

# **Digital Transformation in Accounting:**

**Modern Technologies  
and Ethical Dilemmas  
Reshaping Financial  
Management  
and Reporting**

**edited by  
Bartłomiej Nita  
and Piotr Wanicki**



Publishing House of Wrocław University of Economics and Business

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# Chapter 1

## Transformation in Accounting – Methodological Introduction

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### 1.1. Rationale for the Research

Today's organisations are operating in an era of rapid technological development that is dramatically changing the way business is conducted. The process of digital transformation, understood as the integration of advanced technologies such as blockchain, data analytics, cloud computing and artificial intelligence, is redefining the core functions of businesses, including the particularly important areas of financial management and accounting. These changes, while bringing numerous benefits, present businesses with new challenges in adapting to a rapidly changing technological and regulatory environment. Precisely addressing these challenges allows organisations not only to increase their efficiency, but also to build more sustainable business models.

This monograph attempts to explore key aspects of digitalisation in the context of accounting. The publication draws on recent research and literature reviews to present a multi-dimensional view of the impact of modern technology on financial practices and reporting. In particular, it addresses issues such as the role of blockchain technology in enhancing financial transparency, the use of advanced analytics in strategic decision-making and the ethical implications of accounting process automation. The analysis of these issues identifies both opportunities and risks arising

from digital transformation, as well as directions for further research and development in this field. This approach provides an understanding of how new technologies can be harmoniously implemented in a way that supports organisational development.

Digital transformation in accounting is a process that not only optimises an organisation's internal operations, but also shapes new business models. SMAC (Social, Mobile, Analytics, Cloud) and blockchain technologies are helping to improve the transparency, efficiency and accuracy of financial operations. However, implementing these solutions requires a change in management approach, including cultural transformation and reshaping traditional organisational processes. The challenge remains to understand and adapt to new technological requirements in a way that supports the long-term sustainability and growth of the business. This process also requires an interdisciplinary approach that takes into account both technological and economic and social perspectives. The introduction of technology also implies the need to develop digital skills among employees, which highlights the importance of education and training in this area.

In parallel with technological advances, there is a growing interest in the concept of a circular economy. In this context, accounting and responsibility models are becoming key tools to support the monitoring of resource flows and the assessment of the environmental impact of economic activities. The integration of digital tools with sustainability principles offers a number of opportunities for achieving the goals set out in the UN Agenda 2030, yet these processes imply the need to develop global accounting standards that are in line with the challenges of the modern world. The use of digital technologies in the circular economy, such as predictive analytics and platforms that support resource management, enables more precise tracking of material flows and their reuse, which is key to building sustainable business models. The practices described not only reduce waste but also promote a more responsible approach to the use of natural resources.

The development of digital technologies also leads to new ethical dilemmas. The introduction of systems based on artificial intelligence and decision-making algorithms requires the careful management of risks, including the risk of biases built into the technologies and potential restrictions on access to modern solutions. A key element in the digitalisation process therefore becomes the construction of an appropriate legal and ethical framework that balances the innovation of the technology with the need to protect stakeholders and promote long-term trust in the organisation. This requires an integrated approach that includes both the implementation of ethical standards and the development of oversight mechanisms for the use of technology in accounting processes. In particular, it is important to avoid decision-making errors due to technological limitations and to ensure full transparency of the solutions used.

## 1.2. Purpose and Research Questions

The aim of this monograph is to provide a detailed analysis of the digital transformation in the accounting field, covering both the theoretical underpinnings and practical implications of the implementation of modern technologies, and to set future research directions



in this area. The publication serves as a resource for researchers, practitioners and policy makers, providing a comprehensive view of the future of financial management and reporting in the context of dynamic technological change. It also discusses potential future directions for technological innovations that can enhance the efficiency and transparency of accounting systems worldwide, while maintaining the highest ethical standards.

In order to realise the objective of the study there was a need for a literature review to verify the research areas and directions of ongoing research in the subject of modern technologies applicable to accounting. Based on the literature review, the authors attempt to answer the following research questions.

1. What key competencies are required of today's financial managers in the context of the increasing digitalisation of processes?
2. How are blockchain technologies revolutionising audit processes, and what regulatory challenges arise from their implementation?
3. What is the importance of data analytics in identifying early warning signals and minimising financial risk in companies?
4. What are the key ethical dilemmas associated with the automation of accounting processes and the use of decision-making algorithms?
5. How do digital tools affect the quality and transparency of financial reporting and the implementation of circular economy principles?

The first question concerns the key competences of today's financial managers in the context of increasing digitalisation. Researchers indicate that these competencies include not only technical skills, but also the ability to interpret data and manage risks in a dynamically changing environment. These challenges make it necessary for organisations to invest in the development of staff competencies and the implementation of systems to support their work.

The second question relates to the impact of blockchain technology on audit processes and the regulatory challenges associated with its implementation. Blockchain is revolutionising auditing by increasing transparency and data security, but its use requires regulatory alignment and the implementation of standards to realise the full potential of the technology.

The third question relates to data analytics as a tool for identifying early warning signals and minimising financial risks. This publication highlights the fact that advanced predictive analytics enable better risk management to support strategic and operational decisions. At the same time, they require not only the right tools but also an organisational culture that supports the use of data.

The fourth question addresses key ethical dilemmas related to the automation of accounting processes and the use of decision-making algorithms. The authors point out the risk of algorithmic bias and the need to build trust through transparent use of technology. The solutions should take into account both legal and ethical requirements.

The fifth question relates to the impact of digital tools on the quality of financial reporting and the implementation of circular economy principles. Digitalisation enables more detailed tracking of resource flows and promotes sustainable business

models, but it also implies the need to develop global accounting standards that support sustainability goals.

Summing up, this publication offers an in-depth analysis of the issues raised in the research questions, providing both theoretical underpinnings and practical recommendations. It is a valuable resource for researchers, practitioners and policy makers, supporting them in developing innovative, sustainable and ethical accounting practices in an era of digital transformation.

Despite the growing number of studies on the application of modern technology in accounting, there is still a lack of comprehensive studies that systematically combine theoretical underpinnings with practical implications and identify new research directions in the context of dynamic digitalisation. This monograph aims to fill this gap, offering an integrated approach to the analysis of the problems and challenges of digital transformation in accounting that considers technical, ethical, regulatory as well as strategic aspects.

### 1.3. Methodology of the Research

After defining the purpose of the monograph by seeking answers to the research questions identified, the study was designed according to the following research methodology.

1. **Selection of literature sources** – identification of scientific databases of high merit as a basis for literature review.
2. **Developing a search string** – creating a precise research query, including key phrases related to accounting and modern technology, to find publications that meet specific criteria.
3. **Conducting a literature search** – applying the prepared string to the established databases, taking into account the language (English), type of publication (scientific articles), source (journals) and the date the search was performed.
4. **Pre-selection of results** – review of abstracts of identified articles to assess their alignment with the research objectives of the monograph.
5. **Journal quality verification** – assessing search results for compliance with Academic Journal Guide 2021 (ABS).
6. **Analysis of full texts of selected publications** – detailed reading of the content of selected articles and identification of research areas related to modern technologies in accounting.
7. **Analysis using the VOS Viewer tool** – conducting a co-occurrence analysis of keywords to determine thematic clusters illustrating key research areas.
8. **Identification of research clusters** – dividing topics into four main research clusters.
9. **Developing conclusions and recommendations** – formulating conclusions from the literature analysis and research clusters and making recommendations for further research on digital transformation in accounting.

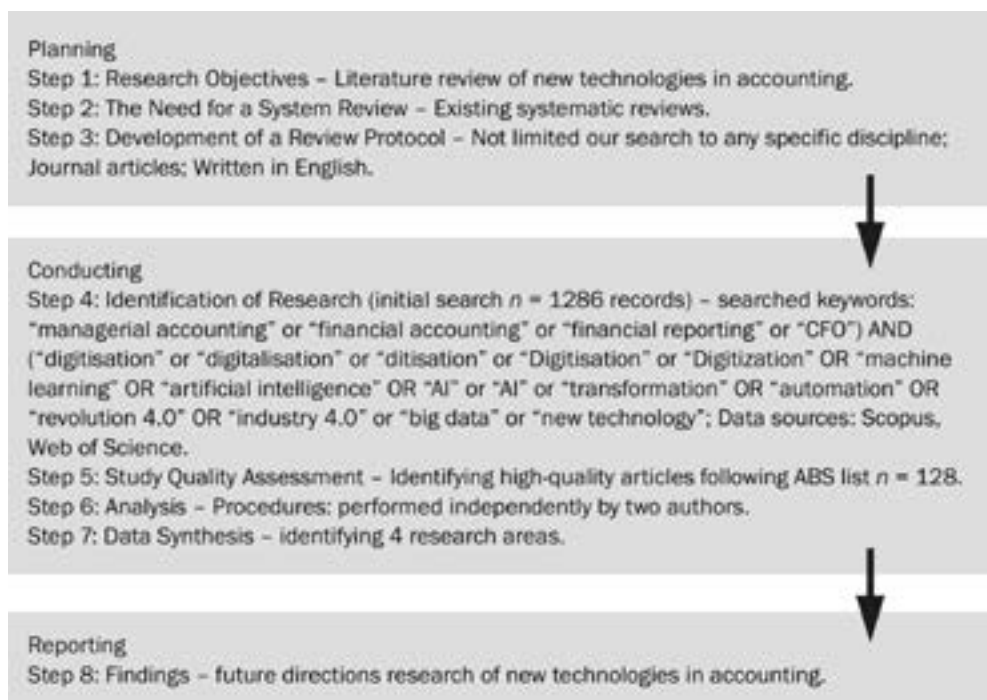
The subjects of this study were scientific publications listed in the Scopus and Web of Science databases. This scientific database is multidisciplinary and the articles indexed in it are considered valuable as a source for scientific research (Dharmani et al.,

2021; Mariano & Laker, 2024). The procedure to conduct a literature review is shown in Figure 1 and follows the methodology used in the social sciences (Ahmed et al., 2022; Z. Jiang et al., 2024; Sauer & Seuring, 2023; L. Wang et al., 2024).

The initial step was to analyse articles from the field of accounting in the broadest sense in order to develop a string that was indicated to be searched in the publication database. The query prepared was in the following, form:

TITLE-ABS-KEY ("managerial accounting" or "financial accounting" or "financial reporting" or "CFO") AND ("digitalization" or "digitalisation" or "digitisation" or "Digitisation" or "Digitization" OR "machine learning" OR "artificial intelligence" OR "AI" or "transformation" OR "automation" OR "revolution 4.0" OR "industry 4.0" or "big data" or "new technology") AND LANGUAGE ("English") AND DOCTYPE ("ar") AND SRCTYPE ("j").

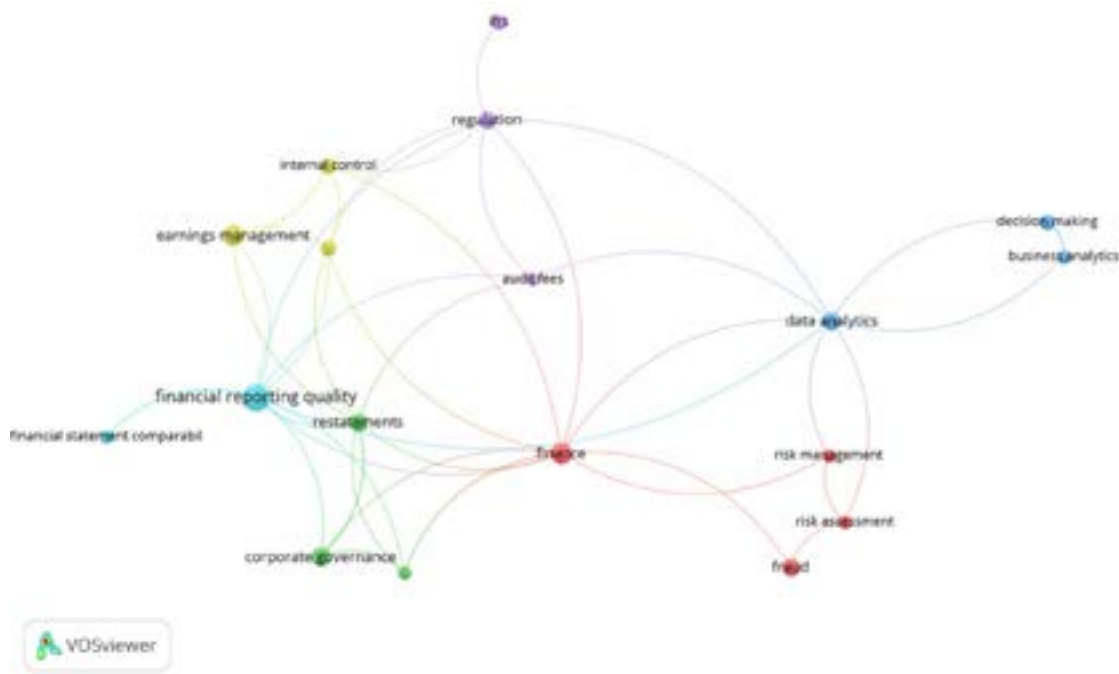
The survey was conducted on 21 March 2024, and resulted in 1286 records matching the indicated query. The authors of the monographs then reviewed the abstracts of the articles and determined whether they fit into the objectives of the monographs on the basis of these abstracts. In the next step, the results obtained were analysed for fit with the Academic Journal Guide 2021 by the Chartered Association of Business Schools (ABS) (Mariani & Dwivedi, 2024). It was decided that articles with a value of 2, 3, 4, 4\* were valuable articles and could be treated as important contributions to research related to the subject of the monograph. The publication database prepared in this way was the starting point for a comprehensive analysis of the selected articles according to the adopted methodology. The entire literature search procedure is presented in Figure 1.1.



**Figure 1.1. Literature review procedure**

Source: own elaboration.

In the next step, the authors looked in detail at selected publications, which resulted in an attempt to identify research areas in the field of new technologies in accounting. For this purpose, the VOS Viewer tool was used (Moral-Muñoz et al., 2020; Piotrowska et al., 2024), and the results are shown in Figure 1.2.



**Figure 1.2.** Result of the analysis for co-occurrence (3) using the VOS Viewer

Source: own elaboration.

Based on the co-occurrence analysis of key words using the VOS Viewer, four research clusters were determined:

- 1) blue – decision-making/risks/warning systems,
- 2) yellow – CEO/CFO role,
- 3) violet – inspection/audit/regulation,
- 4) light blue – financial and non-financial reporting.

Through a detailed analysis of selected publications and the use of the VOS Viewer tool, four key research areas were identified: the role of financial managers, decision-making and alert systems, control and audit, and financial and non-financial reporting. These results not only allow for a better understanding of the issue under study, but also provide a starting point for further research into the digital transformation in accounting and its practical implications.

#### 1.4. Structure of the Monograph

Within each designated research area, the current state of knowledge (research overview), the application of modern technologies, and further research directions are identified. Each of the chapters concludes with a discussion on the ethical issues involved.

The first chapter, entitled “The Role of Financial Managers”, analyses the dynamically changing requirements for financial managers in the context of increasing digitalisation and the implementation of modern technology. The chapter includes a literature review of the key competencies of today’s chief financial officers (CFOs), as well as a diagnosis of the changes resulting from the use of digital tools in decision-making and management processes. The authors highlight the evolution of the CFO’s role from traditional finance functions towards strategic business partners who are actively involved in shaping the direction of the organisation. An emerging key challenge is the integration of technological skills with traditional financial knowledge to enable more accurate data-driven decision-making.

The following section discusses issues related to the impact of SMAC (Social, Mobile, Analytics, Cloud) technologies on the efficiency of financial operations. The authors provide examples of the use of predictive analytics and financial process automation in increasing forecast accuracy and reducing operational risk. Special attention is also given to ethical dilemmas arising from the increasing reliance on technology, including issues related to the transparency of decision-making algorithms and the protection of financial data.

The chapter concludes by indicating directions for further research, which include the development of educational models tailored to the requirements of today’s financial managers, and the exploration of the impact of advanced technologies on organisational structures and corporate decision-making processes. These suggestions are particularly relevant in the context of the growing importance of the digital transformation in building a competitive advantage.

Chapter 2, entitled “Audit, Control, Regulation”, focuses on analysing the impact of modern technology on audit processes and the regulatory framework. The chapter begins with a literature review that points to the growing role of technology in improving financial audit and risk identification. The authors outline how blockchain and advanced analytical tools enable more transparent and tamper-proof audit processes. An example is the use of smart contracts that automate the enforcement of contractual terms, minimising errors resulting from manual interventions.

Regulatory challenges related to the implementation of digital technologies in auditing are also discussed. The authors emphasise that while these technologies contribute to the efficiency and accuracy of auditing, they also require the development of new regulatory standards that take into account the specificities of the digital business environment. Particular attention is paid to the need to harmonise international regulations in the context of the globalisation of financial markets.

The chapter concludes with an analysis of ethical dilemmas, including the risk of manipulation of audit algorithms and the need for transparency in the tools used. The authors propose an ethical framework that can support the responsible use of technology in auditing, and point to the need for further research on the ethical aspects of digital transformation in this area.

The third chapter, “Decision-Making, Cybersecurity and Identifying Early Warning Signals”, addresses the key challenges of implementing digital technologies

in decision-making and risk management. The chapter begins with an overview of research on the use of analytical tools and predictive systems in identifying potential risks to an organisation's operations. The benefits of such systems, such as improving decision accuracy and reducing operational risk, are pointed out, but at the same time the challenges of dehumanising decision-making processes are highlighted.

The authors also analyse issues related to cybersecurity, which is becoming one of the key aspects of management in the digital age. Specific cases of data security breaches are discussed, with recommendations made for implementing protective mechanisms such as data encryption, security audits and employee training. Special attention was paid to the role of financial leaders in building a cybersecurity culture in organisations.

The chapter concludes with a discussion of the ethical dilemmas associated with the use of decision support algorithms. The importance of transparency and accountability in the design of decision-support systems is highlighted, as well as the need to develop regulations that prevent abuse and ensure stakeholder protection.

The fourth chapter, "Reporting and Financial Reporting", explores the impact of digital transformation on the quality and transparency of financial reporting. The chapter begins with an analysis of the evolution of financial reporting in the context of global accounting standards, such as IFRS, and increasing stakeholder demands for non-financial disclosure, including ESG reporting.

The authors discuss how digital technologies, such as ERP systems, big data analytics and data visualisation tools, contribute to more efficient and accurate reporting processes. Particular attention is given to the use of blockchain technology in reporting, which enables the creation of immutable and transparent transaction records, significantly increasing the reliability of financial data.

The chapter concludes with an analysis of ethical dilemmas, including the risk of data manipulation and the need for regulatory compliance. The authors point to the need for global reporting standards that take into account the specificities of the digital business environment, and the importance of education in new technologies for financial professionals.

The monograph closes with a summary which consists of logically structured sections that highlight the monograph's main conclusions on digital transformation in accounting and financial management. The summary addresses in particular:

- 1) A synthesis of the key theses in the research clusters. This section presents the four main research areas that emerged from the literature analysis and the use of the VOS Viewer tool: decision-making and risk management, the role of financial managers, audit and regulation, and financial and non-financial reporting. The impact of technologies such as blockchain, AI and big data on these areas is discussed, highlighting both benefits (e.g. increased efficiency, transparency and relevance of decisions) and challenges (e.g. ethical dilemmas, technology risk management).
- 2) Extended conclusions from the literature review. The literature analysis provided an in-depth understanding of the impact of technology on various aspects of

accounting. The review identified key trends such as the evolving role of the CFO, changes in audit and control processes, the use of predictive systems and the development of automated reporting. The need to further harmonise global standards and develop digital competencies was highlighted.

- 3) Significance of research findings. The research findings highlighted both the theoretical and practical implications of digital transformation. The potential of technology to increase efficiency, promote sustainability and build stakeholder trust was emphasised. The need to develop international accounting standards that take into account the specificities of new technologies was also pointed out.
- 4) Limitations of the research described in the monograph. They include a lack of extensive empirical research, insufficient consideration of regional and cultural diversity, a focus on selected technologies and a lack of long-term projections. The need for a more detailed analysis of the ethical dilemmas and costs of technology implementation was also pointed out.

This structure provides a comprehensive overview of the topics and their practical and theoretical implications, making a coherent contribution to the scientific literature.



## Chapter 2

# The Role of Financial Managers

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## 2.1. The Role of Financial Managers – Review of Research

Digital transformation and the rapid development of technology have changed the fundamental approach to financial management in organisations, while redefining the role of chief financial officers (CFOs) and financial managers. Today's finance leaders face the challenge of integrating traditional management functions with modern technologies such as artificial intelligence, blockchain and big data. Thus, their tasks go far beyond standard accounting and control duties to become a key element in the strategic management of organisations.

Table 2.1 provides an overview of recent academic publications on the role of financial managers, taking into account aspects such as competence, the impact of modern technology, ethical challenges and reporting. The overview identifies the main research directions in this area and highlights the variety of research methods used by the authors, such as empirical analysis, qualitative research or statistical modelling. The added value of the table is the identification of the key findings of these studies,



which allows a better understanding of the evolving role of the CFO in a dynamically changing business environment.

The compilation of publications in Table 2.1 also takes into account the geographical and sectoral diversity of the studies conducted, which provides an opportunity to compare the results obtained in different cultural and institutional contexts. In this way it provides not only an overview of the state of the art, but also a valuable starting point for further research on the transformation of the financial management function.

**Table 2.1. Summary of publications for the area “Role of financial managers (CFO)”**

No.	Paper	Test sample	Methodology	Conclusions	Number of citations
1	Shaikh et al., 2023	A sample of 390 companies from the S&P 1500 in high-tech industries in the US between 2002 and 2015	Panel data analysis (econometric testing) and hypothesis testing	The results confirm that R&D intensity is influenced by the composition of the board of directors. It is also important for maintaining R&D expenditure.	1
2	F. Wang et al., 2023	7492 listed Chinese companies, analysis also in sub-sectors, observations 2010-2017	Statistical methods: time series regression, descriptive statistics, correlation analysis, measure of comparability of data	The results confirm that the gender of the CFO has an impact on quality, including the comparability of financial statements.	117
3	Hrazdil et al., 2023	The final sample consists of 3840 US listed companies from which 19215 different pairs of chief executive/general managers (CEOs) and CFOs were selected by gender between 2006 and 2019.	Statistical methods: e.g. analysis of distributions of variables, factor analysis, regression models	The results support the view that gender diversity among top management improves the quality of financial reporting, which has important implications for corporate governance mechanisms.	2
4	Osei-Assibey Bonsu et al., 2023	A survey of chartered accountants and certified public accountants in Ghana and Nigeria; after qualifying 201 questionnaires for final analysis	Structural equation modelling; regression method. Using a Likert scale, the relationship between the use of AI and improved functionality of accounting practices was confirmed.	The results show the positive impact of technology use on financial reporting and accounting practices.	6
5	Afzali, 2023	US-listed companies from 2001-2018, 30,875 observations, sampling subordinated to the sample of research on organisational culture	A measure of corporate culture (machine learning techniques); measures of comparability of financial statements; empirical model (regression model)	The results show that companies with a strong organisational culture have greater comparability of financial statements.	5
6	Harrison & Malhotra, 2024	14,000 observations	Searching for information in databases; statistical methods: descriptive statistics, correlation analysis	The results show which CEO and CFO personality traits influence the tendency towards higher or lower leverage levels.	1

No.	Paper	Test sample	Methodology	Conclusions	Number of citations
7	Gonzalez & Ashworth, 2021a	307 students, 82 managers	Qualitative analysis – views of business students and senior managers; discriminant analysis	The results show that the profile of CIOs causes them to be perceived as less authoritative and less socially competent, qualities that are important for strategic leadership, so that they are often depreciated in the company structure.	3
8	Kipp et al., 2020	146 participants from Amazon's Mechanical Turk platform (they get 3 USD per participation, they are qualified on the basis of experience)	A 2 × 2 research experiment (agent type × agent autonomy) between participants. Managers are confronted with a decision problem in different contexts (with the support of a different agent).	The results show the impact of using AI in financial reporting decision-making and confirm that managers' use of AI undermines their aggressive financial reporting decisions.	6
9	Bassyouny et al., 2020	283 companies from the FTSE All-Share stock market Index	Lexical analysis – study of the frequency of occurrence keywords using several proprietary regression models	The results show the key factors influencing the tone of the narrative in the UK context, where managers have greater flexibility in shaping the narrative with stakeholders. The upstream theory that financial performance and strategic choices can be predicted by the characteristics of upstream managers is confirmed.	35
10	Uwizemungu et al., 2020	171 online job advertisements for accounting positions published by Canadian organisations in 2016-2017	Using labour market signalling theories, a content analysis of 171 online job advertisements for accounting positions published by Canadian organisations in 2016-2017 as a competency requirements analysis was conducted.	The results are based on an analysis of the competency requirements of 171 job advertisements for accounting positions in Canada and the competencies adopted for the accreditation of professional accountants.	26
11	Wu & Zhang, 2019	Financial data for companies from Worldscope and share price data from Datastream. The names and ages of company directors are collected from BoardEx.	Sensitivity analysis of rotation to performance	The results show whether mandatory IFRS adoption is associated with changes in the sensitivity of CEO turnover to accounting returns and how the impact of IFRS adoption varies by institution at the country level and incentives at the firm level.	13
12	Rubin & Segal, 2019	Director data for the period 2000 to 2010. Data mainly includes companies from the S&P 1500 index.	Regression method using Tobit methodology	The results indicate whether there is a correspondence between CEO skills and company size, and then whether the average measure of board members' skills is positively related to the quality of financial statements.	13

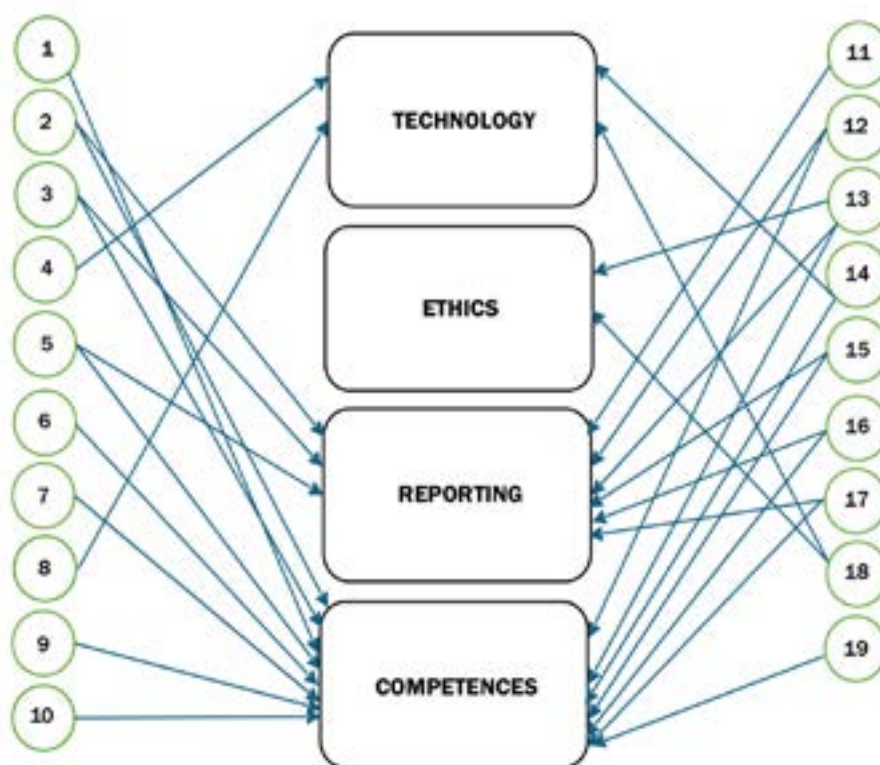
No.	Paper	Test sample	Methodology	Conclusions	Number of citations
13	Albrecht et al., 2018	A sample of 19,058 companies from 2004-2013	Variable decomposition method	The results show that practice and research recognise the importance of a broad knowledge of accounting and financial reporting for the production of reliable financial statements.	30
14	Arnold, 2018	No data available	Structural equation modelling; behavioural methods	The results identified contemporary changes affecting the accounting environment, discussed the potential impact on individual and organisational decision-making, and explored how behavioural research can be used to examine these changes.	44
15	Dauth et al., 2017	German companies listed on the DAX-30 from 2005 to 2010, plus demographics of 1,800 people (members of management and supervisory boards)	Hypotheses tested using pooled OLS regressions, Pearson	The results show a relationship between the quality of financial reporting and the international experience of CFOs. The research shows that managers with international experience provide higher quality financial reports.	37
16	Davidson et al., 2012	A sample of 271 fraudulent companies from the SEC's AAER (US Securities and Exchange Commission)	Dynamic gambling model	The results show how executives' off-duty behaviour, as measured by their ownership of luxury goods (low 'frugality') and previous breaches of the law, is associated with financial reporting risk.	169
17	Bedard et al., 2014	7034 companies from English-speaking countries	Literature review; lexical analysis of reports; statistical methods correlation	The results assess the role of the CFO. Comparisons are made between companies where this position exists and those where it does not. In addition, the impact of the CFO on the quality of the financial reporting of the entity where this role exists is examined. This study considers this issue in the context of chief financial officers (CFOs) sitting on the board of their own company.	78
18	C. Zhang et al., 2023	47 interviews conducted with companies, AI system provider and regulators	'Open coding' technique; lexical analysis	The results help to fill a gap in the literature by examining the actual ethical impact of artificial intelligence on management accounting at both the pre- and post-adoption stages. Compared to other areas of accounting, the application of artificial intelligence in management accounting has a wider impact on the organisation and is more likely to raise ethical issues.	18

No.	Paper	Test sample	Methodology	Conclusions	Number of citations
19	Mian, 2001	The sample covers 2227 events from 1984 to 1997.	Analysis of data variability	The results provide empirical evidence on why companies change their CFOs. The ways in which CFOs are appointed in US companies and their impact on performance are analysed.	177

Source: own elaboration based on the review conducted using the VOSviewer tool.

