adoption, and the transformation of the role reflects the new forms of contribution expected of the controller. This relationship also helps to explain why technology, taken in isolation, is not sufficient to account for the evolution of the function.

7.2. Towards a more analytical and strategic management control function

The literature reviewed also highlights a gradual shift in the focus of management control. Historically, a significant part of its work has centred on producing information relating to past performance: calculating results, analysing variances, preparing reports and comparing actual results with forecasts. Digitalisation does not eliminate this retrospective dimension, which remains essential to management control. However, it does enable this to be complemented by greater analytical and forward-looking capabilities.

Access to a greater volume of data that is available more quickly makes it possible, in particular, to provide a more in-depth explanation of results and to incorporate more variables into analyses. The development of data analytics, simulations and predictive tools also enhances *forecasting* capabilities. Management accounting thus tends to combine three timeframes: understanding past performance, monitoring the present situation more rapidly, and helping to anticipate future developments. This transformation has the potential to enhance its contribution to decision-making processes (Appelbaum et al., 2017; Wasserbacher & Spindler, 2022).

At the same time, this evolution helps to strengthen the strategic dimension of the profession. When technologies take over part of the routine processing, the management controller can devote more time to understanding business activities, interpreting data and engaging in dialogue with managers. This is in line with research describing a shift towards a *business partner* role (Goretzki et al., 2013). It would, however, be an over-simplification to establish an automatic link between digitalisation and strategic positioning. Andreassen (2020) shows that technologies can bring about different transformations depending on organisational levels and configurations. The shift towards a more analytical and strategic management control function is therefore a possibility facilitated by digitalisation rather than a systematic consequence of its adoption.

7.3. Proposal for a synthesis framework

Based on the above findings, a synthesis framework can be proposed to represent the general dynamics identified in the literature. Digitalisation first affects information systems by enhancing integration, automation and processing capabilities. These developments increase data availability and gradually transform control practices. At the same time, they give rise to new requirements in terms of digital, analytical and interpersonal skills. The combined evolution of practices and skills may ultimately facilitate a repositioning of the management controller and strengthen their contribution

to strategic steering. The process can be represented as follows:

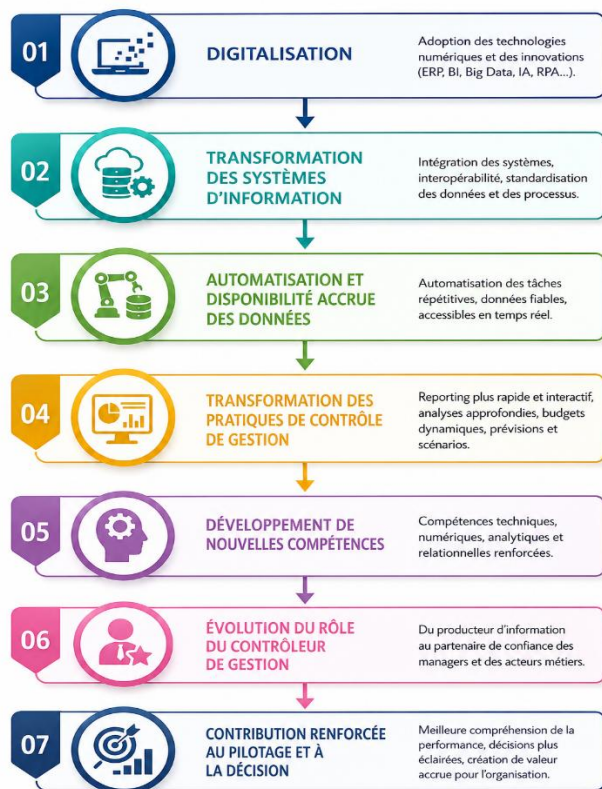


Figure 3 : Summary framework of the transformation of management control in the digital age

Source: Author's own work based on Bhimani and Willcocks (2014), Appelbaum et al. (2017), Oesterreich and Teuteberg (2019) and Andreassen (2020).

However, this framework should not be interpreted as a mechanical sequence of stages. The relationships may be reciprocal and are influenced by the organisational context. Digital culture, data quality, skills, managerial decisions and the adoption of technologies may either facilitate or, conversely, hinder the transformation. The proposed model therefore constitutes, above all, an integrative framework for interpreting the key insights drawn from the literature.