The role of chief financial officers (CFOs) and financial managers in today's businesses is evolving in response to changing market needs, globalisation, technology and stakeholder expectations. Over the past few decades the CFO has undergone a transformation from the role of a traditional financial controller to a strategic leader who plays a key role in shaping the business.

Figure 2.1 illustrates the complex roles played by directors and financial managers, regarding four key thematic areas: competence, technology, reporting and ethics, which are closely interlinked, indicating the interdisciplinary nature of modern financial management. The figure illustrates not only the challenges faced by CFOs, but also the potential growth opportunities arising from the integration of technologies such as artificial intelligence and blockchain with traditional management practices.



**Figure 2.1.** The role of finance directors and managers

Source: own elaboration.

The analysis in Figure 2.1 also highlights the importance of managerial competences in the context of various ethical challenges, e.g. transparency in decision-making processes and accountability for financial data. The role of the CFO is therefore not limited to effective financial management, but also includes shaping organisational culture and building trust among stakeholders. Through graphical representation, the figure provides a synthetic understanding of the key elements influencing the development of today's financial leaders and their importance in transforming organisations.

A review of the literature on the study area of the role of directors and financial managers makes it possible to distinguish four main sub-areas, i.e. competences, technology, reporting and ethics presented in Figure 2.1, together with the assigned article numbers in Table 2.1, and also a detailed analysis of the publications lead to the conclusion that the interests of the researchers revolve around these issues, which are intertwined.

Professional ethics, as manifested by improving professional competence, knowledge and skills, has been and continues to be the subject of much theoretical reflection and empirical research. The high professional competence of staff translates into high quality financial statements. At the same time, high competences may pose a threat to the quality of the reports, as well as knowledge and experience, and if there is a motivation to falsify the report, these competences will facilitate the distortion of the report and thus become a threat to its credibility. Among the issues troubling auditors was whether auditors perceive threats from managerial accounting competences to the credibility of financial statements (Albrecht et al., 2018).

The development of artificial intelligence (AI) and the implementation of its tools in financial and accounting systems makes both the processes involved in the implementation itself and the behaviour of accountants and other members of the organisation of interest to researchers. It has been pointed out that the changes that AI brings to accounting information systems are far more significant than all the previous ones (computer software, data clouds) (*The State of AI...*, 2024). The area of technology is therefore also explored in conjunction with the area of ethics. Researchers are interested in both the ethical use of AI (including the question of responsibility for use) and the long-term impact of AI on organisational members. (C. Zhang et al., 2023).

In the area of competence, often in conjunction with the area of reporting, gender is the subject of research. According to researchers, women in the role of CFO are characterised by a propensity to comply with standards and norms, resulting in higher quality and comparability of financial statements than in entities where the role of CFO is held by men. At the same time, studies show that the presence of female CFOs does not have a significant impact on comparability (F. Wang et al., 2023), but is related to the quality of financial statements (Hrazdil et al., 2023). This higher quality is also, for example, evident in reports produced by different-sex CEO/CFO pairs, as opposed to reports of entities led by single-sex CFO/CEO pairs (Hrazdil et al., 2023). According to other studies, the presence of women in senior management translates

into a negative relationship between female directors and a positive narrative tone with stakeholders. The researcher confirm that financial performance and strategic choices can be predicted by the characteristics of senior managers, whilst the findings have important implications for top management, policymakers, regulators and users of financial reporting (Bassyouny et al., 2020).

Studies have also addressed the competences and skills of those employed as accountants, indicating that whereas there is a positive relationship between the level of competences and their growth and firm value (Rubin & Segal, 2019), at the same time others show the lack of specific core competences that are universally required for accounting positions (Uwizemungu et al., 2020).

Some studies also indicate that it is more important for a business entity to have a CFO than a CEO, while German regulations (in contrast to US regulations) prevent board members from making individual decisions (Dauth et al., 2017). The areas of reporting and competence are also covered by research related to the study of managers' behaviour outside the workplace, suggesting that behaviour in private life (e.g. legal violations, low propensity to save) is associated with risks for financial reporting. Chief executive officers (CEOs) and chief financial officers (CFOs) with a so-called 'legal record' are more likely to commit fraud, yet there is no correlation between frugal executives and the propensity to commit it. However, 'non-thrifty' CFOs oversee a relatively lax control environment, characterised by a relatively high and increasing likelihood of others committing fraud and unintentional material reporting errors during their tenure. Moreover, cultural shifts associated with increased fraud risk are more likely among non-fraudulent (compared to frugal) CEOs (Davidson et al., 2012). The CFO theme (still in the area of competence and reporting) also emerges in the context of CFOs sitting on boards. Research findings suggest that the CFO can increase the effectiveness of the board in terms of the quality of the financial statements. Owners should consider whether the benefits associated with the appointment of a CFO to the board outweigh the costs, as the appointment of a CFO to the board may translate into higher financial statement quality (Bedard et al., 2014).

The empirical research carried out by the authors also showed how the strength of corporate culture relates to the comparability of financial statements. Using a sample of US companies and a newly developed measure of corporate culture based on machine learning, it was found that companies with a strong corporate culture (which recognise integrity, innovation, teamwork, respect and quality as norms and values) have less opportunistic managers who make uniform decisions in the face of similar business events, resulting in greater comparability of financial statements. Further analysis suggests that changes in CEOs who lead the company towards a stronger corporate culture positively affect the comparability of financial statements and vice versa (Afzali, 2023).

In the area of competence, the results confirm that the composition of the board of directors influences R&D intensity and the maintenance of R&D expenditure. This intensity increases significantly when the CEO is accompanied by an internal CTO



(chief technology officer). In contrast, the intensity decreases significantly when the CEO is partnered with the CFO, thus a board consisting of only the CEO is associated with higher R&D intensity than a board consisting of both a CEO and a CFO. Therefore, whether the CTO or the CFO accompanies the CEO on the board makes a difference in maintaining R&D spending. For practitioners, including CEOs and directors of high-tech companies, the study reveals that they may benefit from promoting the CTO instead of the CFO as an internal director (Shaikh et al., 2023).

The personality traits of CEOs and CFOs reflecting their ideal or prototypical roles of a visionary leader (i.e. extroversion) and corporate conscientiousness (i.e. conscientiousness) also interact to influence the tendency towards higher or lower leverage levels. Leverage is higher for companies with more extroverted CEOs and lower for those with less extroverted CEOs, but CFO conscientiousness buffers this relationship by encouraging more moderate levels of debt at both levels of CEO extroversion. In other words, more conscientious CFOs reduce leverage when the CEO is highly extroverted and increase leverage when the CEO has low levels of extroversion, balancing CEO bias in each case (Harrison & Malhotra, 2024).

The area of competence also includes a study that extensively explores the perceptual profiles of chief information officers (CIOs) compared to other top executives, namely CFO and CMO (chief marketing officer). The results reveal two critical dimensions that distinguish participants of the study, i.e. the social dimension and the authoritative dimension. CIOs were perceived as less authoritative and less socially competent than CMOs and less authoritative than CFOs. The position of CIOs in these dimensions means that they are perceived as less similar to successful senior managers than either CMOs or CFOs (Gonzalez & Ashworth, 2021b).

Research findings in this area provide empirical evidence as to why companies change their CFOs. The ways in which CFOs are appointed in US companies and their impact on performance were analysed, and the conclusions drawn are as follows.

1. The succession rate of external CFOs is significantly higher than the succession rate of external CEOs.
2. The frequency of retirement for acting CFOs is less frequent compared to top executives.
3. CFO rotation is preceded by negative excess returns.
4. CFO rotation is preceded by a decline in operating profitability from assets in the preceding period.
5. Announcements of a change of CFO are associated with a significant negative share price reaction if the old CFO leaves and is replaced by an internal appointment.
6. The rotation of the CFO is preceded by an abnormally high rotation of the CEO.

Rapid sales growth accompanied by poor operational performance leads companies to hire 'talent' from outside (Mian, 2001).

The technology area includes research showing accountants, managers and regulators practical evidence that the use of artificial intelligence (AI) and bid data (BDA)

is positive and more effective in improving accounting practices in financial reporting, management performance, budgeting, audit evidence and risk and fraud management. As such, accountants, future accountants and accounting graduates should hone their skills in learning and developing BDA and AI predictive models to help the sector. Furthermore, given the shortage of data science and AI jobs in the market, accounting regulators should increase the demand for these competencies. Hence, universities should develop business courses that include BDA and AI. Research also confirms that BDA and AI can benefit various sectors to develop advanced capabilities, providing increased innovation leading to competitive advantage in the business environment. Finally, policymakers and managers can take the opportunity to invest in BDA and AI technologies to help them achieve their ambitious accounting goal. Note that, overall, the impact of AI on accounting practices is greater than that of BDA (Osei-Assibey Bonsu et al., 2023).

Other studies show the impact of using AI for financial reporting decisions and confirm that managers' use of AI undermines their aggressive financial reporting decisions, yet according to these authors, AI cannot plunge us into a world devoid of human control and accountability; human-assisted decisions are more aggressive than AI-assisted decisions. The researchers noted that the degree of aggressiveness of decisions depends on the degree of autonomy of the AI system, believing that this is linked to the diffusion of responsibility. The less autonomous the AI system, the more it depends on the manager, who is less likely to make risky/aggressive decisions for which he or she is responsible (Kipp et al., 2020).

In an era where the pace of change continues to accelerate, behavioural research is a continuing avenue for explaining the likely effects of emerging changes on decision-making by providers, users and evaluators of accounting information, as well as providing ex-ante information for decision-makers. The aim of the research was to identify contemporary changes affecting the accounting environment, discuss the potential impact on individual and organisational decision-making, and explore how behavioural research can be used to investigate these changes. In particular, the discussion focused on the impact of technological change on financial reporting, external auditing and management accounting, given the potential of these changes to radically alter the future of accounting and auditing research (Arnold, 2018).

In the area of reporting it was investigated whether the mandatory adoption of International Financial Reporting Standards (IFRS) is associated with changes in the sensitivity of CEO turnover to accounting performance, and how the impact of IFRS adoption differs between institutions at country level and incentives at company level. The results confirm that CEOs are more responsive to the company's accounting performance after the adoption of the standards. This increase in the sensitivity of turnover to earnings was concentrated in countries with stronger enforcement of financial reporting standards and more pronounced for mandatory adopters with strong firm-level incentives to comply (Wu & I. X. Zhang, 2019).



## 2.2. The Role of Financial Managers in the Context of the Application of Modern Technologies

The role of chief financial officers (CFOs) and finance managers in companies is undergoing a fundamental transformation in the face of increasing digitalisation and the development of new technologies. The traditional perception of these functions as mainly focused on accounting, financial reporting and cost control is being radically altered by technologies such as artificial intelligence, blockchain, big data and the robotisation of business processes. According to Sandner et al. (2020), "the role of the CFO is not considered particularly innovative. For many, its day-to-day work is associated with balance sheets, cash flow analyses and Excel spreadsheets. However, with the advent of blockchain technology, this perception may change and shift this corporate finance function towards a strategic innovation manager". Whilst this transformation presents CFOs with new challenges, it also opens up a number of opportunities for them to strategically influence the development of their organisation in a rapidly changing business environment. On the basis of the research discussed in the previous section of the monograph, the most important aspects of the work of finance managers in the context of digitalisation and the use of modern technology were identified. In order to obtain synthetic conclusions, the studied material was enriched with additional publications that have appeared recently and are cited in the following text.<sup>1</sup>

**1. Impact of technology on financial and accounting processes.** Technological advances are fundamentally changing the way companies conduct their financial and accounting processes. According to Arnold (2018), all aspects of accounting are now shaped by technologies that collect data and support and, in many cases, direct these processes. In some areas, technology completely controls the accounting environment.

One of the key trends is the automation of routine accounting and financial tasks. As indicated by C. Zhang et. al. (2023), artificial intelligence and business process robotics (RPA) are increasingly being used to automate activities such as posting transactions, reconciling accounts and preparing financial reports. This makes it possible to significantly increase the efficiency of finance departments.

At the same time, business analytics based on big data is developing. Another study (Elbashir et al., 2011), showed that business intelligence systems significantly improve the efficiency of business processes and ultimately the overall performance of an organisation. CFOs gain tools for deeper analysis of financial and non-financial data, which supports strategic decision-making.

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<sup>1</sup> The following string in the Scopus database was used to identify additional articles: TITLE-ABS--KEY ("CFO" OR "chief financial officer" OR "financial managers" OR "finance managers" OR "financial management") AND TITLE-ABS-KEY ("digitization" OR "digitalization" OR "digital transformation" OR "technological change") AND TITLE-ABS-KEY ("artificial intelligence" OR "AI" OR "blockchain" OR "machine learning" OR "FinTech" OR "financial technology").

Blockchain is another disruptive technology that, according to Sandner et al. (2020) can radically change the way accounting and auditing is done. This provides an immutable and transparent record of transactions which can increase the reliability of financial data and improve audit processes.

**2. New powers for finance directors.** In the face of these technological changes, CFOs are required to develop new competencies. Arnold (2018) emphasised that CFOs must not only understand modern technologies, but also be able to implement and use them effectively to create value for the organisation.

Skills in data analysis and the use of artificial intelligence are becoming crucial. As suggested by Osei-Assibey Bonsu et al. (2023), CFOs need to be able to interpret complex data sets and draw business-relevant conclusions from them. This requires combining financial knowledge with analytical and technological competencies.

Strategic skills are also growing in importance. CFOs are increasingly involved in shaping the digital transformation strategy of the entire organisation, and need to understand how new technologies can support business innovation and the creation of new revenue streams.

**3. Changes in risk management.** The digitalisation of financial processes brings new challenges in the area of risk management. Arnold et al. (2015) highlighted the growing importance of cyber risks and the need to implement advanced IT risk management systems.

CFOs also need to understand the risks associated with new digital-based business models. This includes, for example, the legal and reputational risks associated with the use of artificial intelligence or blockchain.

At the same time, new technologies give CFOs better tools to identify and measure various risks. Advanced predictive analytics, for example, allow for the earlier detection of potential financial risks.

**4. Impact on reporting and communication with stakeholders.** Digitalisation is also changing the way companies report their performance and communicate with investors or other stakeholders. Arnold (2018a) pointed to the growing importance of continuous, real-time financial reporting made possible by automated accounting systems.

The interactive visualisation of financial data is also developing. According to Tang et al. (2014), interactive financial data presentation tools can improve investors' understanding of information and increase their confidence in decision-making.

New communication channels such as social media are increasingly being used to communicate financial information. Trinkle et al. (2015) showed that investors use these sources when making investment decisions.

**5. Ethical challenges of new technologies.** The use of advanced technology in finance also raises a number of ethical challenges. Z. Zhang and Wang (2023) emphasised issues of data privacy, potential discrimination when using AI algorithms or accountability for decisions made by autonomous systems.

CFOs must take these aspects into account when implementing new technological solutions, necessary to develop principles for the ethical use of AI or big data in financial processes.

Based on global research, key aspects of the impact of modern technology on the work of financial managers can be characterised as follows.

1. Automating routine accounting and finance tasks. Advances in artificial intelligence and machine learning make it possible to automate many time-consuming and repetitive accounting tasks, e.g. data entry, account reconciliation and basic financial analysis. This allows finance professionals to focus on more strategic and valuable tasks. Automation not only increases efficiency but also minimises the risk of human error, thereby improving the accuracy and reliability of financial processes.
2. Development of advanced business analytics based on big data. Big data opens up new opportunities for financial and business analytics. Advanced analytical tools allow huge amounts of data to be processed in real time, enabling a deeper understanding of market trends and customer behaviour. Predictive analytics using big data can help predict future financial performance and identify potential risks, which in turn supports more informed data-driven business decisions.
3. Implementing blockchain to increase transparency and reliability of financial data. Blockchain technology has the potential to revolutionise the way companies manage and share financial data. Due to its distributed nature and the inability to modify records, blockchain can significantly increase the transparency and reliability of financial transactions. This can be particularly useful in audits, supply chain tracking or international financial transactions. Implementing blockchain can also help reduce financial fraud and increase stakeholder trust.
4. The need to develop new technological and analytical competencies. As technology becomes increasingly integrated with finance, there is a growing need for professionals who combine financial knowledge with technological skills. Competences in data analysis, IT programming and IT project management are becoming crucial. Companies need to invest in training and employee development to keep up with the rapidly changing technological environment. At the same time, universities and educational institutions should adapt their curricula to better prepare future professionals for the digital financial world.
5. The growing importance of cyber risk management. With the increasing digitalisation of finance, cyber risk management is becoming a critical aspect of companies' operations. Cyberattacks can lead to serious financial, data and reputational losses. Companies need to invest in advanced security systems, regular security audits and employee cyber training; it is also necessary to develop comprehensive incident response plans to minimise the potential damage in the event of a security breach.
6. Changing modes of financial reporting and communication (continuous reporting, interactive visualisation). Traditional, periodic financial reporting is giving way to more dynamic and interactive forms of communication. Continuous, real-time reporting is becoming more common, enabling faster responses to market changes. Interactive dashboards and advanced data visualisation tools

allow complex financial information to be presented more intuitively and efficiently. These new forms of reporting increase transparency and facilitate decision-making by stakeholders at all levels of the organisation.

7. The growing role of CFOs in shaping companies' digital transformation strategies. Chief financial officers (CFOs) are increasingly becoming key players in the digital transformation of companies. Their role is evolving from traditional financial management to a strategic business partner that uses data and technology to drive growth and innovation. CFOs must be leaders in adopting new technologies, identifying opportunities to optimise processes and using data to create value. Their unique perspective combining finance and technology is essential to successfully lead the company through the digital transformation process.
8. New ethical challenges of using AI and big data in finance. The use of artificial intelligence and big data in finance raises new ethical questions. Issues such as data privacy, potential discrimination in decision-making algorithms and accountability for AI decisions are becoming more pressing. Companies need to develop clear ethical principles regarding the use of these technologies, while ensuring compliance with legal regulations. It is also necessary to educate employees and customers about the ethical aspects of using AI and big data in finance.
9. The ability to better predict business risks and opportunities through advanced analytics. Advanced analytics enable companies to more accurately predict both risks and business opportunities. Predictive models based on machine learning can analyse vast amounts of historical and market data, identifying subtle patterns and trends. This allows companies to better prepare for potential threats, but also to identify and exploit emerging business opportunities more quickly. This ability to act ahead of time can make a significant difference to an organisation's competitive advantage and long-term success.
10. The need to integrate different systems and data sources for a holistic view of a company's finances. In the digital age, companies are often faced with scattered data across different systems and departments. The integration of these disparate data sources becomes crucial in order to obtain a comprehensive and consistent picture of the company's financial situation, which requires not only advanced technological solutions but also a change in organisational culture towards greater collaboration and data sharing. Effective data integration can lead to better risk management, more effective planning and more accurate strategic decisions.

Thus it is clear that technological advances are fundamentally changing the role of CFOs and corporate finance managers. CFOs are evolving from their traditional role as gatekeepers of corporate finance into strategic leaders of digital transformation, actively shaping the future of their organisations. Key findings from global research are as follows:

1. Technologies such as artificial intelligence, blockchain, big data or robotic business processes have the potential to radically transform financial processes, offering new levels of efficiency, transparency and automation.
2. CFOs need to develop new competencies that combine deep financial knowledge with an understanding of technology and the ability to think strategically.
3. Data analytics is becoming a key tool in the CFO's arsenal, enabling more precise and predictive financial management.
4. New technologies are opening the way to innovative business models and forms of financing, which CFOs must be able to use to increase the value of the company.
5. Risk management in the digital age requires a new approach that takes into account cyber threats and risks associated with new business models.
6. Success in the new reality requires the CFO to actively collaborate with other company departments and external partners, including technology providers.
7. Ethical issues related to the use of new technologies in finance are becoming an increasingly important area of responsibility for CFOs.

To sum up, digital transformation challenges finance directors and managers to redefine their role in the organisation. Those who successfully adapt to the new reality will not only be able to manage finance more effectively, but also actively shape the strategy and future of their companies in a rapidly changing business environment. The role of the CFO in the digital age is evolving rapidly, with modern technologies becoming key tools to support financial management. AI, blockchain and big data are enabling process automation, increased security and transparency and better risk management. As a result, CFOs are transforming into digital transformation leaders who not only manage finance, but also implement technology to optimise processes and add value to the organisation. In the future, the ability to manage modern technologies will be crucial to the success of CFOs in a rapidly changing business environment.

### 2.3. Diagnosis and Directions for Further Research

The role of chief financial officers (CFOs) and financial managers in modern companies is multifaceted and dynamic, and the review of the literature on this issue carried out in section one enabled to point out that articles in this area have been published for many years by various research groups, academia and financial management organisations, as well as by consultancies and analyst firms. These publications cover a variety of aspects, from financial management, the application of modern technology, to the role of the CFO in shaping organisational strategies and social responsibility.

The review of the literature on the role of finance directors and managers in contemporary companies has identified four main sub-areas, i.e. competence, technology, reporting, and ethics, which are closely related and complementary.

Most of the analysed articles address more than one issue, but the link between the areas of competence and reporting is clearly dominant. Fifteen articles

examined the issue of the broadly defined competences of finance directors and managers, such as gender, culture, collaboration, role, skills, behaviour, experience, personality traits and psychological characteristics. Nine articles dealt with financial and non-financial reporting, focused mainly on the quality of financial statements, whilst the five included in the literature review in Chapter 1 were concerned with technology, and were complemented by several papers mentioned in Chapter 2 on the most important aspects of the work of financial managers in the context of digitalisation and the use of modern technology. Two articles addressed ethical issues, including those related to the distortion of reports and the use of artificial intelligence in accounting.

The competences of the CFO and financial manager are the foundation of his or her effectiveness in managing a business. Today's CFO not only manages the company's finances, but also plays a key role in strategic decision-making, risk management, and building the value of the company. Due to dynamic changes in the business environment, the role of the CFO has evolved significantly and the required competencies have become more complex and diverse. The sub-area of technology and innovation is an essential tool in financial management, enabling better data analysis and effective decision-making. Financial reporting, in turn, is becoming more comprehensive, encompassing not only traditional financial reports, but also such areas as ESG reporting. Finally, ethics is the linchpin of the CFO, who is responsible for the transparency and accountability of the company to its stakeholders.

Based on the research conducted to date, it is therefore possible to identify a number of key issues regarding the impact of modern technology on the work of finance directors and managers (see Table 2.2).

**Table 2.2. Areas of influence of modern technology on the role of financial managers**

Key research areas	Description	Examples
Automation of financial processes		
Robotic Process Automation (RPA)	The full automation of repetitive financial tasks such as accounting and billing, through the robotisation of business processes, is changing the CFO's responsibilities, shifting their focus from operations to tasks of a strategic nature.	Arnold, 2018; Osei-Assibey Bonsu et al., 2023; Mi, 2024; C. Zhang et al., 2023
AI in financial analysis	The automation of financial data analysis by artificial intelligence reduces the risk of human error and speeds up the decision-making process, which can change the role of CFOs in an organisation and support them in more complex strategic analyses.	Arnold, 2018; Bisht et al., 2022; Liu & Li, 2025; Sandner et al., 2020
Data analysis and prediction		
Big data	The use of big data analytics to identify hidden patterns and trends in the market environment enhances the CFO's predictive capabilities, although it requires sophisticated infrastructure and high analytical competence.	Arnold et al., 2015; Liu & Li, 2024; Mi, 2024; Sun, 2024; C. Zhang et al., 2023

Key research areas	Description	Examples
Predictive analytics	The use of predictive analytics in financial management enhances the CFO's ability to forecast financial performance and manage risk, which can improve an organisation's financial flexibility, but also raises challenges in terms of predictive accuracy.	Arnold et al., 2015; Bisht et al., 2022; Osei-Assibey Bonsu et al., 2023; C. Zhang et al., 2023; Z. Zhang & Wang, 2023
Data security and cyber risk		
Blockchain	The introduction of blockchain in finance enables transactions to be stored and monitored securely, preventing manipulation and fraud, but requires CFOs to adapt to new security standards and work with IT departments.	Arnold et al., 2015; Liu & Li, 2024; Mi, 2024; Sun, 2024; C. Zhang et al., 2023; Z. Zhang & Wang, 2023
Privacy protection	Advanced financial data management privacy systems minimise the risk of cyberattacks, although their effectiveness is dependent on the regulatory compliance and technological infrastructure of the organisation.	Arnold, 2018; Bisht et al., 2022; Mi, 2024; Osei-Assibey Bonsu et al., 2023; Sun, 2024; Z. Zhang & Wang, 2023
Financial risk management		
Early detection	The use of predictive analytics allows for early detection of financial risks, which strengthens preventive action and financial stability, but requires advanced analytical skills and adaptation in risk management.	Arnold, 2018; Liu & Li, 2024; Osei-Assibey Bonsu et al., 2023; Sandner et al., 2020; Zhang et al., 2023; Z. Zhang & Wang, 2023
Optimisation of investment decisions	Advanced risk analysis allows for more informed investment decisions tailored to market dynamics, but requires an appropriate analytical infrastructure and involves limitations due to data uncertainty.	Arnold, 2018; Bisht et al., 2022; Mi, 2024; Sun, 2024; Zhang et al., 2023; Z. Zhang & Wang, 2023
Transparency and reliability of financial statements		
Real-time reporting	Implementing tools that enable real-time financial reporting promotes transparency and enables ongoing financial control, but requires investment in IT infrastructure and the adoption of new working standards.	Arnold, 2018; Mi, 2024; Sandner et al., 2020; Sun, 2024; C. Zhang et al., 2023; Z. Zhang & Wang, 2023
Reducing fraud	Implementing blockchain to monitor transactions reduces the potential for financial fraud and allows for better control over accounting records, although it can be challenging in terms of implementation and regulatory compliance.	Arnold et al., 2015; Mi, 2024; Osei-Assibey Bonsu et al., 2023; Sun, 2024; C. Zhang et al., 2023; Z. Zhang & Wang, 2023
Development of technological competence		
Training in data analysis	Acquiring CFOs' data analytics skills requires investment in training and adaptation to new roles, where CFOs are also becoming leaders of digital transformation, which affects the strategic nature of their work.	Arnold, 2018; Mi, 2024; Osei-Assibey Bonsu et al., 2023; Sun, 2024; C. Zhang et al., 2023; Z. Zhang & Wang, 2023
Integration of IT technology	Integrating advanced technology into financial processes enables more efficient management of an organisation's resources, but requires the CFO to have advanced technological knowledge and to work closely with IT departments.	Arnold et al., 2015; Liu & Li, 2024; Osei-Assibey Bonsu et al., 2023; Sandner et al., 2020; Sun, 2024
Ethical aspects of technology use		
Data privacy	The introduction of advanced technologies such as AI raises ethical dilemmas around the privacy of financial data and requires CFOs to ensure compliance with regulations and ethical guidelines.	Arnold et al., 2015; Bisht et al., 2022; Mi, 2024; Sun, 2024; C. Zhang et al., 2023; Z. Zhang & Wang, 2023
Problems of dehumanisation	The automation of decision-making processes through AI poses moral dilemmas, such as the reduction of human responsibility for financial decisions and the risk of dehumanising the process, which requires consideration of ethical decision-making frameworks.	Arnold, 2018; Bisht et al., 2022; Liu & Li, 2024; Sun, 2024; C. Zhang et al., 2023; Z. Zhang & Wang, 2023

Source: own elaboration.



Table 2.2 outlines the key areas where modern technology is impacting the work of finance managers, highlighting both the benefits and challenges of implementation. The analysis covers financial process automation, data analytics, risk management, data security, technological competence development and ethical aspects, among others, which are broken down into specific detailed issues that shed light on the evolution of the CFO function in the context of increasing digitalisation and technological advances.

**Automating financial processes** through technologies such as Robotic Process Automation (RPA) and Artificial Intelligence (AI) not only speeds up financial processes, but also minimises the risk of human error. RPA allows for the automation of routine tasks, whilst AI enables deeper financial analysis, which changes the role of the CFO from operational to more strategic. However, automation presents challenges in terms of integration with existing systems and requires high quality input data to avoid potential decision-making errors.

With big data and predictive analytics, CFOs can identify patterns and predict future financial performance. This enables managers to react faster to market changes and optimise resource allocation. However, the use of big data comes with technological challenges, such as the need to develop advanced infrastructure and acquire analytical competences that are not always standard in finance departments.

**Data security and cyber risk** are becoming key areas of focus as blockchain technology and privacy protocols are implemented. Blockchain enables the creation of immutable records of transactions, increasing transparency and resistance to manipulation. However, the full implementation of blockchain can come at a high cost and requires close collaboration between CFOs and IT departments. At the same time, advanced privacy systems protect against cyber threats, but their effectiveness is dependent on an organisation's level of technological and regulatory compliance.

**Managing financial risk** through early detection of risks and optimisation of investment decisions is a significant benefit for CFOs, enabling them to take a proactive approach to potential risks. Predictive analytics allows not only for minimising losses, but also for adapting investment activities to dynamic market conditions. However, the reliability of the predictions relies on the quality of the data and the appropriateness of the algorithms used, which is a potential limitation.

**Transparency and credibility of financial reports** are improved by the implementation of real-time reporting and blockchain technology. Transparent reporting allows for the real-time monitoring of performance, which increases stakeholder confidence. Blockchain additionally enables fraud reduction due to the immutability of recorded data. However, the effective implementation of reporting and blockchain comes with costs and the need to adapt the organisational structure to the new standards.

**The development of technological competences** is crucial in the context of the increasing demands for digital transformation in finance. CFOs need to acquire new skills in data analytics and IT management to effectively integrate advanced tools into financial processes. These competences add strategic value to the CFO, but their



development requires investment in training and close collaboration with other departments in the organisation, especially IT.

**Ethical aspects of the use of technology** in finance, such as data privacy and issues of AI dehumanising decision-making, are increasingly challenging. These technologies require rethinking ethical decision-making frameworks to ensure protection of clients' interests and compliance with regulations. CFOs face the dilemma of how to balance operational efficiency and social responsibility in the context of advanced analytics tools.

To sum up, Table 2.2 shows the multi-faceted impact of digitalisation on the role of the CFO. While these technologies support increased efficiency and transparency, they also come with technological, organisational and ethical challenges. As organisations accelerate their digital initiatives, CFOs must not only adapt their competences, but also make strategic decisions that balance the benefits of new technologies with risk and social responsibility.

The evolution of the role of financial managers (CFOs) in response to increasing digitalisation and the development of modern technology is one of the most important challenges in the management of modern organisations. With the growing importance of technology, the role of the CFO is transforming, requiring new competences, adaptation to the changing environment and the implementation of modern methods and tools.

On the basis of the evaluation of existing research and the characteristics of the areas identified in Table 2.1 concerning the impact of modern technology on the work of finance directors and managers, planned research directions in this area were set.

Table 2.3 presents three strategic directions for future research on the evolving role of financial managers (CFOs) in the face of increasing digitalisation and the development of modern technology, together with research questions and suggested methodology that help to deepen understanding of the impact of automation, digital risk management and ethical challenges. The research directions identified reflect key challenges and developments that are likely to significantly affect the tasks and competences required of today's financial managers.

**Table 2.3. Planned research directions on the role of financial managers**

Direction of research	Research questions	Suggested testing methodology
The impact of automation on the role of financial managers	<ul style="list-style-type: none"> <li>How is the automation of financial processes transforming the competencies required of financial managers?</li> <li>Does automation limit the CFO's ability to interact with other departments and make decisions based on intuition and experience?</li> <li>What are the long-term effects of financial automation on organisational structures and CFO responsibilities?</li> </ul>	<p>Mixed methodology (quantitative and qualitative):</p> <ul style="list-style-type: none"> <li>Survey of CFOs in companies at different levels of financial process automation (RPA, AI).</li> <li>Long-term (longitudinal) analysis – examining changes in CFO tasks as more automation technologies are implemented.</li> <li>In-depth interviews with financial managers in different sectors to explore the impact of automation on their day-to-day responsibilities and decision-making.</li> </ul>

Direction of research	Research questions	Suggested testing methodology
The role of financial managers in digital risk management	<ul style="list-style-type: none"> <li>How do CFOs manage the financial risks associated with storing and processing large data sets in the cloud?</li> <li>How are financial managers responding to the increased reliance on blockchain technology and its impact on the control of financial flows?</li> <li>Is the CFO's technological competence sufficient to proactively manage digital risk, or are new roles or collaboration with other departments required?</li> </ul>	<p>Qualitative and quantitative methodology:</p> <ul style="list-style-type: none"> <li>Survey on the level of adaptation and digital risk management strategies among CFOs.</li> <li>A case study of companies with high levels of integration with blockchain and cloud technologies.</li> <li>Interviews with cybersecurity experts and CFOs to assess whether current financial competencies are adequate to manage digital risks.</li> <li>A comparative analysis of different digital risk management strategies in organisations with varying degrees of digitalisation.</li> </ul>
Ethical challenges of automating financial decisions	<ul style="list-style-type: none"> <li>What are the ethical boundaries in using AI in financial decision-making, especially in areas such as predictive analytics and risk management?</li> <li>To what extent does the automation of decision-making processes change the moral and legal responsibility of CFOs for their decisions?</li> <li>What ethical and regulatory principles should be implemented to ensure responsible management of financial data and customer privacy?</li> <li>What are the possible effects of dehumanising financial decisions on team morale and organisational culture?</li> </ul>	<p>Qualitative methodology:</p> <ul style="list-style-type: none"> <li>Ethnographic research in organisations implementing AI in decision-making processes to observe changes in organisational culture and responsibility for decisions.</li> <li>Interviews with financial managers and business ethics experts to assess their attitudes towards dehumanisation and accountability for AI decisions.</li> <li>Analysis of regulatory documents and industry reports to determine the current state of guidelines and propose possible regulations.</li> <li>A case study of companies using AI in decision-making, including an analysis of incidents involving potential breaches of ethics or privacy.</li> </ul>

Source: own elaboration.

**The first line of research** on the impact of automation on the role of the CFO highlights the increasing reliance on technologies such as Robotic Process Automation (RPA) and artificial intelligence (AI) that are transforming the operational tasks of CFOs, enabling them to focus on strategic activities. The research questions focused on how these changes affect the competences of finance managers and the way they interact with other departments, suggesting the need for quantitative and qualitative research and long-term analysis in order to reveal the deep structural effects of automation.

**The second line of research** explores the role of CFOs in digital risk management, stressing that new technologies such as blockchain and cloud storage bring unique data security challenges. The research questions identified the need for further analysis on whether the current competences of financial managers are adequate for managing digital financial risk. The suggested methodology is based on a mixed-methods approach – both qualitative and quantitative – that will provide an understanding of the different strategies used by organisations and their effectiveness in minimising risk.

**The third line of research** concerns the ethical challenges arising from the automation of financial decisions. This becomes particularly relevant when financial risk

decisions are made using AI, which can lead to the dehumanisation of decision-making processes and a shift in the moral and legal responsibilities of the CFO. The research questions in this section focused on ethical boundaries, accountability and the implications of automation for organisational culture and team morale. In this case, qualitative methods such as interviews and ethnographic research are particularly recommended for an in-depth analysis of attitudes and cultural changes resulting from the implementation of AI in financial processes.

To conclude, Table 2.3 forms the basis for future research that not only provides a better understanding of the transformation of the CFO role, but also points to the need to adapt research methodologies to the increasingly complex interactions between technology, accountability and ethics in financial management.

#### **2.4. Ethical Dilemmas Regarding the Role of Financial Managers in the Context of Modern Technology**

Professional accounting groups are particularly sensitive to ethical issues related to the performance of their professional duties. For example, according to the International Code of Ethics for Professional Accountants, there are five basic ethical principles to which every professional accountant must adhere, namely integrity, objectivity, professional competence and due diligence, confidentiality and professional conduct, whilst the core ethical principles named by the Institute of Management Accountants (IMA) comprise honesty, integrity, objectivity and accountability.

The use of AI by financial managers, accountants, and auditors as suggested in (Munoko et al., 2020), has a number of benefits, but can also have unintended consequences. As Alles (2020) pointed out, when there is a conflict between the decisions made by those influenced by technology and the actions required by a code of conduct or other standards, ethical risks arise.

Given that these professional groups are particularly sensitive to issues of professional ethics, according to C. Zhang et al. (2023), too little attention has been paid so far to the ethical implications of using modern technology in accounting (C. Zhang, 2023). At the same time, based on a 2023 survey of a sample of 595 respondents (*The State of AI...*, 2024), 49% of the accountants surveyed were concerned about the dilemmas and biases associated with the use of artificial intelligence. Accountants struggle with the challenges of balancing technological advances with the ethical standards of their profession and ensuring the responsible use of artificial intelligence (Ajayi-Nifise et al., 2024).

The increasing integration of automation and artificial intelligence in accounting raises a myriad of ethical issues that require special discussion (Hasan, 2022). The ethical dilemma is a form of an alternative or difficult choice – the intelligence of a human, a professional versus artificial intelligence. In the case of financial managers and accountants, the dilemmas related to the application of artificial intelligence in accounting are not related to the choice between good and bad, but to solving the

problem of using AI or other modern technologies in such a way that professional ethics are not violated.

Based on the research of many authors, it was found that ethical problems related to technological advances (including, above all, the use of artificial intelligence), are currently one of the most important research directions in the field of accounting, and one of the most complete synthetic summaries of ethical dilemmas to date was presented by Z. Zhang and Wang (2023), whose results were collected on the basis of qualitative research (47 interviews), in which the respondents described specific situations and presented their point of view.

Ethical dilemmas arise, first and foremost, from the opacity of AI algorithms and the biases exhibited by these algorithms, which may lead to unfair results (Ajayi-Nifise et al., 2024), that may, accountants feel, violate the principle of objectivity. Other authors (Ajayi-Nifise et al., 2024; C. Zhang et al., 2023) also highlighted issues of privacy and accountability for decisions made by autonomous systems. The principle of confidentiality and professional conduct requires that confidential client data be covered and that secure data processing be ensured. In order to maintain the principle of professional conduct, it seems necessary to retain scepticism in interpreting results and analysing judgements generated by AI (upholding professional accountant judgement). Professional competence, as an ethical principle, nowadays requires the expansion of professional competence and skills also (or perhaps especially) in the field of technology. Accountants are also concerned about the potential for AI to undermine human interactions and relationships (*The State of AI...*, 2024). The main, and most frequently identified ethical dilemmas for financial managers related to technological advances are presented in Table 2.4.

**Table 2.4. Basic ethical dilemmas of financial managers related to technological advances**

Key ethical dilemmas	Description	Ethical question/problem	Examples of solutions
Transparency and reliability of financial data	Modern technology enables more sophisticated data analysis, but there is a risk of manipulation of financial results or forecasting models. Ethical concerns arise when automation and artificial intelligence affect the transparency and reliability of financial data. Financial managers must therefore ensure that automated processes do not compromise the quality of financial data.	How to ensure the transparency and reliability of the financial data presented, while protecting trade secrets and competitive advantage?	<ul style="list-style-type: none"> <li>• Implement standardised reporting methods to ensure uniformity and facilitate comparison of financial data.</li> <li>• Identify the scope of confidential information that does not need to be disclosed in reports.</li> <li>• Implementing blockchain technology to verify the authenticity and integrity of data, which increases its credibility.</li> <li>• Defining levels of access to information – e.g. detailed data for regulators and auditors, aggregated information for investors.</li> <li>• Regular audits by recognised auditing firms to increase confidence in the data presented.</li> </ul>

Key ethical dilemmas	Description	Ethical question/problem	Examples of solutions
Accountability for decisions taken by AI	Automating financial decisions with AI can lead to situations where it is difficult to determine who is responsible for mistakes or unethical actions. With automation and artificial intelligence taking over routine tasks, accountants need to protect their professional judgement. Ethical issues arise when they rely solely on automated processes, potentially reducing the importance of human expertise.	How to address the accountability of financial managers for AI decisions?	<ul style="list-style-type: none"> <li>• Striking a balance between technology and human judgement, based on expertise, and applying professional scepticism to the results generated by AI.</li> <li>• Introduce detailed frameworks and regulations defining responsibilities at different levels of the company.</li> <li>• Training financial managers in AI operations and high-tech risk management.</li> <li>• Implement independent audits of the algorithms to assess their compliance with company objectives and regulations.</li> <li>• Application of human-in-the-loop principles, stating that key decisions made by AI must be approved by a human.</li> </ul>
Data privacy and security	Financial managers need to advocate for privacy policies, ensuring the security of customer and company data. The integration of automation and artificial intelligence introduces new risk areas for cybersecurity. Financial managers are therefore responsible for securing systems against breaches, protecting financial data from unauthorised access.	How to ensure data privacy and security?	<ul style="list-style-type: none"> <li>• Transparent communication with customers about data use and protection.</li> <li>• Implement appropriate data protection and cybersecurity measures, adhering to ethical standards and the legal framework governing customer data.</li> <li>• Use of data anonymisation tools to protect confidential information during analysis.</li> <li>• Implement a Federated Learning method to test AI models on local data without the need to send it to central servers.</li> </ul>
Algorithmic discrimination	Ethical concerns arise from the opacity of artificial intelligence algorithms and arise when AI systems exhibit biases, leading to unfair results. Finance managers must advocate for transparent AI systems, providing insight into how algorithms arrive at conclusions. This is because transparent algorithms increase accountability by allowing the results generated by AI systems to be understood, interpreted and validated.	How do we ensure that artificial intelligence algorithms are fair and inclusive?	<ul style="list-style-type: none"> <li>• Implement guidelines and measures to identify and mitigate biases in AI algorithms.</li> <li>• Proactively engage with finance managers to address bias, ensuring that automated processes treat all stakeholders fairly.</li> <li>• Introducing simulation tests and independent reviews of AI algorithms.</li> <li>• Use data anonymisation techniques to eliminate information that may lead to discrimination.</li> <li>• Introduce mechanisms to optimise results towards greater equality (e.g. 'fairness-aware' algorithms).</li> </ul>

Source: own elaboration.

Based on a study of the ethical implications of the use of AI in the accounting systems of multinational corporations, the introduction of ethical review committees (councils)

has been suggested to analyse and assess the ethical implications of solutions proposed by artificial intelligence before they are applied, as well as the implementation of training programmes on the responsible use of AI (Bani Ahmad, 2024).

However, the use of AI to analyse data to make work easier and quicker seems to struggle with concerns about security, privacy and misuse of data, and accountants' negative attitudes towards AI may result in incomplete information being passed on to programmers, resulting in erroneous results. The researchers also found, based on interviews, that after using AI some people lower their expectations towards it, and that human intervention and professional judgement are still necessary to use the new technology. Over-reliance on AI may weaken the professional judgement of accountants.

Nevertheless, users doubt the capabilities of artificial intelligence and fear that theoretical artificial intelligence models may encounter problems when analysing real data and dealing with complex scenarios. Due to inaccurate input of data or models, or misinterpretation of results by accountants for their own benefit, results may be distorted. Another problem is the reluctance to use artificial intelligence due to outdated knowledge and education difficulties in understanding advanced algorithms and unfamiliarity with basic IT functions. Some employees are also not well prepared to use artificial intelligence from a psychological point of view. Indeed, artificial intelligence poses new demands and challenges for accountants (for example, in relation to completing knowledge and acquiring new, necessary competences). The inaccessibility of artificial intelligence systems and data makes it difficult for users to have the autonomy to choose whether, when and how to use artificial intelligence.

The indicated ethical dilemmas that arise today in the work of financial managers and accountants are not a 'closed list'. The current codes of ethics and the so-called ethical dilemma banks should be expanded in the future with descriptions of further cases (situations) so that it is possible to educate staff by analysing cases from professional practice. It seems clear, therefore, that it is a priority to support financial managers and other professional groups in the accounting area in solving ethical dilemmas related to the use of modern technology

This section discusses in detail the ethical challenges of integrating modern technologies, in particular artificial intelligence (AI), into the field of accounting and financial management. These considerations are based on an analysis of the impact of technology on the fundamental principles of professional ethics, including data transparency, accountability for decisions, privacy and the potential risk of algorithmic discrimination.

The identified dilemmas point to the need to balance technological advances with maintaining high ethical standards in accounting. Technologies such as AI enable significant improvements in the efficiency of financial processes, whilst at the same time they also raise a number of issues related to the transparency of algorithms, accountability for automated decisions and data protection.

Research shows that technology cannot completely replace human judgement, and that the professionalism of financial managers requires their active involvement in

overseeing the results generated by AI. It is also important to stress that AI is not neutral – algorithms can introduce biases that negatively impact the fairness of decisions, hence it is crucial to put in place systems that ensure transparency and fairness in algorithmic decision-making processes.

A further challenge is the accountability of decisions made by autonomous systems, particularly in the context of the opacity of AI algorithms, which can generate results that are difficult to verify. In order to minimise the risk it is essential to create clear regulations and auditing mechanisms to reliably assess the results produced by AI systems.

Data confidentiality and security in the context of data processing by artificial intelligence systems is another aspect that requires special attention. Financial managers must strive to ensure the full protection of their customers' and organisations' data, which can be achieved through advanced data protection methods such as anonymisation and Federated Learning technologies.

These issues constitute a rapidly developing area of research that requires ongoing updates to codes of ethics and industry regulations, particularly in the context of the increasing role of technology in accounting and financial management. It is necessary not only to regulate legal liability, but also to undertake educational activities that will prepare professionals for the responsible use of AI.

## Chapter 3

### Audit, Control, Regulation

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### 3.1. Audit, Control, Regulation – Overview of the Research

Audit, control and regulation are the cornerstones of ensuring transparency and credibility of financial statements in a rapidly changing business environment. In the context of the digital transformation of organisations, these areas are experiencing a significant evolution, resulting from the integration of advanced technologies such as blockchain, big data and artificial intelligence. Modern technologies are not only influencing the increased efficiency and precision of audit processes, but also opening up new challenges related to their regulation and ethics.

Table 3.1 provides an overview of the most important academic publications on audit, control and regulation issues in the digital age. The studies presented in the overview illustrate the diversity of methodological approaches, such as empirical analysis, theoretical modelling or case studies. The authors carried out an analysis of the key challenges and opportunities arising from the use of technology in auditing,



such as increasing the transparency of financial data, automating control processes or reducing the risk of human error.

The table also indicates the interdisciplinary nature of the research, which takes into account technological as well as regulatory and ethical aspects. The compilation of publications makes it possible to identify key research trends, such as the impact of blockchain on audit processes, the role of advanced analytical tools in financial control and the need to harmonise global regulations in an era of digital transformation.

**Table 3.1. Summary of publications for the area “Audit, control, regulation”**

Paper	Test sample	Research method	Results/conclusions	Quoted
Maksymov et al., 2023	Survey of 145 chief accountants and interviews with 35 chief accountants at large US public companies	Theoretical model (data collection technique: questionnaire and interviews)	Examine the developed theoretical model of the internal control over financial reporting (ICFR) process from a management perspective. The study indicates that executives feel limited in their ability to direct ICFR and maintain a perspective that reflects these limitations. In particular, the majority of executives feel obliged by auditors to adhere to the preferences of the PCAOB (Public Company Accounting Oversight Board), although executives feel that these preferences often distract management and auditors from riskier areas, additionally indicating that audit committees' involvement in ICFR is too passive and auditor assessments are sometimes too harsh, leading executives to put pressure on auditors.	1
Li et al., 2023	Sample: 579 Chinese listed manufacturing companies in 2020	Empirical methods – logistic regression model	Developing textual indicators for detecting financial fraud. Textual information can complement the effectiveness of indicators in identifying financial fraud, reducing information asymmetry and extending stakeholder theory.	3
Chiu et al., 2023	Sample: 46739 quarterly company data from 2004 to 2020	Regression analysis and other statistical methods	To investigate the usefulness of a new model for detecting misstatements in financial reports and to assess its usefulness for the auditor. The model includes 'big data' extracted from Google. It is demonstrated that the model can serve as a tool to determine the financial position of an entity, which can help auditors to assess the risk of revenue distortion.	2
Sharpe et al., 2023	Financial Analysis Made Easy (FAME) database. Sample: 72227 observations covering 62821 private firms and 9406 are public firms.	Probit model for hypothesis testing	An analysis of the role of auditor selection (Big 4/Non-Big 4) in the debt financing of private and public firms. Private firms have less access to debt than public firms, and Big 4 auditors support debt raising in both private and public firms. Private firms face greater information asymmetry, in turn Big Four auditors are more important for raising debt in private firms than in public firms. The benefits of appointing Big Four auditors to private firm debt raising are greater in the opaque information environment of the global financial crisis and when firms are smaller, younger or have poorer quality financial reporting.	0

Paper	Test sample	Research method	Results/conclusions	Quoted
Maksymov et al., 2023	Sample: 462 questionnaires, 24 interviews among: partners in audit companies, CFOs, audit committee members	Survey, interview	Material errors are identified in approximately 9% of surveys of listed companies and 15% of surveys of unlisted companies. More relevant to the identification of material errors are breaches of contractual conventions and going concern issues than reference to profit (revenue) levels. Identification of various factors that increase audit effectiveness risk (both on the part of the auditor and the company).	2
Estep et al., 2023	Survey with a sample of 43 finance directors; experiment with a sample of 115 finance directors	Questionnaire – experimental method	Investigate whether the use of AI increases the level of auditor adjustments for complex estimates by directors. 1. managers have positive expectations about the use of AI in their companies, worse about the use of AI by auditors 2. the use of AI influences managers' willingness to adjust the fair value of a patent 3. audit evidence supported by AI is more accurate only if the firm also uses AI 4. firms using AI are more open to the use of AI by auditors.	4
Aboud & Robinson, 2022	Sample: 73 Irish companies	Survey	Investigating the effectiveness of fraud prevention and detection techniques, including data analytics, machine learning and data mining, and understanding how widespread the use of data analytics is across sectors, and identifying and understanding potential barriers to implementing these techniques to detect and prevent fraud. The study suggests that there are barriers that may prevent businesses from implementing advanced data analytics to detect financial statement fraud, and indicates how these barriers can be overcome.	15
Austin et al., 2021	No data	Interviews with managers – interpreting the results on the ground of theory	Investigating how auditors, managers and regulators interact with data analysts in the area of financial reporting according to their contribution to the study reveals three areas of conflict on the background of different preferences for data analytics: diagnosing tension between auditors and management on the subject of data. The auditors claim that they use data analytics strategically to increase the knowledge of managers about the business, which according to the regulators may interfere with the independence of the auditors.	42
McCallig et al., 2019	No data	AIS model	The study indicates how developed techniques from IT disciplines could emulate and enhance the audit process (for receivables only). The study is exploratory in nature, generating design ideas applicable to building an AIS for receivables.	73
Abbott et al., 2016	Surveys, a sample of 189 chief internal auditors from Fortune 1000 companies in 2009	The two-factor internal audit quality model	Development of an interactive internal audit quality model. The research supports the hypothesis that the combined presence of competence and independence is a necessary condition for effective monitoring of financial reporting by internal audit. There is an impact of internal audit competence (independence) on the quality of financial reporting, and this depends on the independence (competence) of the internal auditor.	167

Paper	Test sample	Research method	Results/conclusions	Quoted
Troshani et al., 2015	Sample: 21 interviews	Qualitative analysis (interviews)	An examination of the process of XBRL implementation from an institutional perspective in the UK. The results describe how the collaboration between regulators and information stakeholders in the UK on the implementation of XBRL has progressed.	25
Hennes et al., 2014	Sample: 2705 restatements that were announced between January 1997 and June 2006 and 5061 restatements that were announced between January 2006 and 2010	Statistical regression method – logistic regression	The research indicates that auditors are more likely to be dismissed in the case of major transformations, particularly the dismissal of non-Big Four auditors rather than Big Four auditors. Among corporations with Big Four auditors, those that are larger and more operationally complex are less likely to dismiss their auditors. The market reaction to dismissal is much more positive in the case of rigorous, more serious financial restatements. This positive market reaction is consistent with companies restoring credibility to financial reporting by replacing their auditors, and highlights the important role that auditors play in financial markets (paid access).	142
Glancy & Yadav, 2011	No data	Quantitative methods for text research	Proposing a model to detect fraud in financial reporting (CFDM) using a quantitative approach to textual data, the use of an analytical method offers the potential for automation. The method has been tested on Management Reports and Analytics from 10-K reports and has been able to distinguish fraudulent reports from those that did not contain fraud. CFDM can serve as a screening tool in the event of suspected fraud.	128
Hennes et al., 2008	No data	No data	The authors proposed a procedure for classifying restatements as errors or irregularities and showed that the majority of restatements classified as irregularities are followed by class action lawsuits related to fraud, while in the group of restatements classified as errors, only one lawsuit was reported.	537
Fisher, 2007	No data	Application prototype	Presentation of a prototype system to support the temporal reconstruction of financial accounting standards (paid access).	6
Sunder, 2005	No data	No data	To present the reasons why formal standards and enforcement, with their obvious advantages, do not necessarily dominate social norms in financial reporting. To show how financial reporting has moved from being guided by social norms and conventions to being dominated by formalised rules and enforced standards.	49

Source: own elaboration on the basis of a review.

All financial and economic phenomena occurring in the economy should be regulated. The introduction of legal norms ensures the security of economic turnover and also protects the stakeholders of financial statements. Within the framework of the conducted verification of the content of publications, selected according to the applied research methodology, four areas can be distinguished concerning:

- data analysis (datasets),
- fraud detection (control aspects),
- financial reporting,
- internal control over financial reporting (ICFR) processes (control procedures).

Based on the review of the literature, it was possible to identify a publication that develops a model for detecting false information in annual reports of US companies (SEC) (Glancy & Yadav, 2011). The model proposed by these authors aimed to identify attempts to hide information or present incorrect information using textual data from annual filings with the US Securities and Exchange Commission (SEC). The article stresses the importance of automating the detection of potential fraud by using a proper fraud detection model. Using essentially all of the information contained in the reports submitted by companies, the model proposed by the authors provides decision support for early fraud detection and can also serve as a deterrent and countermeasure against fraudulent actions by companies (Glancy & Yadav, 2011).

Errors in reporting and communicating with stakeholders can vary in nature. Hennes et al (2008) pointed out the need to distinguish between errors (unintentional misstatements) and misstatements (intentional misstatements and fraud) when examining financial data restatements in the GAO (General Accounting Office) database. The authors also analysed the impact of errors and fraud on CEO/CFO turnover, and by distinguishing between errors and misstatements, they indicated that the study of the consequences of financial data restatements can be strengthened by examining market reactions to CFO and CEO changes. The authors also suggested focusing on short time windows related to director turnover and controlling for other market and non-market factors that may cause CFO and CEO turnover (Hennes et al., 2008).

Investigating how the use of Google's search engine can be applied as a novel big data analytical approach to detect irregularities in companies' revenue reporting, the authors suggested the high potential of Google Trends data, in particular the search volume index (SVI) for company products, as a source of external information that auditors can use to assess revenue fraud risk (Chiu et al., 2023). Discrepancies between sales growth resulting from SVI changes associated with company products and reported sales growth can be analysed. The study by Chiu et al. (2023) stressed the importance of using external information sources, such as Google searches, to improve audit quality and detect financial reporting irregularities. Working on large data sets, machine learning can be used in the prevention and detection of fraud in financial reporting, however there are barriers associated with the use of advanced data analysis techniques. Chiu et al. (2023) pointed to the technological barriers (use of research tools that have not yet been sufficiently tested), financial barriers (cost of acquiring research tools), and personnel barriers (lack of qualified staff).

Technological developments make it possible to analyse the reports published by companies and, on this basis, attempt to identify attempts at fraud in financial data. Analysis of the texts of information prepared by the boards of Chinese manufacturing companies indicates the importance of multiple dimensions of linguistic features, such

as structure, quality and expression, in identifying financial fraud (Li et al., 2023). The authors combined textual indicators with financial indicators to improve the accuracy of financial fraud detection, hence these measures can reduce information asymmetry and have a positive impact on the market. In addition, the authors highlighted that fraudulent companies tend to exhibit certain characteristics in their linguistic expression, such as being overly cautious, using fewer positive words and increasing the complexity of annual reports to hide financial fraud (Li et al., 2023).

The formalisation of financial and, more recently non-financial reporting regulations, have been ongoing for many years. The transformation from social norms to formalised standards and legislation has far-reaching consequences for accounting and corporate management (Sunder, 2005). One of the manifestations of formalisation in the area of company reporting is the introduction of XBRL. The process of implementing the XBRL format has been multifaceted and involved interactions between different organisations, including regulators (Troshani et al., 2015). The authors explored how regulators played a key role in enhancing the reliability of financial information. XBRL requires an interplay between the institutional and technical environment. Another tool to ensure the credibility of financial information is blockchain technology. The goal of combining multilateral safeguards and blockchain is to ensure that financial reporting information is error-free, complete, neutral, transparent and credible to stakeholders (McCallig et al., 2019).

Another area related to regulation is internal control. Abbott et al. (2016b) developed a model related to the examination of internal audit in the financial reporting monitoring process. The authors emphasised the importance of both the competence and independence of internal audit for effective monitoring of financial reporting (Abbott et al., 2016).

Regulating the accounting environment involves not only the implementation of standards, but also the testing of compliance with accounting rules, including the audit process. Austin et al. (2021) showed how interactions between auditors, managers, regulation and technology influence conflicting preferences among stakeholders, and indicated that the main differences include disagreements about audit fees, concerns about auditor independence and the quality of the audit process, and the lack of specific accounting regulations to provide detailed data for analysis (Austin et al., 2021). The effectiveness of auditors' controls also depends on the relationship with management to eliminate misstatements in the financial statements (Maksymov et al., 2024). This means that not only can one rely on technological tools to assess misstatements, but behavioural aspects also play an important role. According to Maksymov et al. (2023), managers may feel compelled to accept the preferences of auditors. The authors presented a model that considers the key factors that shape and constrain management's efforts to develop and maintain an effective internal control process, including ICFR guidelines, the governance triad (management, auditors and audit committees) and key business conditions (Maksymov et al., 2023). Auditor selection is an important factor in ensuring transparency of financial data and has implications

for the operation of the business, in terms of reducing information asymmetries as well as raising capital (Sharpe et al., 2023).

Year on year, the use of artificial intelligence in the conduct of business, including in the area of reporting and auditing, is becoming more and more popular. Estep et al. (2023) studied the reaction of finance directors to the use of artificial intelligence in financial reporting and auditing. The results of the study revealed that although managers are open to the use of artificial intelligence in their companies and by auditors, there are differences in their expectations. The study also examined how artificial intelligence can affect the quality of financial reporting, the audit process, audit costs, audit duration and the time and effort of company personnel involved in the audit process (Estep et al., 2023). This means that technological innovations are encroaching both on the production process, making it more competitive, as well as on the management of the business unit itself.