7.4. Research prospects

Despite the growing interest in digitalisation, several questions remain unanswered in the literature available up to 2022. One area of interest concerns the impact of artificial intelligence and automation on management control activities. Whilst their potential in terms of processing, forecasting and automation has been recognised, further empirical research is needed to determine which tasks are actually being transformed and how the relationship between digital tools and human judgement is evolving.

A second area of focus concerns the skills and professional identity of the management controller. Digital and analytical skills are becoming increasingly important (Oesterreich & Teuteberg, 2019), but how these relate to financial and interpersonal skills warrants further investigation. In particular, it would be relevant to examine whether automation leads to a genuine transformation of professional identity or simply to a reorganisation of existing activities.

Future research would also benefit from taking greater account of the diversity of organisational contexts. Comparisons between SMEs and large firms, as well as across different sectors, would help determine whether the digitalisation trajectories of management control follow similar patterns. Available resources, system complexity, digital maturity and information needs can indeed lead to very different transformations.

Finally, the organisational conditions underpinning the transformation constitute a particularly important area of research. Culture, training, the organisation of the finance function, data quality and relationships with operational managers can influence the benefits derived from the technologies. In this context, the shift towards the role of Business Partner warrants further empirical study. In particular, it would be useful to determine under what conditions digitalisation actually enables the management controller to reduce their reporting activities in order to increase their involvement in decision-making, and in which situations this transformation remains limited. These perspectives ultimately confirm that the digitalisation of management control must be studied as a phenomenon that is at once technological, organisational and professional. Future research will therefore need to move beyond the isolated study of digital tools in order to better understand the interactions between technologies, practices, skills and stakeholders.

8. Conclusion

The aim of this literature review was to examine how digitalisation is transforming management control, paying particular attention to the technologies employed, evolving practices and the changes affecting the role of the management controller. The analysis shows that this transformation goes far beyond the mere adoption of new IT tools. ERP systems, Business Intelligence, Big Data, Data Analytics, RPA and the first applications of artificial intelligence are helping to change the way information is produced, processed and utilised. In particular, they facilitate the automation of certain tasks, speed up reporting, expand analytical capabilities and foster the development of more responsive forecasting practices (Bhimani & Willcocks, 2014; Appelbaum et al., 2017).

One of the key insights from the literature is therefore the gradual shift from management control primarily focused on the production and analysis of historical information to a function more geared towards interpretation, anticipation and supporting decision-making. This evolution directly affects the role of the management controller. The automation of certain repetitive tasks does not necessarily diminish the controller's importance, but tends to shift their added value towards activities requiring greater analytical skills, an understanding of operational challenges and interaction with managers. The development of digital, analytical and interpersonal skills thus complements the technical skills traditionally associated with the role and may, in certain organisational contexts, facilitate its evolution towards a *business partner* role (Goretzki et al., 2013; Oesterreich & Teuteberg, 2019; Andreassen, 2020).

The main contribution of this review is to offer an integrated analysis of these transformations. The literature examined reveals three closely interlinked dimensions: the transformation of technologies, the transformation of practices, and the transformation of the management controller's role. The proposed synthesis framework shows that digitalisation first affects the information environment, promoting data integration and automation, before impacting management practices and the skills required. This interpretation also helps to move beyond a techno deterministic view: the introduction of a technological, on its own, is not sufficient to improve management control. The benefits achieved depend on the quality of the data, the skills available, the organisational culture, the adoption of the tools and the changing nature of responsibilities.

This research does, however, have certain limitations. Owing to its essentially theoretical nature, it is based on a narrative review of the literature and does not claim to be as comprehensive as a systematic review. Nor does it allow for an empirical measurement of the extent of the transformations identified, nor does it determine whether their effects are similar across all organisations. The diversity of technologies, sectors and organisational contexts also calls for caution when generalising the lessons drawn.

Several avenues of inquiry could therefore extend this discussion. Future research could explore in greater depth the effects of automation and artificial intelligence on management control activities, examine more closely the evolution of the controller's skills and professional identity, and compare transformation trajectories between SMEs and large enterprises or across different sectors. Particular attention could also be paid to the organisational conditions that enable the opportunities offered by technology to be transformed into effective improvements in management

control. Finally, empirical research appears necessary to determine the extent to which digitalisation actually facilitates the transition of the management controller towards a *business partner* role. Based on the knowledge available in 2022, digitalisation thus appears less as the culmination of a transformation and more as the starting point for a lasting reorganisation of the practices, skills and positioning of management control.

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