On the basis of this literature analysis, additional research questions can be formulated: How do the conflicting expectations and preferences of different stakeholder groups of financial and non-financial information (auditors, managers) affect reporting? What are the technological challenges faced by accounting directors?

### 3.2. Audit, Control and Regulation in the Context of the Use of Modern Technology

The literature review conducted in section 3.1 revealed particularly researched themes within the audit and regulatory area. These themes highlighted in the global research are:

- data analysis (datasets),
- fraud detection (control aspects),
- financial reporting,
- internal control over financial reporting processes (ICFR) (control procedures).

The aim of the following section is to establish the impact of digitalisation and technology on the process of data analysis, financial reporting and fraud detection and internal control.

**Data analysis.** Data analysis and the growing technology of today, especially digitalisation, are closely linked, and thus the process of data analysis becomes more dynamic, interactive and results-oriented. Data management becomes easier, allowing for better risk management and identification of new business opportunities. Thanks to new tools it is possible to analyse large data sets and obtain data that was previously unattainable. It is also possible to analyse data from different sources, including combining quantitative and qualitative data analysis. Data analysis allows for pattern identification, anomaly detection, statistical analysis and predictive modelling. Multiple elements can be combined, further supported by visualisation of findings. Analytical tools can integrate data from different sources, transform it into valuable information and then present the results in a way that is understandable and useful to decision-makers.

In this way, managers can make decisions more effectively (Austin et al., 2021). An important element in the process of data analysis is the interaction of those interested in the results of these analyses, therefore interaction between auditors and managers is essential (Austin et al., 2021). Additionally, data analyses are performed for government statistics, where interactions should also include regulatory enforcers (Austin et al., 2021). Combining digitalisation with modern technologies reduces the risk of human error, increases the accuracy of analyses and enables more detailed and complex data examination. This, in turn, improves control over internal processes, optimises costs and the ability to react quickly to market changes.

Based on the literature, the relationship between data analytics and technology, and in particular digitisation, is symbiotic as the two processes interact with each other and are interdependent. Data analytics relies on technological tools and progress, while technological development is also driven by adoption and evolution of data analytics (Austin et al., 2021). Digital transformation in the area of financial reporting and data analytics improves both the audit process and supports decision-making in business units (Austin et al., 2021). Any transformation requires full agreement and understanding of the process change. The introduction of new data analytics solutions may encounter difficulties at the level of human factors (conflict of interest) (Austin et al., 2021). An element of contention may be the costs incurred in digital transformation.

Digitalisation lays the foundation for data availability, technology supports data processing and analysis, and the data analytics process provides organisations with the key information they need to make informed, strategic decisions.

**Fraud detection.** The second area related to digital transformation in audit and regulation is the use of technological solutions to combat and detect fraud. The effectiveness of new solutions to combat manipulation requires ongoing training and time for individuals to gain experience in detecting anomalies (Aboud & Robinson, 2022). The literature also identifies the problem of the reliability of the datasets being analysed, including their availability and integrity. In practice, mechanisms for detecting fraud in financial statements using data analytics, machine learning and large database mining tools have been identified as effective (Aboud & Robinson, 2022). The digitalisation of the fraud detection process benefits not only from quantitative analysis, but also from qualitative analysis (text analysis of internal documents), indicating a deepening integration of technology in fraud detection processes (Aboud & Robinson, 2022). Recently, the possibility of using digitalisation in the tax fraud detection process has emerged: enhanced JPK files, the KSeF system, obligation to keep records electronically, and online cash registers make it easier to track tax fraud (e.g. income tax avoidance, VAT manipulation, cost manipulation).

**Financial reporting.** In accounting, a tool to improve communication and transparency of financial data is the XBRL language (Troshani et al., 2015), which integrates accounting data with business communications. This technology enables easy sharing of financial data and also influences the ability to store standardised company data



(McCallig et al., 2019). XBRL allows for the electronic sharing of financial statements, enabling the seamless exchange of financial data between different computer platforms and applications (Troshani et al., 2015). Financial data are directed to different recipients of information, from managers to counterparties, financial institutions and tax authorities, thus reducing the potential for error with manual data collection. This technology not only cuts down the costs associated with manual data processing, but also minimises the risk of financial reports not complying with applicable accounting standards. With XBRL it is possible to quickly detect inconsistencies and anomalies in the data, which helps to maintain high quality reporting. It is also worth noting that XBRL contributes to greater data accessibility for external stakeholders, which fosters trust and increases transparency in the company's operations. By automating and digitalising reporting processes, XBRL supports better information management and allows for the more efficient use of resources within the organisation.

**Internal control.** The fourth area discussed in this section concerns the use of technological advances in relation to the performance of internal control duties. The digitalisation of processes allows monitoring and response in crisis situations. Tools that restrict access to data reduce the possibility of unauthorised data entry or alteration. In addition, executives expect the latest technologies such as AI, data analytics, blockchain and robotic process automation to have a positive impact on reducing key internal control risks including the failure to detect material irregularities and unauthorised alteration of accounting information (Maksymov et al., 2023). At the same time, data analytics and machine learning tools enable predictive risk analysis to identify potential risks earlier and manage them proactively, yet there is also concern that a challenge arising from new technologies is the lack of accounting staff qualified to use the technology effectively (Maksymov et al., 2023). The integration of modern technologies often involves changing existing processes, which can lead to temporary disruptions in company operations, and also requires large investments in technology infrastructure and ongoing staff training. There are also digital security risks, such as cyberattacks, which can compromise data integrity and control processes. The digitalisation of internal control processes not only brings benefits, but also poses new challenges for organisations. In addition to improving the efficiency and accuracy of controls, technology enables the automation of routine tasks, allowing human resources to be diverted to more complex analysis and strategic activities. Tools such as artificial intelligence can identify patterns and anomalies in real time, allowing fraud and other irregularities to be detected quickly.

### 3.3. Diagnosis and Directions for Further Research

Based on the research carried out on modern technologies and their impact on the areas highlighted:

- data analysis (datasets),
- fraud detection (control aspects),

- financial reporting,
- internal control over financial reporting processes (ICFR) (control procedures),

a critical analysis of the formulated conclusions was carried out, identifying key research areas and indicating directions for further research.

Highlighting the fact that digitalisation increases the availability of data, technology supports the processing of data so that the data analysis process provides organisations with the key information needed for decision-making. In turn, the possibility to use digitalisation in the financial fraud detection process increases the effectiveness of new control tools (expanded JPK files, KSeF system, mandatory electronic record keeping, online cash registers). The automation and digitisation of reporting processes (XBRL) support the better management of reporting information and allows for the more efficient use of resources in the organisation. To this should be added the digitisation of processes in the area of internal control, which, in addition to improving the efficiency and accuracy of controls, enables the automation of routine tasks, allowing human resources to be diverted to more complex analyses and strategic activities. In addition to digitalisation and automation, tools such as artificial intelligence can identify patterns and anomalies in real time, allowing fraud and other irregularities to be detected quickly, both in the area of audit and internal control. As can be seen, the use of new technologies in the practice of companies and in audit institutions requires regulatory changes that take into account new types of behaviour.

To summarise the study on modern technology and its impact on regulation, audit and control, a number of key research areas can be identified, as shown in Table 3.2.

**Table 3.2. Areas of impact of modern technology on regulation, audit and control**

Key research areas	Description	Exemplary publications
Data analysis (data sets)		
Holistic approach	The fourth industrial revolution has blurred the boundaries between the physical, digital and biological realms, leading to a fusion of technologies that is transforming auditing and the wider accounting field.	S. Zhu, 2021
Digitalisation of the economy	The increasing digitalisation of the economy has led to the application of big data technology, which has had a profound impact on the economic and social functioning of the country, influencing the direction of the audit industry.	S. Jiang, 2020
CAATT tools and techniques	Computer-assisted audit tools and techniques (CAATT) have emerged to help auditors look for anomalies in data files and allow more analysis to be performed in less time using more evidence at a lower risk level.	Aksoy & Gurol, 2021
Synergy of science and practice	Big data and analytics offer new opportunities and challenges for researchers and practitioners in all business disciplines, including accounting and auditing.	T. Rana et al., 2023
Fraud detection (control aspects)		
	Financial institutions have turned to automated processes using statistical and computational methods, particularly techniques based on computational intelligence, to detect fraud.	Kadyshevitch, 2024

Key research areas	Description	Exemplary publications
Fraud detection techniques	Data mining (DM) and data analytics (DA) techniques, combined with a better understanding and use of quantitative techniques, have become effective auditing approaches, especially for fraud prevention and detection.	Balkaran, 2017
Use of artificial intelligence	Most fraud detection systems are based on previous frauds, which may be lagging behind as criminals develop new ways to commit fraud using new technologies such as artificial intelligence. The technological revolution in artificial intelligence is sweeping the world, and auditing is no exception. Intelligent audit automation (IAA) is the next generation of audit services, which includes new audit business models and professionals and new ways of looking at data creation.	Saluja et al., 2024
Financial reporting		
New significance of the audit profession	The use of new technologies has had a significant impact on the audit profession, leading to the introduction of new generations of auditors.	Christ et al., 2021; Mališ et al., 2020
New technologies – Blockchain, big data	Technologies such as blockchain, artificial intelligence, data analytics and automation have revolutionised financial reporting and audit processes. Blockchain technology has been identified as a tool that can increase the quality of audits without increasing the time spent on audited data, allowing auditors to increase the number of samples used without increasing their workload.	Herath et al., 2024; Hussein et al., 2025; Jayesh et al., 2022
Internal control over financial reporting processes (control procedures)		
Internal control and technology	Emerging trends in internal audit process technology include the widespread use of artificial intelligence, big data and other technologies to improve the efficiency and quality of internal audit, while also challenging the development of internal audit. In addition, the use of technology-based audit techniques (TBAT) involves conducting more audits, finding more risk factors, making more recommendations.	Eulerich et al., 2023; Marques & Morais, 2022; Teeter et al., 2010; Zhou, 2021

Source: own elaboration.

Table 3.2 shows the key research areas of regulation, audit and financial control. The digital economy has forced the evolution of the audit process from conventional manual audits to continuous electronic audits, driven by rapidly evolving information technologies and the demand for more timely communication of information to business stakeholders. Blockchain technology has been identified as a tool that can increase the quality of audits without extending the time spent on audited data, allowing auditors to expand the number of samples used without adding to their workload. In turn, the development of Big Data and Analytics (BDA) tools is having an impact on the audit profession, shaping the dynamics of technological change and reconfiguring aspects of the audit process.

In conclusion, today's cutting-edge technologies in auditing and financial reporting encompass a wide range of innovations, including blockchain, artificial intelligence, data analytics, automation and distributed ledger technology. These technologies have already had a significant impact on the audit profession and financial reporting processes. Emerging trends point to a shift towards continuous electronic audits and the integration of technology into accounting practices, while the future direction

of technology in auditing and financial reporting points to increasing automation, predictive financial reporting and a changing role for auditors in using innovative technology to enhance the reliability of financial information.

Based on the evaluation of past research and the characterisation of the areas identified in Table 2.1 concerning the impact of modern technology on regulation, audit and control, planned research directions in this area have been set. Table 3.3 presents three strategic directions for future research on the evolving role of the auditor (statutory auditor), controller and regulator in the face of increasing digitalisation and the development of modern technologies. The identified research directions reflect the key challenges and changes that are likely to significantly affect the tasks and competencies required of today's auditors and controllers, as well as financial reporting experts and regulators in the field.

**Table 3.3. Planned lines of research on regulation, audit and control**

Direction of research	Research questions	Suggested testing methodology
Evaluation of new technologies for identifying financial fraud	Are new technologies encouraging the growth of financial fraud?	Quantitative and qualitative research
	Are new technologies helping to detect financial fraud?	Quantitative and qualitative research
The role of auditors in the face of technological change	What challenges do auditors face in terms of new technologies?	Quantitative and qualitative research
	What new competences should auditors have?	Quantitative and qualitative research
	Will the auditing profession continue to fulfil its function?	Quantitative and qualitative research
Responsibility in the face of new technologies – regulatory challenges	What regulations should arise from a responsible approach to new technologies?	Quantitative and qualitative research
	Does modern technology diversify liability?	Quantitative and qualitative research
	What are the effects of dehumanising decisions on accountability?	Quantitative and qualitative research

Source: own elaboration.

As can be seen from Table 3.3, directions for further research should focus around the impact of new technologies on the development of financial fraud (increased risk of financial fraud and identification of new types of financial fraud). On the one hand new technologies influence the development of financial fraud whilst, on the other, they could also help auditors to detect these frauds by equipping them with new control tools. Therefore, research should be directed towards the use of new technologies in the audit and control process, streamlining the process, minimising the risk of errors and fraud being overlooked, and this will ensure that audit and control continues to be an effective tool in the process of detecting financial fraud.

This is undoubtedly a challenge for auditors, controllers and regulators. New technologies make it necessary to review the role of the auditor in view of challenges to the

auditor's new competences, skills and knowledge in terms of using new technologies, analysis of the audit and control function in the face of new challenges, and the use of experts in new technologies – a new role for IT professionals.

In the face of new technologies there must emerge a responsible approach to regulation, which should take into account the dehumanisation of decisions and the diversification of responsibilities. This is a challenge for regulators, who must identify the risks arising from the use of new technologies both in the preparation of reporting information (financial statements), their analyses and assessments used in decision-making processes, and in the audit and control process (audit of financial statements using new technologies, responsibility for the assessments formulated).

### 3.4. Ethical Dilemmas Regarding Audit, Control and Regulation in the Context of the Use of Modern Technology

In section 3.3, areas of impact of new technologies on regulation, audit and internal control are indicated. The use of modern technologies has obvious benefits related, for example, to the use of big data or the automation of control processes. A common issue raised by the authors (see Table 3.2 ) is the use of artificial intelligence in the area of auditing, data analysis, fraud detection and internal control. Artificial intelligence used in the area of control is a new tool that has not yet been fully explored. There is no research on the manipulation of information provided by artificial intelligence, the sources of which are not openly indicated. In today's world, it is necessary to be aware of the risks associated with the use of artificial intelligence, the main ones being the following.

**Bias and discrimination.** Artificial intelligence (AI) can unconsciously reflect various types of biases contained in the input data that forms the input to the system, which can lead to the formulation of subjective results. In the context of control and audit, AI systems may favour certain groups of people or organisations, undermining the objectivity of the process and the usefulness of the results obtained. Artificial intelligence models are learned from historical data, which may contain existing biases and/or subjective opinions. For example, if the data contains discriminatory wording towards certain social groups, AI may unconsciously perpetuate these patterns. In an audit this can lead to unequal treatment of companies or individuals based on criteria such as location or industry. Users may unconsciously introduce and perpetuate biases when adapting AI algorithms to the specific needs of an audit – this may be due to incorrect assumptions about the analysed data.

**Lack of transparency.** Many advanced AI models, such as neural networks, operate in ways that are difficult for humans to understand. Analysing the result itself, without knowing the decision-making process, can lead to errors in interpretation. In control and audit, being unable to explain why an algorithm has made a particular decision can lead to problems of accountability and trust.

**Breach of privacy – protection of personal data.** AI systems often analyse large amounts of data, including personal and confidential data. Inadequate management

of this data can lead to privacy breaches. Processing financial data without adequate safeguards can result in its leakage or unauthorised use. It is particularly important to manage this data appropriately and to comply with regulations related to the protection of personal data (in Poland these are the RODO regulations). Processing large amounts of information increases the risk of security breaches, especially if the data is stored in the cloud or transferred between different systems. Such data may be stolen or used in an unauthorised manner.

**Automation of faulty processes.** If an audit or control process contains errors or unethical practices, their automation by AI can perpetuate or exacerbate them. While automation can increase efficiency, it also carries the risk of replicating errors if the underlying processes on which it is based are incorrect or unethical.

**Risk of abuse of technology.** AI technology in control and audit can be used for purposes contrary to ethics, such as manipulating audit results and surveillance of employees. AI can be used to create realistic but false evidence, e.g. altered video, audio or generated images to mislead auditors. Systems can be used to unfairly classify individuals or organisations, which can lead to unfair treatment in audit and decision-making processes.

**Reducing human responsibility for the process.** Auditors can avoid making difficult decisions by uncritically trusting the results generated by AI. There may also be a reduced role for humans in decision-making as AI systems in auditing can make decisions autonomously, reducing the human role in the audit process. AI decisions based on data may appear neutral, but the lack of human judgement can lead to inappropriate analyses that do not take into account social, cultural or moral context. Artificial intelligence, while very effective at processing data and identifying patterns, may not be flexible enough in unusual situations. In such cases, human intervention may be necessary and its absence can lead to problems. The lack of empathy in AI analyses can also be a major problem since AI does not understand the context of human actions, which can lead to decisions that are effective but not necessarily fair. For example, algorithms that assess risk may ignore human factors such as the needs or concerns of those being audited, turning auditing into a cold, technocratic procedure (Jai Sisodia, 2022).

Based on the above ethical dilemmas related to the use of artificial intelligence, the authors identified remedies that can positively influence this aspect:

- data diversity – incorporating diverse and representative data to train AI models is key to reducing bias;
- algorithm audit – regularly checking AI systems for performance and potential bias is essential for early detection of problems;
- transparency – designing algorithms in a way that is understandable and transparent to users allows better control of their performance and limits unwanted effects;
- involvement of professionals – consultation with ethics experts and social and technological specialists can help to address biases;

- implement data protection principles – AI systems should be designed with data protection principles in mind at every stage of development and implementation;
- data anonymisation and pseudonymisation – the use of these techniques can significantly reduce the risk of privacy breaches, even in the event of data leakage;
- user training and awareness – staff using AI in auditing should be aware of data protection risks and relevant legislation;
- independent audit of AI systems – regular audits of AI systems for compliance with data protection regulations and ethical standards can help prevent problems (Leocádio et al., 2024).

With these considerations in mind, there is a need for research into ethical issues that will contribute to the development of standards for its use in order to negate its negative effects.



## Chapter 4

# Decision-Making, Cybersecurity and Identification of Early Warning Signals

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## 4.1. Decision-Making, Cybersecurity and Identification of Early Warning Signal – Research Review

In a dynamic business environment, decision-making is becoming an increasingly complex process requiring the integration of modern technologies and tools to support the identification of Early Warning Signals (EWS). Today's organisations not only need to manage data effectively, but also use technologies such as predictive analytics, artificial intelligence and automation systems to increase decision relevance and minimise risk. A key aspect of this process is also to ensure an adequate level of cybersecurity, which plays a fundamental role in data protection and the stability of decision-making systems.

Table 4.1 presents an overview of the most important scientific publications on decision-making processes in the context of the use of EWS and modern technology. The compilation includes a variety of research approaches, such as empirical analyses,

experiments and case studies, which illustrate the practical applications of analytical tools and the challenges arising from their implementation. The research points to the key role of EWS in managing risk, identifying potential risks and supporting strategic and operational decision-making.

The publications presented in the table also consider the impact of technology on decision-making processes in the context of ethics and transparency. They point to the challenges of the dehumanisation of decision-making processes and the need to balance the autonomy of systems with human responsibility for decisions. The table also allows for the identification of key research trends, such as the use of artificial intelligence in identifying warning signals, the analysis of cybersecurity risks and the impact of automation on management processes in organisations.

The compilation of publications is a valuable resource for researchers and practitioners alike, providing a comprehensive view of issues related to decision-making and the identification of early warning signals in an era of digital transformation. Hence, the table not only summarises the current state of knowledge, but also inspires further research into the impact of modern technologies on risk management and decision-making processes.

**Table 4.1. Summary of publications for the area “Decision-making/EWS”**

Paper	Test sample	Methodology	Results	Citations by Scopus
Shahana et al., 2023	1749 articles	Systematic review of the literature	Key findings of the study include an analysis of publication trends in the detection of fraud in financial statements, identification of the most influential papers and authors in the field, and identification of limitations and directions for future research.	7
Mousavi et al., 2023	36,984 entities	Comparison of static and dynamic models for predicting financial distress	Dynamic models are more effective than static models. Using more information improves performance in predicting financial distress.	3
Janvrin & Wang, 2022	153 articles	Literature review	Setting research directions for cybersecurity and accounting.	7
Kipp et al., 2020	146 experienced managers	Experiment	The study's findings indicate that managers make less aggressive financial reporting decisions when supported by intelligent agents (IAs) than human agents, and when working with agents with less autonomy.	6
L. Gao et al., 2020	No data	Linguistic analysis	The paper's findings show an increase in the extent of cybersecurity risk disclosure by public companies between 2007 and 2018.	30
Roychowdhury et al., 2019	No data	Model analysis and experimental tests	A review of the literature on the impact of financial reporting and disclosure on corporate investment decisions indicates that there are different effects of these factors on investment performance.	236

Paper	Test sample	Methodology	Results	Citations by Scopus
Allee & Deangelis, 2015	Transcription of 73,201 conference speeches	Linguistic analysis	The study found that the structure of tone in voluntary information narratives plays an important role in the communication and shaping of information by managers and in user responses.	129
Y.-S. Choi & Young, 2015	Companies in the UK before the adoption of International Financial Reporting Standards (IFRS)	Statistical methods	Non-GAAP profit disclosures have a dual role in communicating company performance depending on managers' reporting incentives.	21
Mundy & Owen, 2013	10 managers	Semi-structured interviews, snowball sampling	The results of the study include the identification of areas of potential weakness in internal control over financial reporting.	11
S. Huang et al., 2012	2407 companies	Use of an unsupervised neural network tool called a growing hierarchical self-organising map (GHSOM)	The results of the analysis indicate that the GHSOM classification approach can help capital providers assess the reliability of financial statements and make decisions based on accounting data.	28
Liou, 2008	52 financial variables of Taiwanese companies	Logistic regression, neural networks and decision trees	The results show that many financial variables are effective in detecting fraud and predicting the failure of companies.	51
J. W. Lin et al., 2003	40 companies accused of falsifying financial statements	Fuzzy neural networks (FNN)	Modern technologies, such as a hybrid system integrating fuzzy logic with neural networks, can significantly improve the detection of fraud in financial statements. This approach gives better results compared to traditional statistical models.	130
Osei-Assibey Bonsu et al., 2023	220 accountants surveyed	Statistical analysis from survey data	Research indicates that the adoption of fintech tools such as artificial intelligence (AI) and big data analytics (BDA) positively impacts financial reporting, performance management, budgeting, auditing, risk management and fraud prevention.	6
C. Zhang et al. 2023	41 interviews	Interviews	Artificial intelligence brings numerous benefits, but at the same time carries numerous ethical risks, such as data security, accountability, accessibility, transparency and trust.	11

Source: own elaboration on the basis of a review using the VOSviewer tool.

The very rapid development of information technology poses an unprecedented challenge to managers, including those in charge of corporate finance divisions (hereafter CFOs). The ability and propensity to adapt to the changing information technology environment is a differentiating factor between managers who are less inclined

to use new technologies and those who are constantly making efforts to implement new ways of solving old problems.

Modern CFOs are proactively using the latest technological solutions to increase the efficiency of their work, as well as to make greater use of available internal and external information, which ultimately supports the value creation of the managed organisation. The use of a variety of tools related to artificial intelligence in the broadest sense can be used to (i) support decision-making, (ii) manage cybersecurity and (iii) create internal early warning systems. This was a key finding of the literature review.

Cybersecurity is one of the three issues described in this section that is the least examined in the specialist literature. Due to high-profile cybersecurity breaches resulting in increased attention from professionals and regulators, organisations are under increased pressure to conduct extended analyses of the potential consequences of security breaches also in the accounting area and, as a result of these analyses, to develop and implement adequate safeguards. Recent research identified increased stakeholder communication of the need to protect business entities from network threats. Janvrin and Wang (2022) highlighted the impact of cybersecurity on an organisation's core operations, financial and non-financial performance, and stakeholders, offering a structured approach to identifying threats, assessing impact and developing response strategies. The authors emphasised the need for interdisciplinary collaboration in addressing cybersecurity by considering financial accounting, management and auditing information systems together, and categorised cybersecurity incidents and breaches according to whether the incident falls within the scope of dedicated laws and regulations. This distinction is key to understanding reputation and compliance (compliance) and litigation issues related to cybersecurity incidents. Given the implications for stakeholders, regulators and investors alike, the distinction identified proves important for understanding, monitoring and responding to cybersecurity risks.

Gao, Calderon and Tang (2020) examined the disclosure of information related to cyber risk in reports of listed companies. They studied reports covering over a decade (from 2007 to 2018), focusing on their content, manner (location in the report) and language characteristics of the disclosures, and identified the trend of increasing disclosure of cyber risks, especially those related to operational disruptions and data breaches. While the findings indicated that cyber risks are significant and can materially affect operations and the integrity of financial reporting, yet empirical research on cyber risk disclosure is limited. The results of observing financial statements dating over a decade led the authors to some interesting conclusions, namely that the corporate environment has become much more complex, prompting companies to disclose more information with higher levels of complexity. They observed that over time, cybersecurity disclosures become more difficult to read. Using multiple regression methods, it was found that disclosures become harder to read as company size increases. The conclusion was to stress the importance of effective and clear cyber risk disclosures to stakeholders, which should enable them to adequately assess the scale of the risks generated for companies by cyberattacks and their subsequent impact.

The most widely presented topic in the literature is decision support using new technologies. Despite indicating the high usefulness of tools for these purposes, financial managers feel threatened by artificial intelligence. Kipp et al. (2020) suggested that despite having an agent that can delegate actions to support their financial reporting decision, managers are morally unable to disengage from selfish behaviour due to increased perceptions of AI control, less autonomous accounting robots, and the certainty of these robots' actions in generating results. Concerns about the use of AI are often expressed in the media and beyond. They concluded that the results of their study cannot allay fears of job loss, suggesting that AI must not push us into a world completely devoid of human control and responsibility.

A separate issue of the use of AI in decision support is the ethical dilemmas surrounding its use. C. Zhang et al. (2023) suggested that along with the benefits, there are also ethical concerns associated with the use of AI, such as deprofessionalisation, data breaches and isolation among accountants. The use of AI-based management accounting systems is a largely personalised process, i.e. based on the individual decisions of the accountant, not constrained by any accounting standard but should follow the specific decision-making behaviour of each organisation. Therefore, the behaviour of management accountants can significantly increase ethical risks when using AI and should be properly controlled to reduce bias, unfairness, the risk of harm to user autonomy and independence and poor decision-making. To achieve this, the authors argued for commencing collaboration between regulators and AI solution developers for the rapid collection of key indicators from companies and the notification of anomalies detected to regulators.

In the stream of research on the risks associated with the impact of AI on decision support is the study by Mundy (2013), showing how the use of AI for regulatory compliance can impact organisational roles. In particular, AI managers need to ensure that internal systems using AI take into account regulatory requirements for internal control over financial reporting. The findings allow for a better understanding of IT's role in managing compliance issues and provide insights into the role of AI-enabled ERP systems in addressing legislative requirements. Additionally, Mundy described how managers can use AI to develop effective internal controls.

Roychowdhury et al. (2019) conducted a literature review regarding the trend of using AI to support investment decisions made in stock markets by external stakeholders, and focused on information asymmetry as a fundamental obstacle to sound investment decisions. The authors identified methods of machine learning in a broad sense as a helpful tool in bridging this asymmetry, and also found research gaps that can be a signpost for future research. Moreover, the authors stressed the importance of understanding the sources of variation in the quality of financial reporting and the mechanisms through which reporting information influences stock investors' decisions.

Osei-Assibey Bonsu et al. (2023) chose a very optimistic approach to the use of new technologies in company operations. The authors conducted a study on the use of modern AI tools in optimising a company's internal decisions, particularly to improve

efficiency, and demonstrated that accountants using AI help companies obtain more detailed information, predict more reliable results and streamline non-standard processes. They showed that AI is an opportunity for the accounting profession to create entirely new value for businesses and help them transform their decision-making process in many ways.

Huang et al. (2012) pointed to the use of advanced tools in minimising the credit risk of trading partners, in particular by examining the quality of the reporting information they provide. The results showed that this approach can help a variety of stakeholders when assessing the reliability of reports. Appropriately selected indicators to identify risks in this area, extracted through the use of advanced tools, can be used to assess the reliability of financial reports that form the basis for analyses to assess the reliability of counterparties.

The analysis of the use in decision support of tools for automated analysis of presented reports by counterparties and other external stakeholders is also an important research strand in this field. Allee and Deangelis (2015) examined the narrative structures of voluntary information presented by managers and the role of tone dispersion in the communication and shaping of this information and in the responses of report users to this information. Tone dispersion, or the even distribution of tone words in a narrative, is associated with current and future performance, manager reporting decisions, incentives and actions, and analyst and investor responses to conference narratives. The authors demonstrated that analysts and investors react more adversely to negative news when the tone is less diffuse, and more positively when the positive tone prevails.

The issue of the use of external party reports for internal decision support is found in the study by Y.-S. Choi and Young (2015). The authors presented statistical and economic evidence of a significant asymmetry between the propensity to disclose information and the occurrence of transitional items in the performance reports of these companies. The external regulations under which these reports were prepared are also important. The authors also pointed out tools to help find manipulation in the profit and loss accounts of counterparties or other stakeholders.

The primary task facing financial reporting is to provide external stakeholders with information useful for making economic decisions. An important element of economic decisions is the identification of risk factors, including the risk of significant financial distress and, ultimately, bankruptcy. Research on models to assist in the identification of bankruptcy risk has been ongoing for almost six decades, starting with the pioneering work of Altman (1968) and Beaver (1966; 1968). Over that time, researchers have developed dozens of competing financial distress prediction models (hereafter MPTF), less commonly referred to as bankruptcy (insolvency) prediction models. These models were classified according to a variety of criteria: the time range of the data, the type of data considered, the way the data were processed. Over time, we have witnessed the use of increasingly sophisticated methods which evolved from those purely statistical, then probabilistic, to those based on neural networks, fuzzy logic and using machine learning and AI.

The emergence of so many different MPTF models has laid the groundwork for a research trend of testing their predictive performance and, subsequently, attempting to rank models. Mousavi et al. (2023) pointed out that model comparisons using single-criteria evaluations and with a static approach do not yield good results, preventing reliable model comparisons. Based on this, they proposed a dynamic, multi-criteria MPTF comparison approach, arguing that the dynamic element enables a more accurate assessment of MPTF performance at different points in business and macroeconomic cycles. Their research brings evidence of the following regularities:

- dynamic models have greater predictive power than static models,
- within the group of dynamic models, duration-dependent models have better predictive power than time-independent models,
- in each class of models and configurations, models fed with market data and macroeconomic data in addition to reporting data prove superior,
- models fed only with reporting data had less predictive power than models fed only with market and macroeconomic data (combined),
- in each class of models and configurations, too long a time series of data reduces the predictive efficiency of the model (models fed (learned) with three periods of data perform better than models fed with five periods of data).

Starting from the 1990s, research on the identification of warning signals has also directed the attention of researchers to the problem of constructing accounting fraud risk identification models (Fraudulent Reporting Detection Models – hereafter FRDM). Shahana et al. (2023) conducted a systematic survey of the literature describing approaches to the identification of accounting fraud, indicating that in recent years the identified irregularities have been further divided into:

- intentional, resulting from the misappropriation of the entity's assets by staff,
- unintentional, resulting from errors.

They cited research findings that, in a typical case, irregularities generate a cost to the affected entity of around 5% of annual revenue (ACFE, 2020). They pointed out that the development of effective FRDMs is hampered by the small number of fraud cases identified, yet the potential cost of not detecting fraud is many times higher than the cost of misidentifying fraud (unfounded accusations). An additional difficulty is that often the factors treated as fraud risks are relatively ambiguous.

Shahana et al. (2023) listed the most common methods used in FRDM:

- statistical methods, including frequent use of logistic regression and analysis using Benford's law,
- methods based on data mining and machine learning, especially in developed economies, where the trend towards *ensemble algorithms* and lesser research using deep learning methods is evident.

They noted that these studies often omit textual analysis, and that research based on textual information mostly originates from the US.

In this context, the study by J. W. Lin et al. (2003) focused on the problem of FRDMs assisting auditors is interesting. Estimating the probability of misstatement is the



starting point for the auditor to properly plan the audit of the financial statements and, as the authors demonstrated, determines the effectiveness of the audit work. The most important thing for the auditor is to avoid the risk of undetected fraud, which entails legal and reputational consequences for him/her. The authors confirmed that the most common fraud risk assessment methods used by auditors (interviews, checklists, statistical models) are not effective in detecting fraud. Logit models yield slightly better accuracy than these traditionally used methods in this field, whereas significantly higher predictive accuracy is provided by models based on fuzzy neural networks, yielding seven times higher fraud identification efficiency than logit models.

Another stream of research is directed towards the analysis of models linking MPTF and FRDM. Liou (2008) listed arguments supporting the intuitively perceptible regularity that accounting fraud is more likely to occur in entities experiencing significant financial difficulties. The author conducted a similarity analysis of the MPTF and FRDM models, and concluded that many of the variables used in both types of models are statistically significant for predicting the occurrence of both phenomena (financial difficulties and fraud). These results attribute a high predictive value to those models serving both purposes combined, which are based on logistic regression. In common with other researchers, he suggested that the main limitation to the effectiveness of model calibration is the small sample size of entities identified as having financial difficulties and those where fraud has occurred.

The literature analysis provides a starting point for considering the use of modern technology in decision-making, cybersecurity and early warning models, as well as for setting future research directions in this area.

## **4.2. Decision-Making, Cybersecurity and EWS Identification in the Context of the Application of Modern Technologies**

The literature research points to an important link between modern intelligent IT tools and the development of the accounting/finance profession. The research conducted in section 4.1 indicated three key points of interface between artificial intelligence and accounting, namely cybersecurity, decision support and early warning systems. The following areas in the use of modern technology were identified:

- the role of the accountant and auditor in ensuring cybersecurity,
- cybersecurity risk assessment models,
- modern information technology in the service of economic decision-making,
- methods for predicting financial distress and bankruptcy based on non-financial data.

### **The Role of the Accountant and Auditor in Ensuring Cybersecurity**

Recent research on the issue of cybersecurity stresses the undeniably important role of accounting as a key security link. Janvrin and Wang (2022) described the most glaring cybersecurity breaches, pointing to the need for increased attention to this

issue by professionals, threat-pressured entities and regulators alike to consider the accounting implications of threats and develop appropriate responses. They suggested that cybersecurity incidents can impact an organisation's operations, financial and non-financial performance and, consequently, its stakeholders. To discuss the impact of cybersecurity issues on accounting, the study presented a framework of events, impacts and responses to discuss current research and consider the implications for both practitioners and researchers. The authors indicated how practitioners can rely on the research findings to better assess cybersecurity threats, understand their impact and develop response strategies. The results encourage additional research to examine how organisations identify cybersecurity threats, incidents and breaches, moreover suggesting the need to expand cybersecurity research into the areas of financial accounting, management accounting and auditing.

A link between audit issues and cybersecurity can be found in the research of Kurniawan and Mulyawan (2023). Cybersecurity is seen as highly relevant to protecting and improving the security of corporate information, where auditors play an important role in developing internal controls in technology-based operations by analysing audit findings. However, research models integrating cybersecurity with auditing have not yet been widely developed. Their research results indicate that the development of innovative technologies affects the auditor's ability to support the review of audit findings and risk measurements, yet the auditor's ability to apply technology to review audit findings has little impact. This research contributes to the development of a model for understanding cybersecurity audit processes in industry and academia based on professional standards to improve audit performance through advanced technology.

**Cybersecurity risk assessment models.** An interesting study on the payment system in the aviation industry was conducted by Alghamdi et al. (2024). Due to its ubiquity, e-payments have caught the attention of many companies in the aviation industry and are fast becoming the dominant means of payment, however, as technology advances, the number of the associated fraud cases has been increasing at a comparative rate. Over the years the airline industry has seen a sharp increase in payment fraud, reducing the credibility of payment systems and confidence in the industry as a whole. Despite attempts to eradicate e-payment fraud, decision-makers lack the technical expertise required to apply best judgement in detecting and preventing fraud. The authors identified the lack of an established decision-making model for the detection and prevention of e-payment fraud as an obstacle to the successful elimination of fraud, therefore setting as their goal the development of such a model, and developed a hierarchical decision-making model based on expert input regarding validation, quantification and attractiveness. The results of the validation and quantification factors show that decision-making is mainly influenced by economic, financial, and safety perspectives. Airline companies can use the developed framework to test whether they are ready to adopt online fraud prevention technology to increase their success rate. To measure the readiness of payment organisations to adopt digital payment fraud protection technology, this study developed a scoring methodology.

Lattanzio and Ma (2023) went even further, proposing a textual ex-ante measure of company exposure to cybersecurity risk, and documented how the digitalisation of the US economy is changing innovation policies of companies. As cybersecurity risk increases, businesses are hedging against the risk of data breaches by protecting their intangible capital under national patent and intellectual property laws, yet this strategic response is not without its price as it reduces the cost of implementing the growth strategies adopted by industry for firms with low innovation leaders, resulting in a reduced return on R&D investment. Another conclusion was to highlight the crucial role of trade secrets, intellectual property and patent law in today's cyber age. The negative impact of cybersecurity risk on innovation has resulted in diminishing returns on R&D investment, not in a reduced R&D investment.

A different solution was proposed by Al-Hawamleh (2024) exploring a comprehensive cyber-resilience framework designed to strengthen the defence mechanisms of organisations of the changing cyber-threat landscape, while enhancing business continuity capabilities. The aim was to provide businesses with a robust system that transcends traditional cybersecurity paradigms. The author applied a methodology based on extensive research of the cybersecurity literature to develop a conceptual and iterative model of cyber resilience. From a behavioural perspective the research covered human factors, user awareness and decision-making processes. This resulted in an action plan including technological resilience, regular audits and assessments, emphasising evidence-based improvements. As businesses increasingly rely on interconnected technologies, this framework remains relevant as an essential tool for enhancing security, protecting critical assets and ensuring continuity in the face of an ever-changing cyber-threat.

A similar study was conducted by Alhanatleh et al. (2024), taking as its objective the diagnosis of the link between cybersecurity awareness and the public value theory of mobile financial services (fintech), and the results can be applied to the development of financial services. Moreover, the findings showed that the cybersecurity of fintech services and its predictors positively and significantly influence the use of fintech services among an increasing proportion of the population; the findings can also be used in work relating to the development of mobile devices.

The link between security issues and the public sector is emphasised by Hilario et al. (2023). The aim of the researchers was to assess the phenomenon of cyber sabotage in public entities based on the state policies in place in the cybersecurity infrastructure, through reviews of research and academic articles. The research was conducted to help technologists improve their knowledge of the tools, methods and effectiveness of using metrics to mitigate multiple anomalies in entities. A research method with a qualitative approach, based on scientific research methodology with case study methods, was used to achieve the objective of analysing the strategic situation, outlining the policies of public entities. The results highlighted the basic structure of these strategies, including the priorities and main problems identified for the countries studied, to establish an overall model of the strategy, taking into account the political

background of the countries. The authors concluded that if a cyberattack is successful, then security recommendations will be provided, thus laying the groundwork for protecting networks and telecommunications systems for the future, in order that more people become aware of lesser-known vulnerabilities and gaps in such systems.

**Modern information technology in the service of economic decision-making.** Just as important as ensuring cybersecurity is providing a high level of efficiency in the business conducted, which is not possible without the development of new decision support tools based on artificial intelligence. In this vein, an interesting analysis of the good practices of major Western European companies in automated decision-making was conducted by Bonsón et al. (2023), who pointed out that the automation of decision-making is still at an early stage and that the first beneficiaries are mainly companies operating in the financial sector. Only 22 Western European companies disclosed the use of such practices in their annual reports (or sustainability reports), and a total of 33 mentions were recorded. The main categories of decision automation disclosures identified in this study were automations in credit risk assessment, algorithms and medical diagnostics, and others. The latter was related to the electronics sector disclosing AI technology used in devices such as smartphones, smartwatches, and home robots. The most common company disclosures regarded to CRAs operating in the banking and financial services sector, which can be explained by both the signalling theory and the voluntary disclosure theory. According to the signalling theory, by being transparent about their use of AI technologies, companies try to reduce information asymmetry and attract the attention of their stakeholders. Nevertheless, they only disclose favourable or very general information. Different approaches to this type of disclosure have been observed as some companies simply expressed their general concerns about the unacceptable consequences of AI decisions or future scenarios in which decisions will be made solely on the basis of an algorithm.

Artificial intelligence algorithms can be used to assess aggressive investor behaviour, as presented in a study by Rizal et al. (2024), aimed to develop and validate a questionnaire to measure aggressive investor behaviour. The questionnaire design is important given the lack of validated questionnaires in the current literature since only limited research is currently available on aggressive investor behaviour. This survey involved three stages: first, the development of the questionnaire; second, checking its validity and reliability; third, conducting a statistical analysis. The results provide valuable information for researchers and financial institutions with a keen interest in financial decisions.

A continuation of research linking investor behaviour to accounting using artificial intelligence algorithms was presented by Hussain and Alaya (2024). Their aim was to examine investor reactions to bad financial news based on financial statement disclosures, as well as the impact of investor herd behaviour and the reactions of individual investors. This study identified key elements of investor behaviour that are reactions to adverse financial news, which can be effectively managed using algorithms.

The developed algorithms can also be used to study the propensity of managers to dispose of shares in the companies they manage, as was demonstrated by Firk et al. (2021a). The main focus of their research was to use management accounting in the broadest sense as a basis for building algorithms to support investor decision-making. This study examined under what circumstances an algorithm can play a facilitating role in divestment decisions. The significant information advantage of advanced algorithms over, for example, profitability measures such as ROI was demonstrated.

**Methods for predicting financial distress and bankruptcy based on data.** Researchers are following new paths in the area of corporate insolvency risk diagnosis, going beyond the well-established standard models based on financial reporting data. Costa et al. (2022) attempted to link bankruptcy risk to the quality of published reports. They studied companies in the SME segment, highlighting that the quality of reports influences decision-making due to the impact on the information content of financial ratios based on reporting data. The authors analysed the data of 1560 Portuguese companies in the SME segment from the construction sector. Reports from the years from 2012 to 2018 were included in the analysis. The researchers adopted the following approach: first, they assessed the ex-ante bankruptcy risk based on simple quantitative criteria proposed in the literature for SME entities (Lisboa et al., 2021), dividing the research sample into groups bankrupt, and non-bankrupt. Then, using an iterative approach, they made a selection of other variables that improved the predictive accuracy of the model. The results obtained show that measures of the quality of financial statements, i.e. the quality of accruals and settlements and revenue recognition, significantly affect the insolvency of companies, confirming their importance in predicting financial distress. Hence, using logit methods for bankruptcy prediction, the accuracy of the model increased when quality variables were included. The results obtained were validated with 'new age' qualifiers, specifically the random forest methodology.

Blanco-Oliver et al. (2016) conducted a similar study focusing, however, on micro-segment firms, resulting in the development of a hybrid bankruptcy screening model through a combination of parametric and non-parametric approaches. As in previous research, variables with the highest predictive power for bankruptcy detection were first selected using logistic regression. Then, alternative non-parametric methods (Multilayer Perceptron, Approximation Sets and Classification-Regression Trees) were applied to the discrimination of firms obtained in the first step in order to improve the classification accuracy. The authors showed that hybrid models, especially those combining logit Perceptron multi-layer regression, provide better predictive accuracy, interpretability and are faster than each method applied separately. Furthermore, the authors showed that the introduction of non-financial and macroeconomic variables enhances the predictive value of the bankruptcy of pure financial indicators.

A similar study was conducted by Fathi et al. (2023), who attempted to develop a bankruptcy prediction model based on combining the worst-practice-frontier method with the data envelopment analysis method (WPF-DEA) and using an artificial

neural network. Using the prepared model from a sample of 106 companies listed on the Tehran Stock Exchange, for data from 2017-2019, 103 cases were accurately predicted, indicating that the obtained neural network had a 97% probability of accurately qualifying a company.

The rapid development of advanced cyber technologies increases both risks and opportunities in the accounting area related to decision-making, cybersecurity and the identification of early warning signals. The research stream in this area is evolving with changing technology, pointing to undoubted challenges for practitioners and academics alike, the most important of which is keeping pace with the changing reality.

### 4.3. Decision-Making, Cybersecurity and EWS Identification – Diagnosis and Directions for Further Research

To summarise the research carried out so far, it is necessary to highlight the key issues concerning the impact of robotic tools, in the broadest sense, on the processes of cybersecurity assurance, EWS support, characterised in Table 4.2.

**Table 4.2. Areas of impact of modern technology on cybersecurity, decision support and bankruptcy prediction**

Key research areas	Description	Exemplary publications
Role of the accountant and auditor in ensuring cybersecurity		
Compliance	The significant impact of cybersecurity on an organisation's core operations, financial and non-financial performance, and stakeholders. The need for interdisciplinary collaboration in addressing cybersecurity issues by considering the combined information systems for financial accounting, management accounting and auditing is highlighted.	Janvrin & Wang, 2022
Challenges for the auditor	Cybersecurity is seen as highly relevant to protecting and improving the security of corporate information, where auditors play an important role in developing internal controls in technology-based operations by analysing audit findings. However, research models that integrate cybersecurity with auditing have not yet been widely developed.	Kurniawan & Mulyawan, 2023
Cybersecurity risk assessment models		
Risk disclosure	The corporate environment has become much more complex, prompting companies to disclose more information with higher levels of complexity. Rapid diffusion of threat intelligence is necessary, as cybersecurity disclosures become increasingly difficult to read over time.	L. Gao et al., 2020
Security e-payments	A scoring methodology has been developed for selecting online fraud prevention technologies to protect against digital payment fraud. The need to provide businesses with a robust system that goes beyond traditional cybersecurity paradigms is emphasised.	Alghamdi et al., 2024; Al-Hawamleh, 2024; Lattanzio & Ma, 2023
Modern information technology in the service of economic decision-making		
Ethical risks of robotic decision support	Along with the benefits come ethical concerns related to the use of AI, such as deprofessionalisation, data breaches and isolation among accountants. The use of AI-based management accounting systems is a largely personalised process, i.e. based on the individual decisions of the accountant, which is not constrained by any accounting standard, but should follow the specific decision-making behaviour of each organisation.	C. Zhang et al., 2023



Key research areas	Description	Exemplary publications
New role for the accountant and controller	Accountants and controllers using AI help companies get more detailed information, predict more reliable results and streamline non-standard processes.	Firk et al., 2021b; Osei-Assibey Bon-su et al., 2023a
Methods for predicting financial distress and bankruptcy based on non-financial data		
Predictive models	Measures of the quality of financial statements significantly affect the insolvency of companies, confirming their importance in predicting financial distress. Hybrid models provide better predictive accuracy, interpretability and are faster than each method used separately. In addition, the introduction of non-financial and macroeconomic variables enhance the predictive value of a hybrid model.	Fathi et al., 2023; Lisboa et al., 2021
Identification of warning signals	Research on identifying warning signals has directed the attention of researchers to the problem of building models for identifying accounting fraud risk. Analysis using Benford's law and methods based on data mining and machine learning are often used.	Shahana et al., 2023

Source: own elaboration.

Table 4.2 presents the most important research areas linking new technologies to the daily work of financial and accounting services, in particular accounting controllers and internal risk analysts. The dynamic development of robotisation requires a new definition of these roles in developed companies and institutions. Each of the highlighted areas also demands the setting of an impassable limit to dehumanisation in the form of the revision of codes of ethics.

**The role of the accountant and auditor in ensuring cybersecurity** – threats to e-payments and data confidentiality are now the responsibility of everyone in the entity. However, accountants and auditors are a key element of internal control in the broadest sense, which often manifests itself in the form of active participation in the development of internal compliance policies. These risks are also becoming a new challenge for national regulators in defining a new role for the auditor as a link in mitigating such risks.

**Cybersecurity risk assessment models** are difficult to develop in individual institutions. Literature research points to the need for knowledge diffusion in the preparation of tools to protect against digital threats. Detailed information about new forms of attacks by criminals allows for the protection of other market participants, as well as the collective creation of new tools to counter threats also through new robotic tools.

**Modern information technology in the service of economic decision-making** is becoming an integral part of the work of the financial and accounting services of modern business. Accountants and controllers using artificial intelligence algorithms are more useful for effective management. However, there are new ethical risks associated with the loss of livelihood due to staff reductions resulting from the implementation of solutions that allow humans to be replaced by robots.

**Methods of predicting financial distress and bankruptcy based on non-financial data** will allow better identification of ongoing concern risks. The classic approach is based mainly on ratio analysis of presented financial statements supplemented by counterparty information. The use of effective analytical tools based on extensive and



publicly available non-financial information significantly enriches the process of estimating risks. Again, however, the risk of dehumanisation may prove to be more of a threat than a benefit.

On the basis of the conclusions drawn from the research to date and the areas characterised in Table 4.1 concerning the impact of modern technologies on selected aspects of the functioning of finance and accounting departments, the planned research directions in this area were determined. Table 4.3 presents three strategic directions for future research on the evolution of cyber-security management processes, business decision support and the prediction of financial distress and insolvency in the face of increasing digitalisation and the development of modern technologies. Each of the designated research directions was extended to include future research methods, geared towards identifying the new competencies needed to understand the impact of new technologies on the implementation of the designated roles of the cadres dealing with the aforementioned problems of the broader accounting.

**Table 4.3. Planned research directions for cybersecurity, decision support and bankruptcy prediction**

Direction of research	Research questions	Suggested testing methodology
The impact of automation in ensuring cyber security	How does the automation of financial processes support increased cybersecurity?	Survey of finance and accounting staff
	Doesn't the automation of security processes reduce staff vigilance levels?	In-depth interviews with managers of the finance and accounting divisions
Responsibilities associated with decision support automation	Will the analytical decision-making process require a human presence?	In-depth interviews with managers of the finance and accounting divisions
	How to design an automated decision support process so that it is free from external interference (e.g. cybersecurity aspects)?	In-depth interviews with IT managers
	How should the problem of liability for erroneous recommendations made by artificial algorithms be resolved?	In-depth interviews with managers of finance and accounting, risk divisions and auditors
Evaluation of new technologies in anticipation of financial distress and bankruptcy	What challenges do financial managers face in adapting procedures to anticipate financial difficulties?	In-depth interviews with managers of the finance and accounting divisions
	Are the algorithms created by new technologies able to identify new threats to business continuity?	In-depth interviews with risk managers and auditors
	What mandatory controls should be implemented in the regulations to mitigate the risk of a flawed ongoing concern analysis?	In-depth interviews with auditors

Source: own elaboration.

**The first line of research**, on the impact of automation on the provision of cybersecurity, highlights the increasing reliance on technologies such as Robotic Process Automation (RPA) and Artificial Intelligence (AI) to accompany finance professionals in their day-to-day business processes. The research questions are directed towards the

possibility of reducing cybersecurity risks. It is also necessary to recognise whether such algorithms will not become the cause of the development of new threats which may be based on the dormant level of vigilance of employees.

**The second line of research** involves liability for the inadequate preparation of recommendations before business decisions are made. Risks to accountants and controllers due to the possibility of losing their livelihood are also an important issue that requires in-depth investigation. Moreover, the full transfer of decision support to virtual reality generates a new problem, i.e. liability for wrong decisions, hence it is necessary to direct future research towards the establishment of impassable regulatory boundaries for decision liability.

**The third line of research** recognises the role of the risks associated with the de-humanisation of the process of identifying business continuity risks and the over-reliance on algorithms. This section emphasises the responsible preparation of new legal regulations limiting the elimination of the human factor from this type of analysis. The proposed methodology is oriented towards in-depth interviews with an interdisciplinary panel of specialists in finance, risk and information technology in order to reduce the impact of undesirable factors on the proper identification of new types of risks and financial difficulties.

Concluding, Table 4.3 provides a basis for future research work that not only highlights new challenges for accounting controllers and financiers, but also points to the need to adapt research to the rapid development of artificial intelligence, the development of new legal regulations and new rules for adhering to ethical standards in accounting and finance for companies and institutions.

#### **4.4. Ethical Dilemmas in Decision-Making, Cybersecurity and EWS Identification in the Context of the Use of Modern Technology**

Technological advances, particularly in the field of artificial intelligence (AI), are opening up new opportunities in accounting, but at the same time pose a number of ethical challenges for professionals. Automated systems, decision-making algorithms and advanced analytical technologies are changing the way accountants, financial managers and auditors work. This chapter discusses the ethical dilemmas associated with the use of technology in accounting, focusing on three key sub-areas: information user decision-making, cybersecurity and identifying early warning signals (EWS). The literature review provides a better understanding of the challenges and identifies possible solutions to maintain ethical standards.

Technological advances, particularly in artificial intelligence (AI), are changing the way accounting works, opening up new opportunities but also posing a number of ethical challenges for professionals. Process automation, advanced decision-making algorithms and systems that support the analysis of financial data are bringing significant innovations to the work of accountants, financial managers and auditors. However, the rapid pace of implementation of new technologies raises significant

issues such as accountability for AI decisions, transparency of algorithm performance and data protection.

Table 4.4 presents key ethical dilemmas in three relevant areas: decision-making, early warning signal (EWS) identification and cybersecurity. The summary considers distinctive challenges, ethical questions and proposed solutions that can help maintain high ethical standards in AI applications in accounting. Problems such as the lack of transparency of data, the risk of algorithmic biases and the difficulty of assigning responsibility for errors of autonomous systems, are increasingly evident in financial management practice.

The literature analysis points to the need to implement explainable AI systems, regulatory frameworks and data protection procedures such as anonymisation and advanced machine learning methods (e.g. Federated Learning). In addition, special attention should be paid to eliminating algorithmic biases through simulation testing and optimisation of results. The table below provides a valuable tool for understanding the main issues and developments in the ethical framework for the application of modern technologies in accounting and finance.

**Table 4.4.** Key ethical dilemmas in the areas of decision-making, EWS and cybersecurity

The ethical dilemma	Description	Ethical question	Proposed solutions
Transparency data	Risk of manipulation of results and ambiguities in decision-making algorithms	How to ensure transparency in AI decisions?	Ethical guidelines, explainable AI, algorithm audits
Accountability for AI decisions	Lack of clarity on who is responsible for errors generated by autonomous systems	Who is responsible for the decisions made by AI?	Regulatory framework, training, 'human-in-the-loop'
Data privacy and security	Risk of financial data leakage and unauthorised use	How to protect customer and organisational data?	Data anonymisation, Federated Learning
Algorithmic bias	AI systems can perpetuate discrimination and injustice	How to eliminate bias in AI algorithms?	Simulation tests, optimisation of results

Source: own elaboration based on the literature.

### Decision-Making by Information Users

Automation in accounting is changing the decision-making process, which raises challenges of accountability and transparency. Wang et al. (2024) analysed the performance of decision-making algorithms in the context of historical data, using predictive modelling methods on a sample of 150 companies. They identified the problem of unrepresentative data, which is that historical data used to train algorithms often reflect past errors, biases or limitations. Such data can lead to distorted analysis results and inappropriate decisions, especially in a changing business environment. The authors recommend creating more balanced and representative data sets that better reflect current and future market conditions.

Identified ethical issues include questions of responsibility (difficulty in clearly assigning accountability), bias (partiality and reinforcement of prejudices), lack of transparency (black box effect), and potential violations of privacy and individual autonomy. The authors concluded that EBA can enhance procedural transparency and stakeholder trust while acknowledging limitations such as conceptual and technical barriers. They recommended integrating EBA with organisational governance mechanisms, promoting interdisciplinary collaboration, ensuring system transparency, clearly assigning roles and responsibilities, and establishing independent oversight mechanisms for systems.

Lehner et al. (2022) addressed the ethical challenges associated with the use of artificial intelligence (AI) in decision-making processes in accounting and auditing. Their analysis was based on Rest's four-component model of ethical decision-making, aimed to understand how AI affects ethical processes and to identify implications for practitioners and researchers.

The study relied on a hermeneutic analysis of literature from 2015-2020, focusing on the identification of five main ethical challenges: objectivity, privacy (lack of control over how AI processes sensitive information), transparency, responsibility, and trust. The methodology involved a semi-systematic literature review and narrative analysis.

The authors noted that, despite AI's ability to process data and make decisions, it cannot independently meet ethical requirements due to its lack of autonomous morality. They suggested the need for shared responsibility between humans and AI, with adaptations in governance and audit processes to ensure ethical compliance, and recommended establishing AI governance committees within organizations, promoting algorithmic transparency, and enhancing users' knowledge and skills regarding AI applications in accounting.

C. Zhang et al. (2023) analysed the risks of introducing AI into management accounting. The study included an analysis of surveys of 500 accounting managers and simulations in AI systems, which showed the risks of dehumanising decision-making processes and technological misuse. The authors stressed that educating accountants on the ethical applications of AI and strengthening data security are key to minimising risks. The findings also suggested increasing individual and professional accountability in the use of these technologies.

Ahmad (2024) conducted a survey-based study among 312 respondents working in international organizations operating in Jordan, identifying ethical challenges related to the use of AI in accounting. Similarly to other authors, the study highlighted key ethical concerns such as data security, algorithmic bias, and accountability, while also incorporated respondents' expressed concerns about job losses and the need for retraining due to the automation of certain tasks by AI-driven systems.

Cybersecurity plays a key role in protecting financial data. Perols and Murthy (2021) analysed the impact of cybersecurity incidents on investors' decisions, using data from 200 listed companies. The study found that incidents reduce investor confidence, especially when auditors offer risk management services, and recommended reducing conflicts of interest.

Janvrin and Wang (2019) conducted a literature review and case study analysis of cybersecurity breaches in major organisations, including Equifax, Sony, and Target. The authors examined how cyber incidents impact the credibility of accounting information, regulatory compliance, and ethical practices within organisations.

The study identified key ethical issues, including a lack of transparency in disclosing cybersecurity incidents and a minimalist approach by companies to cybersecurity measures – often limited to merely meeting minimum regulatory requirements.

The authors emphasised that cybersecurity in accounting is not just a technological or regulatory issue but, above all, an ethical one. Companies and auditors have a professional ethical obligation to protect data, ensure honest reporting, and manage risk in a way that safeguards the interests of clients, investors, and society as a whole. An ethical approach to cybersecurity management is essential for maintaining trust and the reliability of financial data.

Their recommendations included strengthening internal ethical codes that highlight data management responsibilities, educating stakeholders involved in these processes, and introducing mandatory reporting requirements for cybersecurity incidents.

Munoko et al. (2020) pointed out the risks to data privacy arising from the use of advanced AI technologies in auditing. Their research was based on case study analysis and interviews with key stakeholders in the audit sector. The authors attempted to envisage and analyse potential future scenarios related to AI adoption, focusing on possible ethical conflicts that may arise when AI replaces traditional audit methods and the broader implications for stakeholders.

One of the key concerns identified was the excessive collection of data, which may be misused or stored in non-compliant ways, posing a direct threat to privacy. The authors proposed developing detailed data protection policies, including restrictions on data storage and processing, as well as the use of anonymisation tools to enhance trust in AI-driven accounting processes.

They stressed that while AI technology offers significant benefits, it also requires robust ethical risk management, including greater transparency, accountability, and consideration of social factors.

### **Identification of Early Warning Signals (EWS)**

Predictive systems, such as Early Warning Systems (EWS), support risk identification but can also lead to manipulation of results. The literature highlights cases of manipulation, including deliberate algorithm tuning to achieve favourable outcomes for specific stakeholders, falsification of risk indicators to conceal financial issues, and the improper use of training data, resulting in inaccurate forecasts.

Jiang et al. (2024) focused on the challenges associated with using modern technologies to predict corporate bankruptcies. They examined how manipulation of input data in bankruptcy prediction models can generate false early warning signals and lead to flawed financial decisions. One of the main issues with these models is the limited number of bankrupt firms available for calibration. To address this, the authors

analysed the potential of Generative Adversarial Networks (GANs) to improve input data quality by supplementing datasets.

However, several key risks were identified, including:

- data manipulation by report creators – dishonest firms, aware of how the algorithms work, may deliberately distort financial reports to avoid detection;
- inaccurate AI model predictions – underestimation of financial risk by predictive systems can shorten the early warning horizon, leading to misguided financial decisions;
- use of generative models (GANs) for data supplementation – while improving forecast accuracy, this approach also carries the risk of introducing false trends if applied unethically.

From an ethical standpoint these challenges raise concerns about AI algorithm transparency and the difficulty of implementing effective auditing mechanisms.

A recurring theme in researchers' conclusions is the risk of early warning model distortions due to fraudulent corporate reporting practices. Liu et al. (2024) proposed a solution combining Benford's Law, which detects data irregularities caused by manipulation, with early warning models. This integration enhances the predictive value of the models, providing a more reliable approach to financial risk assessment.

# Chapter 5

## Reporting

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## 5.1. Financial and Non-Financial Reporting – Overview of Research

Financial and non-financial reporting play a key role in communication between organisations and their stakeholders, ensuring transparency and reliability of financial data. Against the backdrop of dynamic technological change, the traditional approach to reporting is evolving, by using tools such as big data analytics, blockchain, artificial intelligence and integrated ERP systems. Today's technologies not only enable the automation of reporting processes, but also provide new opportunities for data analysis and data quality improvement.

Table 5.1 provides a summary of key academic publications on the impact of digitalisation on financial and non-financial reporting. The cited studies illustrate the diversity of research methodologies and approaches, from empirical studies to theoretical analyses. The authors analysed both the benefits of digital technologies, such as increased accuracy and speed of reporting, and the challenges, including the need for regulatory alignment and data security risks.



This presentation of publications also takes into account global trends in financial and non-financial reporting, including the growing importance of ESG reporting and the need to harmonise international standards. The research highlighted the fact that technologies such as blockchain are helping to improve transparency and data verifiability, key to building trust among stakeholders. The table also stresses the importance of education and the development of digital competencies among professionals responsible for reporting processes.

In conclusion, Table 5.1 provides an overview of the current state of knowledge on the digitalisation of financial reporting and reporting, offering insights into the main research directions and practical implications of the application of modern technologies in this area. This is a valuable source of inspiration for both researchers and practitioners who want to better understand how digital technologies are transforming approaches to financial reporting globally.

**Table 5.1. Publications on financial and non-financial reporting**

Paper	Test sample	Research method	Results/conclusions	Citations
Z. Zhang & Wang, 2023	Companies with Class A shares listed on the Shanghai or Shenzhen Stock Exchange; study period: 2007-2020; sample: annual reports for 10,798 companies	Textual analysis with the assumption that narratives in MD&A contain information about the function generating numerical financial data.	Increased comparability of financial statements is only associated with improved analyst forecasts in industries that do not operate on a short-term basis. Businesses with more short-termism in management are more likely to have unusual corporate behaviour and thus have less comparable financial statements.	1
Wen et al., 2023	Small companies, companies with smaller physical assets and companies that have not been audited by the big four audit firms selected	Empirical methods – regression model	Fintech developments have been shown to reduce the management of real earnings of entities and determine the increase in the quality of financial information. The development of FinTech will play a greater role in reducing opaque companies in terms of real earnings management. The idea is that their information tends to be difficult to obtain by external investors, and their investors have a greater need for ex ante information production.	16
Kovach et al., 2023	No data	Linear degression	Researchers have demonstrated that a new one, based on readily available data from financial statements, can be used to measure and predict production outsourcing.	0
J. H. Choi et al., 2023	Public companies listed on US stock exchanges	Statistical analyses on comparative data for employers and employees in the United States	The low quality of financial reporting is linked to an offsetting pay gap i.e. a risk premium.	5

Paper	Test sample	Research method	Results/conclusions	Citations
Bini et al., 2023	Interviews conducted with 13 participants from different Western European countries. Interview time: 45-60 minutes; form: online video conference; period: 10/20-04/21	Theoretical model (data collection technique: questionnaires and interviews with purposive sampling strategy) – constructing an interview guide	The findings indicate a lack of general consensus around a specific definition of a business model, its constitutive elements and its reporting function. The importance of business model reporting for assessing information related to corporate sustainability is highlighted.	2
Lantto, 2022	Interviews conducted between November 2006 and May 2009 among accountants	Case study – observation	Areas explored: company mergers, goodwill, provision requiring new types of entity-specific information; impact of accounting changes – conversion from FAS to IFRS and the impact of this transition on the consolidated financial statements.	2
Ibrahim et al., 2021	No data	Literature review on theories: agency, stakeholders and legitimacy	There are points of convergence between big data and financial reporting, performance measurement, auditing, risk management, corporate budgeting, etc. There is a need for convergence between big data and the theories of agency, stakeholders and legitimacy. Big data sets and advanced analytics can overcome data limitations in accounting techniques that require estimates and forecasting.	31
Nguyen et al., 2021	No data	Survey research; adaptive structure theory	The results show that system strictness, professional IT support and the accountant's sense of self-efficacy influence the faithful use of the accounting information system. Information systems play an increasingly important role in the accounting process and influence its efficiency.	14
Row-bottom et al., 2021	No data	Case study – interviews; literature review	The study found that the IASB has sought to address the impact of digitisation on disclosures by including information provided by companies, not just that required by the IASB – Digitisation of Corporate Reporting – XBRL.	26
Shan & Tros-hani, 2021	US and Japanese companies	Share price and return value adequacy models – implementation	The study deepens the knowledge of the time on the implications of digital corporate solutions, accounting information reporting technology. It is shown that selected accounting measures will be more relevant once XBRL is mandatory. Evidence is presented to support the predictions for the US sample. It was confirmed that the contribution of XBRL to the relevance of selected accounting measures to value is greater in the US than in Japan.	19

Paper	Test sample	Research method	Results/conclusions	Citations
De Franco et al., 2020	No data	No data	The reports of companies with the same auditor are textually similar (more so than others). This suggests that there is an impact on the report, even though it is only reviewed, as it is not audited strictly. A positive relationship was identified between the aforementioned impact and the improved readability of the report, due to the fact that the textual similarity of the report may improve the quality of disclosure, as greater audit impact is a positive feature of financial reporting.	16
Omer et al., 2020	No data	Social network survey methodology – the network depicts the audit committees' linkages using four standardised measures of linkage (measures of centrality: degree centrality; eigenvector centrality; proximity centrality; linkage centrality)	Companies with well-connected audit committees are less likely to have distorted annual financial statements, as committee links through director networks mitigate the negative impact of board interlocks on errors in the quality of financial reporting.	50
Pei & Vasarhelyi, 2020	No data	XBRL taxonomy	The U-XBRL system has been shown to combine all types of information relevant to entities (internal data and data from external sources/ financial and non-financial data), then standardise the information according to guidelines and collect it in a repository for use as required.	15
Christensen et al., 2018	No data	No data	Differences in local gambling attitudes help explain the incidence of financial reporting errors – potentially increasing the likelihood that financial reporters will be willing to take gambling risk in company performance.	54
R. Gao & Sidhu, 2018	Entities from 22 countries applying IFRS on a voluntary basis	Investment efficiency/ optimality models; multivariate regression analysis; quartile model, binary models, multinomial logit models	On the basis of entities where IFRS has been adopted, it was found that investment efficiency has increased as a result of the change in standards. The probabilities of underinvestment and overinvestment have also decreased.	13
Amiram et al., 2018	No data	A review of the literature on financial reporting irregularities from a legal, accounting and financial perspective	Financial reporting fraud and other forms of financial misconduct are a significant threat to the existence and efficiency of capital markets. The aim was to develop a common language for researchers interested in this line of research and to identify directions for future research.	164

Paper	Test sample	Research method	Results/conclusions	Citations
Hope & Vyas, 2017	No data	Data analysis; literature review	Sources of finance in private companies are heterogeneous. The usefulness of the financial reporting of these companies to capital donors was examined. There is considerable heterogeneity in the way private companies are financed, influenced by their specific business context.	51
Melloni et al., 2017	No data	Analysis of financial statements	It has been shown that increased disclosure does not mean better information in integrated reporting.	222
Appelbaum et al., 2017	No data	Review of the literature on the subject	The role of accounting is evolving from a traditional emphasis on financially-oriented decision analysis to a more strategic approach that emphasises identifying, measuring and managing key operational drivers of shareholder value. It is important to align the Managerial Accounting Data Analytics (MADA) framework based on balanced scorecards in the context of business analytics.	262
Black et al., 2017	No data	Multivariate regression analysis	It was found that many US companies continue to use exclusions in their financial statements that are not in line with GAAP standards.	43
Leuz & Wysocki, 2016	No data	A review of the empirical literature	Identification of disclosure information needs based on economic disclosure and financial reporting regulations, drawing on US and national evidence. The study looked at the costs and benefits of disclosure, the real effects of disclosure and regulatory developments.	698
Loureiro & Taboada, 2015	No data	Scenario analysis; difference-in-difference methodology	The ability of insiders (internal investors) to learn from outsiders (investors from foreign markets) improves after IFRS adoption, and this improved ability to learn from outsiders leads to real economic benefits. Conclusions: 1) price sensitivity of investments increases after IFRS adoption, 2) the relationship between market reaction to M&A announcements and the probability of completing a deal becomes stronger after IFRS adoption, 3) significant improvements in operating performance and stock returns after IFRS adoption, 4) feedback effect.	41

Paper	Test sample	Research method	Results/conclusions	Citations
Park & Jang, 2014	No data	Literature survey	The results indicate a lack of interdisciplinary research in hotel accounting. The authors propose new areas: behavioural accounting, human resource management, and indicate the usefulness of interdisciplinary research in this area with CSG reporting.	30
H. Zhu & Wu, 2014	No data	Regression method	The authors proposed a framework for assessing the quality of disclosures under XBRL: quality of information, XBRL versus GAAP taxonomy, XBRL versus GAAP standards; It was concluded that adding non-standard elements to the next version of the taxonomy could increase data interoperability with minimal adverse impact on the complexity and relevance of the taxonomy; industry specifications would increase both the completeness and relevance of the standard.	23
Cameran et al., 2014	No data	Literature review; lexical analysis of reports; statistical methods: correlation and regression; robustness tests as verification of results	The results show that the adoption of IFRS has not improved the quality of reporting among private companies; on the contrary, the quality has deteriorated because companies can use the level of flexibility contained in IFRS to pursue their own reporting interests.	41
Crawley & Wahlen, 2014	No data	No data	The study aims to: (1) inform business professionals about cutting-edge analysis in accounting research and (2) stimulate researchers to explore new and creative research opportunities.	9
Lantto, 2014	No data	Literature review; face-to-face interviews with professionals from New York Stock Exchange-listed companies	The results indicate the need to approximate and minimise the differences between IFRS and US GAAP. IFRS requires preparers to take more responsibility for reporting than domestic accounting standards (DAS) – which depends on the set of accounting standards.	17
J. J. Chen et al., 2014	No data	Descriptive statistics method	The results show a negative relationship between goodwill and voluntary disclosure for firms that rely heavily on guanxi for value creation (e.g. non-high-tech firms and firms located in regions with underdeveloped institutions). In contrast, a positive relationship between firm value and voluntary disclosure is found for firms that rely less on guanxi and more on other sources of core competencies (e.g. high-tech firms and firms in highly marketised regions).	30

Paper	Test sample	Research method	Results/conclusions	Citations
F. Lin et al., 2014	No data	Literature review; hypothesis testing based on Benford's law	The results indicate that companies with more conservative financial reporting are less likely to engage in earnings manipulation activities. A negative relationship was also found between earnings management and institutional investor holdings. However, if firms' financial statements tend to be conservative, institutional investor holdings may increase managers' incentives to manage earnings.	42
Debreceeny & Gray, 2001	No data	No data	Research indicates that a standard set of specifications for web-based financial and business reports is needed. One way to deal with the huge sources of information should be to automate web search through the development and use of intelligent agents. The 'eXtensible Business Reporting Language' (XBRL) is an initiative to develop specifications for web-based business reporting (taxonomies, database accounting, financial reporting, providing: intelligent agents, human/computer interfaces, standard development process and formal ontologies).	172
Baldwin & Williams, 1999	No data	No data	The financial reporting environment presents an opportunity for the development of intelligent agents to assist in financial reporting and analysis tasks.	6
Martinsons et al., 1999	No data	Developing a balanced scorecard concept for business functions, departments and even individual projects	The authors point out that the ability to mobilise and exploit softer and less tangible intellectual assets is becoming increasingly important. Information age companies need to focus on specific market segments or use technologically enhanced processes to efficiently produce and deliver their products and services.	356
Souza et al., 2024	Companies in the Brazilian electricity sector	Statistical methods. adapted Ohlson model (value relevance) and Hirfindahl-Hirschman Index (complexity of firms)	The impact of organisational complexity on value materiality under regulatory and financial accounting standards was analysed. The results contribute to demonstrating to policymakers that, depending on the level of organisational complexity, materiality from a financial perspective tends to decrease compared to the materiality of regulatory information.	0

Paper	Test sample	Research method	Results/conclusions	Citations
Elad et al., 2023	Sample: 245 African companies (214 were eventually surveyed)	Analysis	The study examined the accounting policy choices made by the largest non-financial companies from major jurisdictions in Africa when listed companies are required to adopt IFRS.	
Barker et al., 2013	No data	No data	Existing financial reporting until 2013 was characterised, on the one hand, by an excess of disclosures and, on the other hand, by a lack of a conceptual framework for organising and communicating disclosures. At the same time, there was a reported problem of better adapting the framework to the context in which financial statements are disclosed. This context has an important influence on the appropriate disclosure policy and practice in a given situation.	9
Murphy et al., 2018	No data	Experiment using a real case of fraud	Word choice and tone can help identify falsified financial statements. Through an experiment, it was found that people unconsciously show little suspicion.	5

Source: own elaboration on the basis of a review using the VOSviewer tool.

As a result of the literature review, publications on financial reporting and reporting were identified. A detailed summary of these, with indication of titles, authors, year of publication, methods and research samples, with conclusions and a number of citations is presented in Table 5.1. On this basis, it can be clearly stated that the largest amount of research in this period was directed towards the quality of reporting information, whereas a smaller number of publications concerned technology, single studies covering accounting regulations and competence issues.

Z. Zhang & Wang (2023) analysed the relationship between short-term planning and comparability of financial statement information. They used measures of short-termism in planning constructed using text analysis and machine learning based on Chinese language in management discussion and analysis (MD&A). The authors found that companies with a short-term approach produce financial statements with lower comparability (comparability is one of the qualitative characteristics of reporting information).

Wen et al. (2023) demonstrated in their research the role played by financial technology (fintech) in shaping information in the financial market in relation to the quality of corporate financial reporting. As fintech developments support credit finance in financial sectors through appropriate monitoring, this may further shape how firms report their activities in relation to disclosure costs and benefits. Using hand-collected data on fintech patents, the authors characterised regional fintech development and investigated its impact on firms' real earnings management. The results suggest that



fintech development improves the process of creating information and monitoring external financing.

J. H. Choi et al. (2023) posed the question of whether the quality of financial reporting affects employee compensation. Using employer-employee matched data in the United States, the authors verified employee characteristics by: regression of wages on firm-level reporting quality, documentation of wage changes, employee turnover and estimation of structural approach. They identified evidence consistent with two channels: pay for performance and turnover risk, where employees bear the risk of chaos in performance measurement. To mitigate endogeneity concerns, the authors pointed out that following the 2002 accounting scandals and the announcement of internal control weaknesses (ICW), former clients of Arthur Andersen and ICW firms pay bonuses to employees.

Research was also carried out on non-financial reporting in a selected area, namely Bini et al. (2023) highlighted that recent regulatory initiatives such as the EU Non-Financial Instruments Directive, the Reporting Directive, and the UK Companies Act, encourage companies to use the business model concept as disclosure of non-financial information in the annual report. These regulatory initiatives are based on a reflexive approach that avoids specifying what should be disclosed or formulating minimum disclosure requirements, indicating whether and to what extent users of non-financial information have a common understanding of the business model concept and its role in reporting.

Lantto (2022) examined how accountants obtain entity-specific information, how they read their financial statements and how they deal with uncertainty in this regard. The paper addressed cases of implementation of International Financial Reporting that incorporate the new types of entity-specific information that the standards require. The most important issue in such implementation is that accountants are becoming increasingly dependent on the knowledge of business managers. The study found that the result (or possible results) in financial reporting played an important role in controlling production, accountants actively used this as a problem-solving tool when the business side was unable (or unwilling) to present a 'clear picture' of the business activity.

Ibrahim et al. (2021) aimed to develop accounting standards, curricula and research to support individuals in dealing with the rapid growth of big data. The study revealed several potential points of convergence between big data sets and various accounting data, and discussed how big data sets can overcome the limitations of accounting data. The findings indicated a significant convergence between big data and accounting. Advanced analytics can address accounting data constraints that require estimates and forecasts.

Nguyen et al. (2021) demonstrated that the newly issued International Financial Reporting Standards (IFRS) have significantly transformed the accounting process and accounting information system (AIS). With the changes in information technology (IT), the proper use of AIS is crucial in order to have accurate information on which to

process business transactions and reporting information in accordance with the new requirements (IFRS).

Rowbottom et al. (2021) pointed out that digital corporate reporting enables computers to 'read' accounting information. Relevant here, 'standard setters' must construct a taxonomy to assign contextual 'metadata' that codifies disclosures derived from accounting concepts, standards and practices. However, digitalisation poses a problem for corporate reporting as under internationally accepted accounting practice, 'principles-based' standards give companies considerable discretion in deciding what they disclose and how they present information in their financial statements.

In turn, the study by Shan & Troshani (2021) extended the current understanding of the implications of digital reporting technologies on accounting information. The authors analysed how XBRL, the benchmark for digital corporate financial reporting, affects the relevance of accounting information in the United States and Japan, two key jurisdictions where XBRL has become mandatory. The researchers predicted that selected accounting measures will be more valuable once XBRL is fully implemented. The evidence gathered confirms that digital corporate reporting technology improves relevance and information reliability (Shan & Troshani, 2021). A study on data quality, quality of schemas, ontologies and other forms of metadata, and the quality of XBRL taxonomy was also conducted by H. Zhu & Wu (2014), who proposed a framework to assess the quality of disclosures according to XBRL.

A similar body of research was provided by Pei & Vasarhelyi (2020), who proposed the use of a new accounting system called User XBRL (U-XBRL) to address issues related to slow information dissemination, outdated accounting systems and high levels of data aggregation. U-XBRL collects, analyses and displays information in a way that meets the requirements of today's stakeholders. The article also discusses the measurement and corporate assurance ecosystem, highlighting the role of automation and machine analytics in data processing and evaluation (Pei & Vasarhelyi, 2020).

Omer et al. (2020) examined the impact of linkages between audit committees through directors' networks and the quality of financial reporting, particularly as it is related to misstatements in annual financial statements. They studied multiple dimensions of the linkage and found, after accounting for performance and corporate governance characteristics, that firms with well-functioning audit committees were less likely to misrepresent annual financial statements.

Christensen et al. (2018) analysed whether attitudes towards gambling help explain the occurrence of intentional misreporting, and showed that, similarly to gambling, some financial reporting choices are associated with deliberate, speculative risk taking. It is suggested that in places where gambling is more socially acceptable, managers are more likely to take financial reporting risks that increase the likelihood of having to restate financial statements. The study considered geographical variation in local attitudes towards gambling and finds that restatements due to deliberate misreporting are more common in areas where gambling is more socially acceptable (Christensen et al., 2018).

The research goal of R. Gao & Sidhu (2018) was to assess how IFRS adoption affects investment decisions and reporting performance in different countries. The study focused on the impact of mandatory IFRS adoption on externalities reporting and investment performance, analysing various variables such as operating cycle, leverage, dividend policy and financial performance indicators including CFO, sales and investments.

The fraud aspect was addressed in a review study by Amiram et al. (2018). The researchers highlighted that financial reporting fraud and other forms of financial misreporting pose a significant threat to the existence and efficiency of capital markets. This is a form of literature review on financial reporting fraud conducted from the perspectives of law, accounting and finance.

Hope & Vyas (2017) provided a comprehensive assessment of the sources of financing of private firms and their relationship with financial reporting practices. The study covered debt financing (bank financing, leasing and government guarantees), equity financing (family ownership, government ownership, employee ownership and private equity financing) and trade credit (supplier credit and factoring). It was pointed out that there is considerable heterogeneity in the way private firms are financed, influenced by their specific business contexts, and that this heterogeneity in financing is associated with differential demand and supply of financial reporting (Hope & Vyas, 2017).

Melloni et al. (2017) conducted research with reference to the Integrated Reporting Framework developed in 2013, stressing that they represent the most recent international attempt to combine a company's financial and sustainability performance (i.e. environmental, social and corporate governance) in a single report. It was pointed out that an integrated report (IR) should 'succinctly' communicate how a company's strategy, governance, performance and prospects, in the context of its external environment, lead to sustainable value creation. At the same time, the internal report must be 'complete and balanced', i.e. cover all the relevant issues, both positive and negative, in a balanced way. Drawing on research on impression management, selected performance determinants were investigated to gain insights into factors related to conciseness, completeness and balance in IR. The results from a sample of early adopter companies show that when a company's financial performance is poor, the IR is significantly longer and less clear (i.e. less concise) and more optimistic (i.e. less balanced). Moreover, it was found that companies with poorer social performance provide reports that are more vague (i.e. less concise) and contain less information on their sustainability performance (i.e. are less complete). The evidence gathered suggests that early adopters of IR use manipulation of quantity and syntax, as well as manipulation of thematic content and verbal tone as impression management strategies (Melloni et al., 2017). The results also indicated that such strategies depend not only on the level of firm performance, but also on the type of performance (financial or non-financial/sustainability).

Appelbaum et al. (2017) addressed the nature of the responsibility of management accounting which is evolving from simply reporting aggregate historical values to

measuring organisational performance and providing management with information related to decision-making. Corporate information systems such as enterprise resource planning (ERP) systems, provided management accountants with both expanded data storage power and increased computing power. It has been pointed out that with large data sets from both internal and external data sources, management accountants can now use data analysis techniques to answer questions such as what happened (descriptive analysis), what will happen (predictive analysis) and what is the optimised solution (prescriptive analysis). However, research showed that the nature and scope of management accounting has hardly changed, with management accountants using mainly descriptive analytics, some predictive analytics and an absolute minimum of prescriptive analytics (Appelbaum et al., 2017). The authors proposed a framework for management accounting data analysis (MADA) based on balanced scorecard theory in the context of business intelligence.

Black et al. (2017) addressed the frequency of non-GAAP (or 'pro forma') data reporting, which has steadily increased in the United States over the past decade, despite preliminary evidence that regulatory intervention has led to a decline in non-GAAP disclosures (cf. Almulla et al., 2024). In particular, the Sarbanes-Oxley Act of 2002 (SOX) and Regulation (2003) imposed strict reporting requirements for non-GAAP figures. Overall, the results suggest that although regulation has generally reduced aggressive non-GAAP reporting, some companies continue to disclose non-GAAP earnings figures that may be misleading in the post-SOX regulatory environment.

Leuz & Wysocki (2016) reviewed the literature on the economic consequences of disclosure and financial reporting regulation, drawing on US and international evidence. Given the policy relevance of regulatory research, they highlighted the challenges of: quantifying regulatory costs and benefits, measuring disclosure and reporting outcomes, and drawing causal inferences from regulatory research. They pointed out that understanding these linkages is important in evaluating the introduced regulations. The study synthesised empirical evidence on the economic effects of disclosure regulation and reporting standards, including evidence on the adoption of International Financial Reporting Standards (IFRS).

A study by Loureiro & Taboada (2015) enabled answering whether and how an exogenous shock in the information environment changes the ability of insiders to learn from outsiders. The authors found an increase in the price sensitivity of investments after the adoption of International Financial Reporting Standards (IFRS), additionally indicating that the relationship between market reaction to M&A announcements and the probability of completing a deal becomes stronger after IFRS adoption. They also found a significant improvement in operating performance and stock returns after IFRS adoption.

Park & Jang (2014) examined the intersection of finance and accounting in the hospitality industry from a global perspective. The paper stressed the need for research in hospitality finance/accounting (HFA) to not only understand past trends, but also identify future directions, whilst Crawley & Wahlen (2014) presented various analyses

in empirical/archival financial accounting research, and focused on research questions that are central to accounting, on analyses used to test hypotheses, and evidence. They described voice and text analysis that generates interesting new datasets and hypothesis testing, offering promising potential for future research. Their study aimed to inform business professionals about cutting-edge analytical methods in accounting research, and also encourage researchers to explore creative new research opportunities.

Debreceeny & Gray (2001) indicated that a standard set of specifications for web-based financial and business reports is required, as one of the ways to deal with huge sources of information should be to automate an Internet search through the development and use of intelligent agents. They identified three factors that are prerequisites for the effective use of the web, namely there should be adequate representation of metadata of financial reporting information, the ability to reliably analyse (recognition problem) on web pages, and that standard mechanisms are required to encourage or require corporations in reporting to be consistent.

Baldwin & Williams (1999) highlighted two factors that positively influence the likelihood of intelligent agents for financial analysis becoming a viable option for Europe in the future. Firstly, the science of intelligent agents is developing rapidly, with huge advances in the design and operation of the underlying agents being reported each year. Secondly, the European financial community is moving towards a better relationship between financial markets and accounting standards.

Souza et al. (2024) analysed the impact of organisational complexity on value materiality according to regulatory and financial accounting standards in the Brazilian electricity sector. Performing the analysis by business segment of companies in the electricity sector, differences in the materiality of financial and regulatory information were noted. In the transmission segment, data refer to equity, while in the distribution segment, profit information is more relevant. For both segments, complexity has negatively affected the materiality of their information, thus reducing it. The results contribute to demonstrating to policymakers that, depending on the level of organisational complexity, materiality from a financial perspective tends to decrease compared to the materiality of regulatory information.

Murphy et al. (2018) investigated whether and how linguistic indicators of fraud find their way into the management discussion and analysis (MD&A) section of financial reports. While research has shown that word choice and tone can help identify fraudulent financial reports, it is not yet clear how this happens when these reports are written by multiple individuals, some of whom are unaware that financial fraud is occurring. By examining industry recommendations and interviewing people experienced in writing MD&A sections, the authors confirmed that many a hand are involved in writing this part of financial reports.

To sum up, it can be concluded that the main stream of research in the area of financial reporting and (non-financial) reporting in the period under review addressed the qualitative aspect of reporting information, the technological aspect (the use of new technologies in the process of developing reporting information), the regulatory aspect

(the impact of balance sheet law standards on the scope and type of disclosures) and competence issues were also distinguished, with two involving single publications.

## 5.2. Impact of Digitalisation on Financial and Non-Financial Reporting

Among the technological solutions related to digitalisation, it is important to highlight the tools that have a significant impact on accounting processes, facilitating their automation, efficient data analysis and reporting of reporting information, and ultimately improving the decision-making process. In this aspect, the following areas can be highlighted.

### Cloud Computing

Cloud Computing is one of the main innovative AI tools used in accounting because of its ability to store data in the so-called cloud which users can access simultaneously and edit information from anywhere. This allows flexibility, increased scalability and speed of data processing and contributes to the effective modernisation of accounting policies. The advantages of cloud technology include:

- the speed with which cloud technology can be introduced into the operations of any organisation,
- real-time data analysis,
- filtering out irrelevant information,
- automation of calculations,
- the ability to store large amounts of data (Khomiak et al., 2022).

### Blockchain

Blockchain technology ensures the security of records due to the fact that they cannot be altered or duplicated, which helps to ensure a high level of trust and transparency in accounting policies (Blessing, 2024). In addition to reliability, blockchain ensures integrity of records and the use of big data allows analysis and identification of relationships and trends, which supports strategic decision-making, etc. (Khomiak et al., 2022). With blockchain technology it is possible to store structured and easily accessible data in real time. Such a solution determines an increase in accuracy, speed and interoperability in routine accounting processes and in the reporting of their results.

### Machine Learning (ML)

Machine Learning algorithms allow the rapid processing of large financial data sets, identifying trends, patterns and anomalies that would be difficult or impossible to detect without digital technology, also because they are constantly evolving as new data is provided, and this makes them highly adaptive to the changing financial environment. This ability to continuously learn makes the technology essential to improving the efficiency of both financial reporting and audit processes, thus real-time reporting results in increased confidence in the organisation and its accountability

(Blessing, 2024). Using ML algorithms, organisations can identify patterns of, for example, environmental behaviour, predict trends and assess the environmental impact of their activities with unprecedented precision. One of the key advantages of artificial intelligence, relevant to the concept of sustainable accounting is its ability to enhance the accuracy and reliability of data (Adelakun et al., 2024).

### **Internet of Things (IoT)**

The Internet of Things refers to a network of physical devices (sensors, sensors, etc.) that exchange data with each other via the Internet. The implementation of the Internet of Things allows the collection of large amounts of data in real time, which helps to streamline accounting processes and ensures the accuracy and speed of information exchange. IoT devices equipped with environmental sensors can stream data to AI systems that immediately process and analyse the information, which is crucial for timely reporting and its compliance with e.g. environmental standards (Adelakun et al., 2024).

### **Big Data**

Big data technology can improve the quality of financial reporting by increasing the transparency of accounting information, since by combining different data sources into an integrated system, it can improve the quality of reporting information, e.g. by transforming narrative information into numerical values, images and other forms of visualisation in non-financial, narrative reporting. Large data sets are also important for building continuous and two-way communication with all users of information from each organisation's accounting systems, and this determines the consideration of the diverse information needs of all stakeholders. With the use of this tool, the role of accountants is evolving as specialists with the right information processing skills are becoming increasingly necessary. The main disadvantages of big data include privacy issues and those related to the risk of cyberattacks – resulting in the loss or adverse use of information (Bonsón et al., 2021; Khomiak et al., 2022; Shapovalova et al., 2023).

### **Artificial Intelligence**

The use of artificial intelligence tools simplifies complex financial reporting by generating personalised financial statements in real time, essential for stakeholders of business entities who demand increasingly transparent and timely data (Almulla et al., 2024). AI-based systems can generate real-time financial reports, enabling organisations to access up-to-date financial and non-financial information, which allows for faster decision-making and more responsive business strategies. Hence, AI-based reporting tools can be configured to comply with multiple reporting standards simultaneously.

### **Visualisation of Data and Information**

The use of digital technology for the visualisation of data and information makes it possible to present them in graphical or visual forms that are easier to interpret for the audience. Thus the use of tools of this type enables creating dynamic, interactive



financial and non-financial reports that can be adapted to the information needs of report users, e.g. through different levels of detail, making it easier to understand financial results, trends, etc. With the use of dashboards, key performance measurement indicators can be monitored in real time by adapting to their specific reporting framework, which ensures that stakeholder requirements are met and, at the same time, determines the regulatory compliance of the reports (Blessing, 2024).

### **eXtensible Business Reporting Language (XBRL)**

XBRL allows for structuring and labelling of data in financial reports, ensuring standardisation and automated processing of data and information. Through automated analysis and data processing, this standard facilitates the efficient exchange of data and information, ensuring greater accuracy, accessibility and transparency (Shapovalova et al., 2023). As a machine-readable format for electronic transfer of business and financial data, XBRL allows organisations to communicate seamlessly and accurately (Nofel et al., 2024).

### **Natural Language Processing (NLP)**

In financial reporting, NLP plays a key role in processing unstructured data and information from contracts, emails, legal documents, reports, etc., which helps to ensure that financial statements comply with complex regulatory frameworks. By automating the extraction and interpretation of textual data, NLP increases the efficiency of accounting processes (Blessing, 2024). The use of the NLP technique leads to the transformation of financial reporting by automating the generation of reports, using linguistic analysis tools resulting in the presentation of data and information in a consistent and structured manner. NLP algorithms can also process large data sets, identify key trends, generate text summaries, etc. This speeds up not only the report generation process itself, but also ensures, in addition to consistency, the accuracy of the presentation (Jejenywa et al., 2024).

### **Robotisation of Business Processes (RPA)**

RPA technology in accounting is particularly effective in automating routine, repetitive tasks, reducing the likelihood of human error and the labour intensity of these processes. The technology – through its ability to collect data from multiple sources, financial systems, databases and external documents and incorporate them into financial statements – ensures their consistency (Blessing, 2024). Hence, the integration of artificial intelligence (AI), machine learning (ML) and RPA technology is revolutionising the accounting sector by improving the efficiency and accuracy of various accounting processes (Samson Ayinla et al., 2024).

### **Digitalisation in Management Accounting**

Technologies such as artificial intelligence – expert systems, machine learning, natural language processing (NLP), robotics – are transforming traditional management

accounting practices. Key areas where the development of new technologies adds value are in efficient data analysis and decision-making, automation of routine tasks, real-time monitoring and reporting, and predictive analytics for risk management. Thus, the accuracy and timeliness of financial forecasts and budgeting processes can be significantly improved, while the implementation of, for example, RPA technology can allow operational costs to be reduced. Real-time reporting, facilitated by artificial intelligence, increases the transparency of data and information on an organisation's financial and asset position and enables proactive management, while predictive models help managers make decisions to mitigate risk. Expert systems that mimic the capabilities of a human expert can support complex decision-making processes and the use of machine learning and business intelligence systems by analysing large data sets to discover patterns, trends, etc., determine the increase in accuracy and timeliness of financial forecasts as well as budgeting processes (Almulla et al., 2024). This enables proactive risk mitigation, thereby increasing competitiveness in an increasingly dynamic market, whilst the data and information generated is generally very complex and requires specialist skills to interpret it accurately (Hamidah, 2024).

### Technology in Sustainable Development

The implementation of digital technologies plays a key role in sustainability, with specific social and ethical implications for organisations and their stakeholders (Bonsón et al., 2021). Big data tools enable the collection, analysis and reporting of ESG data in a more streamlined and accurate way, helping organisations meet regulatory requirements, and demonstrates their commitment to sustainable and ethical practices; large data sets also support more effective communication with all stakeholders (Faccia & Petratos, 2024). A significant contribution of artificial intelligence is to increase transparency and accountability in environmental reporting. Through the use of NLP algorithms one can analyse and interpret regulatory texts, corporate reports, etc., confirming that organisations are complying with sustainability standards and guidelines (Adelakun et al., 2024).

Based on contemporary research, the relevant aspects of the impact of digital technologies on financial and non-financial reporting can be summarised as follows.

1. Implementation: artificial intelligence (AI) solutions are revolutionising real-time financial reporting by increasing accuracy, efficiency in decision-making processes and reducing the risk of human error. This enables regulatory compliance, improving operational transparency and resulting in a reduction in operating costs at the same time (Sanjiwani et al., 2024).
2. The use of modern IT tools such as big data technology, XBRL language, machine learning, cloud computing can lead to improvements in reporting quality, as the financial reporting process relies heavily on the verifiability and transparency of transactional data (Autore et al., 2024).
3. Digital transformation tools enable flexible, secure, efficient processing of large volumes of data, with automation of routine accounting processes, increasing

the accuracy and transparency of reporting from the accounting system. However, there are risks associated with errors in digital technologies and the threat of losing confidential data, which implies the need to establish ethical standards related to the implementation of artificial intelligence (Shapovalova et al., 2023).

4. The integration of artificial intelligence with accounting information systems offers significant potential to improve the quality of decision-making, which may ultimately lead to changes in accounting procedures and financial reporting standards (Sanjiwani et al., 2024).
5. Big data in financial and non-financial reporting facilitates the processing of large amounts of data from a variety of sources, improving predictive accuracy and enhancing the quality of decision-making processes. The technology addresses the challenges of complexity and high data velocity using advanced analytical tools (Indrayani et al., 2024).
6. Thanks to modern technologies, various methods and techniques can be used at the stage of data entry, processing, and analysis of reporting information, namely voice recognition, natural language, images, automatic document scanning, and visualisation of information. This leads to a reduction in the level of distortion of accounting information and helps to ensure its authenticity and accuracy (Khomiak et al., 2022).
7. Automating routine tasks in reporting and reporting reduces the need for human resources, allowing accounting teams to focus on strategic analysis and decision making (Maksymov et al., 2023).
8. Artificial intelligence technologies such as optical character recognition (OCR) and natural language processing (NLP) have revolutionised data entry, enabling machines to read and interpret text from images and documents. This leads to more reliable and accurate data reconciliation processes, reducing the risk of errors and ensuring compliance with regulatory requirements.
9. A configurable reporting framework enabled by artificial intelligence tools determines organisations to align their sustainability reports with international standards and guidelines, providing a comprehensive set of indicators for reporting environmental, social and governance (ESG) performance, which ensures transparency, comparability and credibility of reports.
10. Dashboards, based on artificial intelligence technology, enable an organisation's stakeholders to analyse data, tracking progress towards sustainability goals, with access to detailed reports and analysis (e.g. through dynamic and interactive visualisations of environmental data). This real-time transparency fosters a culture of accountability by reinforcing stakeholders' confidence in the organisation's commitments in this regard.
11. Technologies enable organisations to meet and even exceed stakeholder expectations by providing timely, accurate and relevant information on their environmental performance. This proactive approach to stakeholder engagement

enhances an organisation's reputation and fosters positive relationships with key audiences for reporting information (Jejenywa et al., 2024).

12. In the field of accounting, the impact of artificial intelligence goes beyond the mere implementation of technology, as it marks a paradigm shift in the way financial processes are conceived, executed and evaluated. The combination of technological agility and financial insight – in effect, the integration of modern digital technologies into accounting practices – not only increases the efficiency of routine tasks, but also enables accountants to take on more strategic roles in organisations (Jejenywa et al., 2024).
13. The convergence of AI and accounting requires interdisciplinary collaboration with data analysts, AI specialists and IT professionals (Jejenywa et al., 2024). In fact, artificial intelligence has become an ally of accountants, changing accounting practices and redefining the accounting profession.
14. The effect of integrating artificial intelligence with accounting practices was to create a balance between the benefits of increased quality in decision-making and the challenges of ethical considerations, data security and workforce dynamics (de Villiers et al., 2024).
15. The capability of generative artificial intelligence tools such as ChatGPT has serious implications for the future of corporate reporting, including sustainability reporting. This implies the threat posed by greenwashing in terms of reporting credibility, creating a gap between an organisation's disclosure to stakeholders and the organisation's actions (Moodaley & Telukdarie, 2023).
16. AI technology can make non-financial information more accessible to stakeholders by providing easy-to-understand and interactive information. This can help organisations to better communicate the impact of their sustainability initiatives and thereby ensure increased trust in their operations (Arkhipova et al., 2024).
17. Business Intelligence Systems which include a variety of support systems for reporting and data analysis, offer timely, relevant and easy-to-use information for strategic, tactical and operational levels of decision-making within an organisation. These systems are increasingly being used to provide management reporting capabilities and to enable deeper analysis of data obtained through advanced analytical techniques (Martins et al., 2024).
18. The use of natural language processing (NLP) in financial reporting represents a transformative step forward in the way organisations communicate their financial performance. As technology continues to evolve, the use of artificial intelligence tools, and NLP in particular, has the potential to redefine standards of financial transparency, accessibility and communication, ushering in a new era of informed and engaged stakeholders (Jejenywa et al., 2024).
19. RPA enables organisations to scale their operations by automating repetitive tasks with large amounts of data, thereby increasing operational efficiency without increasing human resources (Blessing, 2024).

20. The implementation of artificial intelligence requires responsible governance and the existence of ethical standards, as it raises concerns about data security, privacy and the ethical use of the technology (F. Zhang et al., 2024).

Contemporary research clearly indicates that digital technologies are having a revolutionary impact on financial reporting and reporting. The implementation of artificial intelligence enables the generation of real-time reports, which significantly improves accuracy, efficiency and regulatory compliance. AI eliminates many human errors, reduces operational costs and at the same time increases the transparency of decision-making processes. These developments contribute to improving the quality of reporting and building stakeholder confidence.

Modern IT tools such as big data, XBRL language, machine learning and cloud computing are revolutionising the way financial data is processed and presented. These technologies support the verifiability and transparency of transactional data, leading to more reliable and accurate reports, whilst the automation of routine accounting processes allows finance teams to focus on strategic activities, increasing the value of their work in organisations.

At the same time, the development of technology brings with it challenges related to data security and ethical standards. The implementation of AI and digital tools requires careful governance and the development of regulations to ensure data protection and information confidentiality. There is also a need to educate and develop digital competencies among professionals so that they can realise the full potential of modern technologies in reporting and reporting.

The role of technology in sustainability reporting (ESG) is also significant. AI and other digital tools enable reports to be aligned with international standards, ensuring transparency and comparability. Interactive dashboards allow stakeholders to monitor an organisation's progress in real time, reinforcing a culture of accountability and trust.

In conclusion, digital technologies are transforming financial reporting, increasing its transparency, efficiency and strategic relevance for organisations, while their development requires continuous regulatory adaptation, addressing ethical challenges and building interdisciplinary competencies, which are key to maximising their potential in the future.

### **5.3. Diagnosis and Directions for Further Research**

The development of reporting is leading to a combination of financial and non-financial reports towards presenting a holistic view of the entity. A review of the literature on financial and non-financial reporting in modern companies identified four main sub-areas: quality of reporting, technological aspect in reporting, regulation, and competence. The review showed that the articles in this area were mainly concerned with the quality of the financial statements presented, and addressed the technological aspect to a lesser extent. Section 5.2 extended the research to recent publications on

the impact of digitalisation on reporting. Technological tools were presented that have a significant impact on accounting processes, facilitating their automation, effective data analysis and reporting of reporting information.

The third section identified key areas indicating how digitisation affects the process of reporting information. In particular, the analysis addressed:

- automation in the reporting process,
- the use of technology for ESG reporting,
- the quality of the reports prepared,
- the development of technological competence in the area of reporting.

Table 5.2 highlights the transformative potential of automation in impacting the quality and presentation of financial and non-financial reports. Digital technologies like Blockchain, Big Data, Artificial Intelligence (AI), Machine Learning (ML) and the Internet of Things (IoT) are providing individuals with big data processing, process automation, greater accuracy and transparency in reporting. The strength of digital technologies is the speed and efficiency of the reports generated. A breakthrough in financial reporting was the use of **natural language (NLP)**, enabling entities to extract important information from unstructured sources. Traditional reporting processes were both labour intensive and time consuming. NLP, using linguistic analysis, speeds up the process of generating reports and ensures consistency and accuracy in the presentation of financial information, and plays a key role in the speed of reporting. With NLP technology, individuals have access to up-to-date information and can use it for reports. The ability to process data in real time increases the timeliness and relevance of reporting. With NLP, the financial reports presented are enriched by the interpretation of factors affecting financial performance, as NLP allows financial reports to be customised based on the preferences of different stakeholders. The use of **cloud computing** providing real-time data reporting is also becoming commonplace. Real-time transaction reporting is also enabled by **blockchain** technology.

**Table 5.2. Areas of influence of modern technology on the reporting process**

Key research areas	Description	Exemplary publications
Automation in the reporting process	Automation of repetitive operations such as data entry, reconciliation and reporting has streamlined the work of finance and accounting services. Units have reduced the time it takes to produce both financial and non-financial reports. Automation has also ensured consistency in accounting records. NLP algorithms can process huge data sets, identify trends and generate text summaries. The widespread use of cloud computing has enabled real-time data processing and reporting.	Azaan & Elsa, 2024; Adeyelu et al., 2024; Jejenywa et al., 2024
Improving the quality of reports	Digital technologies favour efficiency, accuracy and speed of reporting. AI-based systems can process huge amounts of data with high precision. The use of data analytics and blockchain technology increases the transparency and overall quality of reports.	Islam Priom et al., 2024; Jejenywa et al., 2024; Yarmoliuk et al., 2024

Key research areas	Description	Exemplary publications
Use of technology for environmental reporting	Digitalisation is essential for environmental aspects. Through AI tools, ESG assessment is more accurate, which in turn enhances accountability and stakeholder engagement. Using ML algorithms, individuals can identify patterns, predict trends and assess the environmental impact of their actions with unprecedented precision. IoT devices equipped with environmental sensors can stream data to AI systems that immediately process and analyse it.	Abhishek et al., 2024
Development of competence	There is a need to intensify the use of technological and analytical tools in curricula, and to invest education and training in different AI models.	Azaan & Elsa, 2024; Pargmann et al., 2023; Rabbani, 2024

Source: own elaboration based on the literature review.

There is a growing body of research dedicated to the use of AI in environmental reporting. When creating an ESG report, it is important for entities to provide a comprehensive picture of activities in key environmental, social and governance areas. For many entities, however, the accuracy of reported ESG data is a major stumbling block. An analysis of articles in this area indicated that digitalisation enabled entities to analyse environmental variables, allowing them to anticipate emerging risks and develop strategies.

Current global trends emphasise the relevant competence requirements for accounting graduates (Table 5.3). Concepts of understanding the challenges and opportunities created by digitalisation need to be introduced into curricula, whilst companies also need to invest in training programmes to help employees adapt to technological advances.

**Table 5.3. Planned research directions on the impact of digitalisation on reporting**

Key areas	Description	Suggested testing methodology
Automation in the reporting process	What digital techniques are used in the reporting process?	A case study of companies with high levels of integration with blockchain and cloud technologies
	What is the impact of AI on reporting in different industries and regions?	Analysis of regulatory documents and industry reports to determine the current state
	What are the determinants of the use/choice of digital techniques?	Interviews with financial managers
	What units perceive problems when implementing AI?	Case study of companies using AI, interviews with financial managers
	What are the challenges of integrating AI with existing F-K systems?	Case study of companies using AI
Improving the quality of reports	Can artificial intelligence be detected in reports? Does it make a difference?	Case study of companies using AI
	Is there a framework for collaboration between the technology industry and the accounting industry?	Case study of companies using AI in reporting



Key areas	Description	Suggested testing methodology
Use of technology for environmental reporting	How can digitalisation improve the monitoring and reporting of ESG indicators?	Analysis of national and international literature, analysis of regulations and, in particular, analysis of sustainability standards
	How to explore the most effective ways to incorporate ESG indicators into financial reports?	Quantitative and qualitative research
Development of competence	Are curricula aligned to a hybrid skill set that combines specialist knowledge with technological proficiency?	Quantitative and qualitative research
	Are there innovative solutions that integrate AI with accounting education?	Quantitative and qualitative research
	Are employees willing to learn new skills to adapt to changing expectations on the job?	Quantitative and qualitative research

Source: own elaboration based on survey.

The future of accounting is the convergence of automation and artificial intelligence. It is important to emphasise that they provide unprecedented opportunities in terms of efficiency and quality of prepared reports, but their implementation requires a considered approach to ensure ethical conduct and take into account the evolving role of accountants in this transformation.

The implementation of modern technology in reporting, while addressing data security, ethics and regulatory compliance issues, will be crucial in an era of digital transformation. Blockchain is now emerging as a technology that has the potential to transform traditional double-entry accounting to a novel so-called triple-entry accounting (Yadav et al., 2024), and this system may be a more reliable way to secure financial information. Triple-entry accounting increases transparency by providing a more comprehensive and accurate representation of financial transactions, achieved by incorporating a third entry that serves to confirm and validate the traditional double-entry accounting system. At the same time, it reduces the time gap between the occurrence of a financial event and its subsequent recording.

However, the widespread implementation of blockchain faces some problems that need to be addressed. Limitations in this context include lack of standardisation, scalability issues and privacy. Therefore future research on the convergence of accounting systems with blockchain technology and triple-entry accounting should address the following aspects (Yadav et al., 2024): exploring the dynamics of inter-organisational collaboration in the context of triple-entry accounting, formulating and implementing a formal legal framework for triple-entry accounting, and assessing the opportunities, challenges and best practices in implementing blockchain and triple-entry accounting. Studying triple-entry accounting not only promises to redefine the organisation of accounting in business entities, but also implies reshaping audit processes, increasing the accuracy of financial reporting and reducing the risk of fraud.

As the future of reporting is non-financial reporting, it is necessary to highlight research directions in this area using artificial intelligence techniques presented in Table 5.4.

**Table 5.4. Research on ESG reporting using artificial intelligence techniques**

Key ESG research areas	Typical problems	Typical ESG areas	Typical AI techniques	Research in this area
ESG disclosures	Analysis of ESG disclosure data and identification of trends	Assessment of ESG disclosures and investor sentiment towards organisations in ESG reports and their categorisation	Event analysis, interaction modelling, learning, modal analysis, prediction techniques, etc.	(Briere et al., 2022; Chang & Lee, 2022; A. H. Huang et al., 2023; Reig-Mullor et al., 2022)
ESG measurement	Measuring the social and financial impact of climate change	Develop predictive models to help investors and other organisation intersectors anticipate changes in an organization's ESG performance	Time series analysis, sequence analysis, pattern mining, dynamic processes and programming, machine learning and deep learning models, etc.	Briere et al., 2022; Chang & Lee, 2022; A. H. Huang et al., 2023; Reig-Mullor et al., 2022)
ESG management	Identifying and assessing potential ESG risks, as well as monitoring and ensuring compliance with relevant regulations	Monitor and enforce ESG compliance by automating the tracking and analysis of ESG data	Probabilistic modelling, classification, clustering, learning, behaviour modelling, sequential modelling, novelty/exception/change detection, pattern mining, event modelling, etc.	M. Chen et al., 2021, 2022; Fan & Wu, 2022; Lim, 2024
ESG data analysis	Identify and extract ESG-related information from large amounts of unstructured data, such as newspaper articles, social media posts, company reports, etc. for assessing environmental factors	Access textual data from corporate sustainability reports to extract ESG-related information, using natural language processing techniques, etc.	Text analysis, pattern mining, classification, generative adversarial network, prediction, evolutionary computing	Gupta et al., 2021; Lopez et al., 2020; Rizzato et al., 2022; Sokolov et al., 2020

Source: own compilation based on (Lim, 2024).

In the area of ESG reporting practitioners can use artificial intelligence tools to analyse data on ESG disclosure, develop ESG measurement tools and improve ESG management practices. Future research directions could focus on the following areas: exploring the potential of emerging artificial intelligence techniques such as graph neural networks, learning models, etc. to improve ESG-related financial applications and address the responsible use of artificial intelligence; assessing the impact of regulatory frameworks, industry standards and stakeholder expectations on the adoption and integration of ESG and AI.

Directions for further research in the aspect of technology and ESG integration are determined by the following research questions (Lim, 2024):

- How will technology applications facilitate better quality ESG reporting?
- Will ESG disclosures based on the application of modern technology improve ESG reporting performance?

- How will disclosed ESG information further facilitate investors' and organisations' decisions to achieve sustainability goals?

The research directions presented, together with the research questions, provide direction for the area related to financial and non-financial reporting.

#### **5.4. Ethical Dilemmas of Financial and Non-financial Reporting in the Context of Modern Technology**

Accounting ethics is commonly defined as the totality of principles, the norms of behaviour in force in a given collective, era and environment, and is identified with morality, i.e. the rules of conduct considered appropriate. This includes societal standards of behaviour, including those related specifically to the accounting profession. Since ethical decision-making is more than just making a choice, it involves critical thinking that accepts the existence of multiple viewpoints and values that are sometimes in conflict with each other. The hierarchy of ethical decision-making includes acting in accordance with the law, with the rules of the profession and/or code of conduct, and on the basis of moral values and philosophical reasoning from the area of right and wrong (Cieślak, 2011). There are ethical dilemmas associated with accounting ethics – relating to financial and non-financial reporting in the context of modern technology – such as artificial intelligence and blockchain, which can affect many areas, hence this monograph highlights only the most important ones.

##### **Transparency and Honesty**

One of the main challenges is to ensure transparency in the use of artificial intelligence, which includes understanding the basis of decisions made by algorithms and the implications of their use in financial reports. The inappropriate use of AI can lead to reporting errors, affecting the credibility of financial information, and thus leading to a lack of transparency in decision-making processes and in the financial reports themselves. The use of algorithms in financial analysis may increase the risk in terms of distortions or simplifications that could falsify the presented financial position of the audited entity, undoubtedly affecting the fairness of the analyst's assessment and accountability (Groşanu et al., 2024).

##### **Responsibility**

In the context of the use of AI, an important issue is the problem of accountability for decisions made by automated systems. Attributing responsibility for erroneous decisions or fraud that may result from the use of technology is becoming a key challenge for companies, and this can lead to ethical concerns regarding the professional responsibility of accountants (Groşanu et al., 2024). The balance sheet legislation indicates the scope and type of responsibility in this aspect, however there is a doubt whether this will be a barrier when implementing new technologies in reporting practices, as the responsibility for interpreting and presenting financial statements using AI software will also fall on accountants (P. H. Rana, 2024).

### **Security and Data Protection**

Another key area is information security. The increased digitalisation of financial data raises new data protection and privacy challenges. Potential security breaches can lead to unethical practices such as the leak of confidential information (P. H. Rana, 2024). In the context of non-financial reporting, adequate protection of personal data and sensitive information is a significant challenge. The increased processing of data by AI raises concerns about privacy breaches and regulatory needs for data protection (Groşanu et al., 2024), which also needs to be taken into account in business practice. Implementing monitoring systems that can identify and assess AI risks, including potential algorithmic bias, is undoubtedly an important step in maintaining security and ensuring the right conditions are in place to accept responsibility for AI activities.

### **Objectivity and Impartiality**

Artificial intelligence can also be susceptible to biases, which can lead to unfair practices in the reporting of financial results. Automated systems can reproduce existing biases in the data, requiring special attention from accountants to ensure equality and fairness in reports (Groşanu et al., 2024). Technology can affect the objectivity of accountants, whereas the use of AI can introduce bias in decision making if algorithms are not designed to be neutral (W. Zhang, 2024) also in the context of the quality of reporting information.

### **Ethical Use of Algorithms**

Accountants are responsible for the ethical use of technology, which includes the responsibility to verify the reliability of AI algorithms. The inappropriate use of technology can lead to the manipulation of financial data and fraud, therefore it is important for accountants to understand AI algorithms and be able to assess their implicit risks (W. Zhang, 2024). Accountants should ensure that AI-based decision-making processes are clear and understandable. It is vital that information stakeholders have access to knowledge of the methods and models used to prepare and analyse financial data (Groşanu et al., 2024). In view of the above, accountants need to be familiar with the basic algorithms and models behind AI systems to be able to assess their reliability and make ethical decisions when using and sharing data generated with support from new technologies (W. Zhang, 2024).

### **Compliance with Professional Ethics**

Technological change introduces new challenges in complying with existing ethical standards. Accountants must adapt their practices to the new realities, which implies the need for training in the ethical use of new technologies (Groşanu et al., 2024). This suggests the need to adapt ethical standards and ensure that accounting professionals are adequately trained to effectively identify and manage risks in the face of the challenges involved.

Note that many countries and regions have become aware of the ethical risks posed by AI and introduced a number of ethical principles for the areas in question. In March 2018, the EGE announced a Statement on Artificial Intelligence, Robotics and Autonomous Systems, comprising seven ethical principles, namely (C. Zhang et al., 2023):

- human dignity – artificial intelligence algorithms should not be used in a discriminatory manner;
- autonomy – whether, how and when to use AI systems are determined by humans, and that systems should be transparent and predictable;
- responsibility – the design, development and use of artificial intelligence systems should not introduce an unacceptable risk of harm to humans;
- justice, equity and solidarity – related to the prevention and detection of discriminatory biases and deviations in the AI system and the establishment of a mechanism for equitable distribution and benefit sharing;
- rule of law and accountability – governments and organisations should clarify with whom the responsibility lies if undesirable AI behaviour causes harm;
- safety, security and bodily and mental integrity – referring to the reliability of artificial intelligence in relation to human-machine interaction;
- data protection and privacy.

To sum up, the ethical challenges associated with the use of AI in financial and non-financial reporting include the need for ongoing education and adaptation to changing technologies (Table 5.5). Accountants are forced to reliably assess the impact of modern technologies on ethical standards and take steps to protect the quality of financial reports. Through these actions, they can strengthen stakeholder confidence and enhance the overall quality of practice in their profession.

**Table 5.5. Basic ethical dilemmas of financial managers related to technological advances**

Key ethical dilemmas	Description	Ethical question/problem	Examples of solutions
Transparency and reliability of financial data	Modern technology enables more sophisticated data analysis, but there is a risk of manipulation of financial results or forecasting models. Ethical concerns arise when automation and artificial intelligence affect the transparency and reliability of financial data. Financial managers must therefore ensure that automated processes do not compromise the quality of financial data.	How to ensure the transparency and reliability of the financial data presented, while protecting trade secrets and competitive advantage?	<ul style="list-style-type: none"> <li>• Implement standardised reporting methods to ensure uniformity and facilitate comparison of financial data.</li> <li>• Identify the scope of confidential information that does not need to be disclosed in reports.</li> <li>• Implementing blockchain technology to verify the authenticity and integrity of data, which increases its credibility.</li> <li>• Defining levels of access to information – e.g. detailed data for regulators and auditors, aggregated information for investors.</li> <li>• Regular audits by recognised auditing firms to increase confidence in the data presented.</li> </ul>

Key ethical dilemmas	Description	Ethical question/problem	Examples of solutions
Accountability for decisions taken by AI	Automating financial decisions with AI can lead to situations where it is difficult to determine who is responsible for mistakes or unethical actions. With automation and artificial intelligence taking over routine tasks, accountants need to protect their professional judgement. Ethical issues arise when they rely solely on automated processes, potentially reducing the importance of human expertise.	How to address the accountability of financial managers for AI decisions?	<ul style="list-style-type: none"> <li>• Striking a balance between technology and human judgement, based on expertise, and applying professional scepticism to the results generated by AI.</li> <li>• Introduce detailed frameworks and regulations defining responsibilities at different levels of the company.</li> <li>• Training financial managers in AI operations and high-tech risk management.</li> <li>• Implement independent audits of the algorithms to assess their compliance with company objectives and regulations.</li> <li>• Application of human-in-the-loop principles, stating that key decisions made by AI must be approved by a human.</li> </ul>
Data privacy and security	Financial managers need to advocate for privacy policies, ensuring the security of customer and company data. The integration of automation and artificial intelligence introduces new risk areas for cybersecurity. Financial managers are therefore responsible for securing systems against breaches, protecting financial data from unauthorised access.	How to ensure data privacy and security?	<ul style="list-style-type: none"> <li>• Transparent communication with customers about data use and protection.</li> <li>• Implement appropriate data protection and cybersecurity measures, adhering to ethical standards and the legal framework governing customer data.</li> <li>• Use of data anonymisation tools to protect confidential information during analysis.</li> <li>• Implement a Federated Learning method to test AI models on local data without the need to send it to central servers.</li> </ul>
Algorithmic discrimination	Ethical concerns stem from the opacity of artificial intelligence algorithms and arise when AI systems exhibit biases, leading to unfair results. Finance managers must advocate for transparent AI systems, providing insight into how algorithms arrive at conclusions. This is because transparent algorithms increase accountability by allowing the results generated by AI systems to be understood, interpreted and validated.	How do we ensure that artificial intelligence algorithms are fair and inclusive?	<ul style="list-style-type: none"> <li>• Implement guidelines and measures to identify and mitigate biases in AI algorithms.</li> <li>• Proactively engage with finance managers to address bias, ensuring that automated processes treat all stakeholders fairly.</li> <li>• Introducing simulation tests and independent reviews of AI algorithms.</li> <li>• Use data anonymisation techniques to eliminate information that may lead to discrimination.</li> <li>• Introduce mechanisms to optimise results towards greater equality (e.g. 'fairness-aware' algorithms).</li> </ul>

Source: own elaboration based on the literature review.

Based on a study of the ethical implications of the use of AI in the accounting systems of multinational corporations, the introduction of ethical review committees (councils) has been proposed to analyse and assess the ethical implications of solutions proposed by artificial intelligence before they are applied, as well as the implementation of training programmes on the responsible use of AI (Bani Ahmad, 2024).

However, the use of AI to analyse data to make work easier and quicker seems to struggle with concerns about security, privacy and misuse of data, whereas accountants' negative attitudes towards AI may result in incomplete information being passed on to programmers, resulting in erroneous results. The researchers also found, based on interviews, that after using AI some people lower their expectations of AI and that human intervention and professional judgement are still necessary to use the new technology. Over-reliance on AI may weaken the professional judgement of accountants.

Moreover, users doubt the capabilities of artificial intelligence and fear that theoretical AI models may encounter problems when analysing real data and dealing with complex scenarios. Due to inaccurate input of data or models, or misinterpretation of results by accountants for their own benefit, results may be distorted. Another problem is the reluctance to use artificial intelligence due to outdated knowledge and education difficulties in understanding advanced algorithms and unfamiliarity with basic IT functions. Some employees are also not well prepared to use artificial intelligence from a psychological point of view. In fact, artificial intelligence poses new demands and challenges for accountants (for example, in relation to completing knowledge and acquiring new, necessary competences). The inaccessibility of AI systems and data makes it difficult for users to have the autonomy to choose whether, when and how to use artificial intelligence.

The indicated ethical dilemmas that arise today in the work of financial managers and accountants are not a 'closed list'. The current codes of ethics and the so-called ethical dilemma banks should be expanded in the future with descriptions of further cases (situations) so that it is possible to educate staff by analysing cases from professional practice. Therefore, it appears that it is a priority to support financial managers and other professional groups in the accounting area in solving ethical dilemmas related to the use of modern technology.

This section discussed in detail the ethical challenges of integrating modern technologies, particularly artificial intelligence (AI), into the field of accounting and financial management. These considerations were based on the analysis of the impact of technology on fundamental principles of professional ethics, including data transparency, accountability for decisions, privacy and the potential risk of algorithmic discrimination.

The identified dilemmas point to the need to balance technological advances with maintaining high ethical standards in accounting. Technologies such as AI enable significant improvements in the efficiency of financial processes, but they raise a number of issues related to the transparency of algorithms, accountability for automated decisions and data protection.



Research indicates that technology cannot completely replace human judgement, and that the professionalism of financial managers requires their active involvement in overseeing the results generated by AI. It is also important to stress that AI is not neutral as algorithms can introduce biases that negatively impact the fairness of decisions, hence it is crucial to put in place systems that ensure transparency and fairness in algorithmic decision-making processes.

A further challenge is the accountability of decisions made by autonomous systems, particularly in the context of the opacity of AI algorithms, which can generate results that are difficult to verify. In order to minimise the risk, it is essential to create clear regulations and auditing mechanisms to reliably assess the results produced by AI systems.

Data privacy and security in the context of data processing by AI systems is another aspect that requires special attention. Financial managers must strive to ensure the full protection of their customers' and organisations' data, which can be achieved through advanced data protection methods such as anonymisation and Federated Learning technologies.

These issues are a rapidly developing area of research that requires ongoing updates to codes of ethics and industry regulations, particularly in the context of the increasing role of technology in accounting and financial management. It is necessary not only to regulate legal liability, but also to undertake educational activities that will prepare professionals for the responsible use of AI.

## Chapter 6

# Digital Transformation in Accounting – Summary and Research Findings

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## 6.1. Synthesis of Key Theses in Research Clusters

The monograph is an analysis of the impact of modern technology on the broader accounting and financial management processes, and reveals the multidimensional transformation of these processes taking place in response to dynamic technological development and the changing needs and expectations of stakeholders. Key findings from the analysis point to the importance of integrating technologies such as blockchain, big data, artificial intelligence, cloud computing and business process automation in shaping the future of accounting. This transformation is helping to increase operational efficiency, improve the transparency of financial data and enable more accurate and relevant strategic decision-making. At the same time, new challenges are also emerging, such as the need to manage technological risks, ethical dilemmas and the need for organisations to adapt to rapidly changing technological and regulatory standards. An example is the use of blockchain in auditing, which allows for the creation of an immutable record of transactions, but also requires the development of new legal and auditing frameworks.

The objectives set out in the introduction to the monograph were achieved through:

- **review of current academic literature** – the analysis included key publications on the role of financial managers, audit and controls, decision making and cybersecurity, and reporting based on a structured research procedure;
- **use of advanced bibliometric tools** – VOSviewer technology was used to analyse the co-occurrence of keywords, allowing the main research clusters to be distinguished.

The most important achievement of the monograph was to demonstrate that accounting and financial management are not only evolving under the influence of digital transformation, but are also becoming more integrated with other key functions of the organisation. Technologies such as AI and big data enable the rapid processing of vast amounts of data, which contributes to better risk management, financial forecasting and a more effective implementation of business strategies. Furthermore, the monograph points to the need for a balanced approach to technology – on the one hand, technological innovations open up new opportunities, such as the implementation of real-time reporting or the automation of complex decision-making processes, whilst on the other they impose the need to redefine traditional roles in organisations and to create legal and ethical frameworks that support the responsible implementation of new tools. An example of the benefits of modern technology in financial processes is the increased transparency of results through blockchain, however the technology also requires a new approach to regulation and accountability in data management. Artificial intelligence, while improving decision-making processes, comes with challenges in terms of ethical accountability for decisions made by algorithms, as highlighted in the chapters on ethics and regulation.

On a practical level, the monograph also highlights the key role of education in preparing human resources for digital transformation, pointing to the need to develop technological skills among CFOs and finance professionals, essential to successfully implement innovation and build competitive advantage in a rapidly changing business environment.

The monograph achieves a goal, which was providing a detailed analysis of the digital transformation in the field of accounting, covering both the theoretical underpinnings and practical implications of the implementation of modern technologies and setting future research directions in this area. Through a review of the current literature, the study also provides valuable insights for both researchers and practitioners, setting new directions for the field.

The monograph explored four key areas of the impact of digital transformation on accounting and financial management, offering observations about the role of technology in modern business, whilst consideration of the ethical issues involved in each of the areas examined was also an important aspect.

### **The Role of Financial Managers**

The transformation of the CFO's role into a strategic technology leader was the first of the issues addressed in the monograph. It was pointed out that CFOs are moving

from being merely control and operational roles to becoming key architects of an organisation's digital strategy. The research showed that the integration of traditional financial knowledge with technological skills, such as data analytics and knowledge of advanced management tools, is essential in the modern business environment. The monograph also discussed the challenges of preparing financial managers for these new roles, stressing the need to invest in education and the development of technological competencies. Another important thread was the analysis of the impact of SMAC (Social, Mobile, Analytics, Cloud) technologies on the daily work of CFOs. Integrated into decision-making processes, these technologies allow not only for the better forecasting of financial results, but also faster identification and neutralisation of operational risks, and introduce new ethical challenges, such as accountability for decisions made by algorithms and the need to ensure transparency in the technological tools used.

### **Audit, Control and Regulation**

The monograph extensively discusses the impact of technology on audit, control and regulatory processes, pointing to a fundamental change in the way financial audits are conducted. Blockchain, as a technology that guarantees the immutability and transparency of transaction records, is particularly highlighted as a tool that can revolutionise the traditional audit approach. Smart contracts integrated with blockchain make it possible to automate the enforcement of contractual terms, minimising the risk of errors and fraud. From the literature review, the authors emphasised the regulatory challenges arising from the implementation of new technologies. The lack of uniform international standards for the use of blockchain or AI in auditing requires the development of new legal frameworks and standards that take into account the specificities of the digital business environment. The monograph also highlights the importance of ethics in audit processes, underlining the risk of algorithm manipulation and the need to ensure auditors' accountability for the use of modern technologies.

### **Decision-Making, Risk Management and CyberSecurity**

The third research area concerned the use of digital technologies in decision-making processes and risk management, including cybersecurity. The monograph stresses that predictive analytics and early warning systems (EWS) are key tools in identifying potential threats and minimising operational risks. The use of advanced AI algorithms not only allows for more accurate decision-making, but also for predicting the long-term impact of strategic choices, an important thread being the analysis of cybersecurity challenges. Many authors suggested that the digitalisation of financial processes increases an organisation's exposure to cyberattacks, which requires the introduction of advanced protection mechanisms such as data encryption, regular security audits and employee training. The need to build a cybersecurity culture in which the CFO plays a key role as the leader responsible for the data protection strategy was also indicated.

## Reporting

The final area focuses on the impact of technology on financial and non-financial reporting. The monograph discusses how digitalisation enables the automation of reporting processes, increasing their accuracy, transparency and speed. Technologies such as blockchain, integrated with ERP systems, allow for the creation of immutable transaction records that can be easily verified by stakeholders.

ESG reporting, which is becoming increasingly important in the context of meeting global sustainability goals, has a special place in the discussion. The monograph shows that digital technologies enable more accurate monitoring of ESG indicators and real-time reporting, which is key to building more sustainable business models, along with pointing out the ethical challenges associated with the manipulation of ESG data and the need for global reporting standards in this area.

Each of the monograph's chapters not only introduces a unique perspective, but also fits harmoniously into the overall argumentation of the work. The analysis of the CFO's role provided the foundation for understanding the impact of technology on financial management, while the chapters on audit and regulation and risk management describe how these technologies are used in practice. The chapter on financial reporting integrates these strands, presenting the benefits and challenges of their application in stakeholder communication processes. Structured in this way, the monograph provides a holistic view of the digital transformation of accounting and financial management.

## 6.2. Extended Conclusions from the Literature Review

Table 6.1 presents the extended conclusions of the literature review. It focuses on four main research areas: the role of financial managers, audit and control, decision-making, and reporting. The conclusions relate to an analysis of the state of the art and the key research directions around the world, which provides a starting point for further discussion in each chapter.

**Table 6.1.** Extended conclusions from a review of global studies

Research area	Extended findings from a review of global studies
The role of financial managers	A review of research shows that the role of the CFO is evolving from traditional financial management to a strategic function, where technological and analytical skills are key. CFOs are now responsible for implementing innovative technologies, such as artificial intelligence (AI), big data analytics and robotic process automation (RPA), which improve efficiency and decision precision. The research also points to the need to adapt the education of managers to the demands of digitalisation and the ethical dilemmas associated with decisions based on data analytics. The role of CFOs in building organisational culture and social responsibility is becoming increasingly important, especially in the context of sustainability and ESG reporting.

Research area	Extended findings from a review of global studies
Audit, control and regulations	The results of the review highlight the fundamental change in audit and control processes resulting from digitalisation. Blockchain enables the creation of immutable transaction records, which significantly improves the transparency and reliability of audits. At the same time, the research shows that the implementation of these technologies requires a modern regulatory framework that takes into account global standards and the diversity of local regulations. Harmonising international auditing standards and identifying risks associated with audit algorithm manipulation remains a key challenge. The research also indicates that the increase in digitalisation increases the risk of technological bias and requires building auditors' competencies in the use of technological tools.
Decision-making and cybersecurity	The literature review points to the growing role of advanced predictive analytics and early warning systems (EWS) in decision-making processes. These tools enable faster identification of risks and better reasoned decisions, making organisations more resilient to risk. At the same time, research shows that digitalisation is associated with an increasing risk of cyberattacks, which can lead to financial data loss and reputational damage. The need for integrated cybersecurity management strategies that include employee education, implementation of advanced data protection systems and security audits is indicated. Managing the ethical aspects associated with decisions made by autonomous systems is also a key challenge, especially in the context of the dehumanisation of decision-making processes.
Reporting	The digitalisation of reporting processes is revolutionising the way companies communicate with stakeholders. A review of research highlights that technologies such as blockchain, ERP systems and big data analytics are enabling greater accuracy, transparency and speed in the delivery of financial data. ESG reporting is becoming increasingly required by stakeholders and regulation, and digital tools enable more accurate monitoring and reporting of sustainability indicators. However, research points to challenges related to the lack of uniform reporting standards and the risk of ESG data manipulation. Implementing technology also requires developing staff competencies and building real-time reporting systems to better respond to changing market conditions and stakeholder expectations.

Source: own elaboration.

The extended conclusions of the academic literature review confirm that the digital transformation in accounting and financial management offers significant benefits in terms of efficiency, transparency and process quality. At the same time, it highlights the challenges associated with technological risks, ethical dilemmas and the need to adapt staff competencies and regulations to the new requirements. In each of the areas analysed, the importance of harmonising global standards and the role of education in preparing organisations and their leaders to meet the challenges of digitalisation is highlighted. The conclusions reached provide a solid basis for further research and practical implementations in the field of financial management.

Table 6.2 considers four main research areas corresponding to the subsequent chapters of the monograph, in the context of the application of modern technology in each of these areas. The conclusions focus on analysing the impact of technology on changes concerning the role of financial managers, audit processes, decision-making and financial reporting. Each conclusion is presented in bullet points to highlight the most relevant aspects arising from the review of research on the application of technologies, namely AI, blockchain, big data and ERP systems.

**Table 6.2. Extended conclusions on the impact of modern technology on key research areas**

Research area	Applications for modern technology
The role of financial managers	<ol style="list-style-type: none"> <li>1) Modern technologies, such as artificial intelligence (AI) and big data, enable CFOs to analyse data in real time to support sound strategic decision-making.</li> <li>2) The introduction of process automation (RPA) tools frees up CFOs' time from routine duties, allowing them to focus on innovation activities.</li> <li>3) Technology supports the creation of more integrated financial management models, with the CFO taking a leadership role in digital transformation.</li> <li>4) Education and the development of technological competences are becoming essential for the effective management of the digital transformation.</li> </ol>
Audit, control and regulations	<ol style="list-style-type: none"> <li>1) Blockchain enables the creation of immutable records of transactions, increasing the reliability and transparency of audits.</li> <li>2) Smart contracts automate control processes, eliminating human error and speeding up the enforcement of procedures.</li> <li>3) AI allows for more effective detection of anomalies in financial data, reducing the risk of fraud.</li> <li>4) New regulatory standards need to be developed that take into account the specificities of digital tools and ensure their compliance with local and global legal requirements.</li> </ol>
Decision-making and cybersecurity	<ol style="list-style-type: none"> <li>1) Predictive algorithms support better forecasting of risks and modelling of different strategic scenarios.</li> <li>2) Early warning systems (EWS) enable potential risks to be identified at earlier stages, increasing the resilience of the organisation.</li> <li>3) Modern security technologies, such as advanced data encryption systems, are key to protecting against cyberattacks.</li> <li>4) The use of autonomous decision-making systems requires ethical considerations, including accountability for decisions made by algorithms.</li> </ol>
Reporting	<ol style="list-style-type: none"> <li>1) Blockchain and ERP systems automate reporting processes, increasing the accuracy and transparency of financial data.</li> <li>2) Real-time reporting allows organisations to monitor financial performance and ESG indicators in real time.</li> <li>3) Big data enables a more detailed analysis of the environmental and social impact of a company's operations.</li> <li>4) The lack of uniform ESG reporting standards is a challenge that requires global harmonisation.</li> <li>5) Technology supports transparency in reporting, but requires continuous development of staff competencies and appropriate adaptation of organisational systems.</li> </ol>

Source: own elaboration.

The findings presented in Table 6.2 clearly indicate that modern technologies are playing a key role in the transformation of accounting and management processes. In each of the research areas analysed, technologies such as AI, blockchain and big data, open up new opportunities, but also involve significant regulatory, ethical and organisational challenges. Expanding technological competence, developing global standards and implementing innovations responsibly are key to maximising the benefits of digital transformation.

Table 6.3 presents the key findings from the third section of each of the four main chapters of the monograph. Each row relates to one of the research areas (the role of the CFO, audit and control, decision-making, reporting), with two columns presenting a diagnosis of the current state of the field and an indication of directions for further research.



**Table 6.3. Extended conclusions on diagnosis and research directions in the third section of each chapter**

Research area	Diagnosis of the current state	Directions for further research
The role of financial managers	<ol style="list-style-type: none"> <li>1) The role of the CFO is evolving from traditionally operational to strategic, with an emphasis on technological competence.</li> <li>2) Big data and AI enable better forecasting, but require a developed analysis of management competencies.</li> <li>3) The automation of financial processes contributes to the reduction of manual work, but generates new challenges in the integration of ERP systems and cloud technologies.</li> <li>4) There is a noticeable gap in the preparation of financial managers to manage technology transformation in a holistic way.</li> <li>5) There is a need to combine analytical, technological and management skills in training for future CFOs.</li> </ol>	<ol style="list-style-type: none"> <li>1) Analysis of the effectiveness of educational models to support the development of digital competence in CFOs.</li> <li>2) Exploring the impact of process automation on the CFO's ability to manage strategic risk.</li> <li>3) Develop a framework for effective collaboration between CFOs and IT departments in the context of implementing new technologies.</li> <li>4) Exploring methods to manage digital transformation with cultural and industry differences.</li> </ol>
Audit, control and regulations	<ol style="list-style-type: none"> <li>1) Blockchain significantly increases the transparency of financial data, but there are limitations related to its scalability and implementation costs.</li> <li>2) Automated control algorithms improve fraud detection, but can lead to false positives in analysis.</li> <li>3) There is still a lack of global standards for the use of blockchain and AI in financial auditing.</li> <li>4) The development of AI-based tools requires analysis of their vulnerability to manipulation.</li> <li>5) Audit automation technologies can reduce the role of the human factor, which affects the assessment of non-standard cases.</li> </ol>	<ol style="list-style-type: none"> <li>1) Investigate the impact of blockchain and AI integration on the efficiency and quality of audits.</li> <li>2) Developing hybrid audit models that combine automation with human oversight in critical cases.</li> <li>3) Development of standards for reporting audit results generated by AI algorithms.</li> <li>4) Cost-benefit analysis of the introduction of automation in global audit systems.</li> <li>5) Exploring the potential of using smart contracts to automate internal and external audits.</li> </ol>
Decision-making and cybersecurity	<ol style="list-style-type: none"> <li>1) Predictive analytics supports risk prediction and strategic decision-making, but there is still the problem of incorrect predictions due to inaccurate input data.</li> <li>2) Cyber threats targeting financial organisations are on the rise, increasing the importance of advanced data protection systems.</li> <li>3) The automation of strategic decisions raises questions about human responsibility for the consequences of these decisions.</li> <li>4) There is a need for better data security in predictive systems, which are key to protecting an organisation's reputation.</li> <li>5) The development of automatic response systems to cyberattacks requires an analysis of their effectiveness and the limits of interference.</li> </ol>	<ol style="list-style-type: none"> <li>1) Testing the effectiveness of predictive algorithms in different industry and cultural scenarios.</li> <li>2) Analysis of the feasibility of implementing AI-based data encryption systems in financial organisations.</li> <li>3) Creating ethical and technical standards for autonomous decision-making systems in the context of finance.</li> <li>4) Development of real-time cybersecurity incident management mechanisms using AI.</li> <li>5) Investigating the impact of automating strategic decisions on an organisation's management and financial performance.</li> </ol>

Research area	Diagnosis of the current state	Directions for further research
Reporting	<ol style="list-style-type: none"> <li>1) Automation of reporting processes enables real-time generation of reports, but requires standardisation of the indicators used in ESG reports.</li> <li>2) Big data supports reporting accuracy, but at the same time poses challenges in interpreting huge data sets.</li> <li>3) Blockchain improves the transparency of reporting data, but limits the flexibility of corrections for erroneous records.</li> <li>4) Global standards for ESG reporting are still lacking, making it difficult to compare data between organisations.</li> <li>5) There is a need for better management of reporting data, which can be selectively interpreted by organisations to manipulate their image.</li> </ol>	<ol style="list-style-type: none"> <li>1) Develop global ESG reporting standards that take into account regional and cultural diversity.</li> <li>2) Exploring the effectiveness of block-chain-based financial and ESG reports in building stakeholder trust.</li> <li>3) Analysis of the impact of real-time reporting on stakeholder decision-making processes.</li> <li>4) Creating tools to automatically validate financial reports generated from big data.</li> <li>5) Development of mechanisms to prevent manipulation of ESG indicators in automatically generated reports.</li> </ol>

Source: own elaboration.

The findings presented in the table emphasise the enormous potential of modern technology in the areas of financial management, auditing, decision-making processes and reporting, while also outlining significant challenges. The diagnosis points to the need for further research into the standardisation of technology, the development of management competencies and the implementation of innovative tools to support organisations. The identified directions for further research could contribute to the creation of more transparent, efficient and sustainable management systems in a dynamically changing business environment.

Table 6.4 presents the key conclusions arising from the analysis of the fourth section of each of the four main chapters. These conclusions are related to the ethical dilemmas arising from the application of modern technologies in the four research clusters, whilst the analysis of these dilemmas provides a better understanding of the challenges posed by digital transformation.

**Table 6.4. Extended findings on ethical dilemmas in key research areas**

Research area	Extended conclusions on ethical dilemmas
The role of financial managers	<ol style="list-style-type: none"> <li>1) The automation of decision-making processes shifts some of the responsibility to algorithms, which requires the definition of human responsibility in the management of these systems.</li> <li>2) AI and big data can generate decisions based on biases built into algorithms, which can lead to unfair outcomes.</li> <li>3) The ethical challenge is the balance between automating processes and protecting jobs.</li> <li>4) The processing of sensitive data presents CFOs with the need to ensure its protection in accordance with regulations (e.g. RODO).</li> <li>5) Use of financial performance monitoring tools can invade employee privacy.</li> <li>6) There is an emerging need for greater transparency in the reporting of decisions made using AI.</li> </ol>

Research area	Extended conclusions on ethical dilemmas
Audit, control and regulations	<ol style="list-style-type: none"> <li>1) Blockchain in auditing eliminates human error, but generates the risk of not being able to modify the data if it is wrongly recorded.</li> <li>2) The use of AI in data analysis can result in a lack of clarity about the analytical methodology, making it difficult for human verification.</li> <li>3) The ethical dilemma of accessing audit data relates to the conflict between the need for full control and the protection of client confidentiality.</li> <li>4) The automation of financial control reduces human involvement in the process, which can lead to a reduction in the quality of financial judgement in non-standard cases.</li> <li>5) The misconfiguration of audit algorithms can lead to the exclusion of certain entities from the market for technical rather than substantive reasons.</li> <li>6) The problem is the lack of global ethical standards for the use of modern technology in auditing.</li> </ol>
Decision-making and cybersecurity	<ol style="list-style-type: none"> <li>1) Automatic decision-making systems can make decisions without taking into account the specific cultural or social context, leading to inequalities.</li> <li>2) The processing of personal data in predictive systems raises risks of breaches of the right to privacy and abuse of access to sensitive information.</li> <li>3) The ethical challenge is to balance the effectiveness of security systems with the protection of users' rights, such as the right to privacy.</li> <li>4) The use of technologies that monitor user activity can lead to excessive surveillance and infringement of individual autonomy.</li> <li>5) Inadequate security of IT systems can cause enormous social damage, for example in the case of leaked health or financial data.</li> <li>6) Developing autonomous systems to respond to cyberattacks requires defining the limits of their operation so that they do not infringe on the rights of third parties.</li> </ol>
Reporting	<ol style="list-style-type: none"> <li>1) Blockchain increases transparency in reporting, but raises questions about the ethical use of technology to manipulate data interpretation (e.g. in ESG reporting).</li> <li>2) The lack of uniform ESG reporting standards leads to difficulties in comparing performance between organisations, which can be deliberately exploited by some actors.</li> <li>3) The automation of real-time reporting increases the risk of errors that may go unnoticed due to limited human oversight.</li> <li>4) It is also a problem to ensure that the data reported by organisations is understood by all stakeholders, regardless of their technological competence.</li> <li>5) Big data technologies can be used to selectively present ESG indicators that are favourable to the organisation, thus misleading stakeholders.</li> <li>6) The introduction of new reporting tools can lead to inequalities between organisations with different technological and financial capabilities.</li> </ol>

Source: own elaboration.

The findings highlight the complexity of ethical dilemmas that arise as a result of the introduction of modern technologies in financial managers' work, auditing, decision-making and reporting. Digital technologies offer significant benefits in terms of efficiency and transparency, but also generate new challenges related to accountability, privacy, technological inequalities and ethics. The challenge is to develop global ethical and regulatory standards that help minimise risks and enable responsible and sustainable use of innovations. Implementing these standards requires collaboration between researchers, practitioners and regulators to ensure a balance between technological benefits and the protection of fundamental societal values.

### 6.3. Relevance of Research Results

The monograph makes an important contribution to the development of the discipline of accounting in the management sciences in terms of both theory and practice. The research presented expands the knowledge of the role of digital technologies in shaping contemporary accounting practice, offering new perspectives and practical applications.

#### Contribution to the Development of Accounting Theory

The findings of the monograph are crucial to furthering accounting theory, particularly in the context of integrating technologies such as blockchain, artificial intelligence and big data analytics. It was pointed out that these technologies not only support operational efficiency, but also redefine fundamental assumptions about roles and functions in accounting. An example is the role of the CFO, being transformed into a strategic technology leader, integrating traditional competences with analytical and technological skills. The research also sheds new light on theories related to risk management and financial decision-making, in particular highlighting the potential for the use of predictive analytics and early warning systems (EWS) in identifying risks and modelling risk minimisation strategies. The findings expand classic management accounting theories, adapting them to the requirements of today's digital business environment.

#### Practical Implications For Sustainable Development

The monograph makes an important contribution to the study of the circular economy, showing how digital technologies can support sustainability goals. Tools such as blockchain enable the precise tracking of material and resource flows, which is key to building more efficient and responsible business models. In the context of ESG reporting, the monograph shows that digital technologies can significantly improve the quality and transparency of disclosures, enabling organisations to better align with global standards and stakeholder expectations.

#### Development of International Accounting Standards

One of the achievements of this monograph was to identify the need to develop new accounting standards and regulations that take into account the specificities of the digital transformation. The findings highlight the importance of harmonising international standards for the use of technologies such as blockchain and AI in auditing and reporting. The proposals make a valuable contribution to the development of a global legal and regulatory framework that can enhance the transparency and credibility of financial systems.

#### Strengthening Transparency and Accountability

The monograph describes how the use of advanced technologies can contribute to making financial processes more transparent and strengthening organisational accountability. An example is the use of blockchain in auditing, which eliminates the risk of manipulation of financial data and enables more transparent and error-proof audit

systems. These results are particularly relevant in the context of building trust in financial institutions and strengthening the ethical basis of organisations.

### **New Directions in Research and Interdisciplinary Cooperation**

The monograph also opens up new research perspectives, indicating the need for further exploration of areas such as:

- the impact of digitalisation on organisational structures and decision-making processes,
- the long-term ethical implications of the use of artificial intelligence,
- the adaptation of digital technologies in small and medium-sized enterprises and non-profit organisations.

The interdisciplinary nature of the research contained in the monograph is an important invitation to collaboration between researchers in fields such as accounting, computer science, business ethics, and law.

### **Relevance to Education and Practice**

The results presented in the monograph point to the need to adapt educational programmes to the requirements of the digital transformation. It has become crucial to equip future professionals with the skills to combine traditional financial knowledge with modern technological tools. The authors also suggest the creation of platforms for cooperation between academia and business, allowing for the practical implementation of innovative technological solutions in organisations.

## **6.4. Limitations of the Research Conducted in the Monograph**

Despite the wide range of analyses presented in the monograph, the research faced some limitations that need to be taken into account when interpreting the results. The key aspects of these limitations are discussed in detail below.

### **Methodological Limitations**

The monograph is largely based on a literature review and theoretical analyses, which provides a solid basis for understanding the impact of technology on accounting and financial management. However, the lack of extensive empirical research, such as quantitative studies (e.g. practitioner surveys) as well as qualitative studies (e.g. expert interviews, case studies), limits the ability to verify the theses presented in real business settings. In addition, there is a shortage of comparative analyses that could indicate how the use of new technologies varies across industries, which makes it impossible to assess their effectiveness in different contexts.

### **Failure to Take Full Account of Cultural and Regional Diversity**

Although the study considered global trends and references technologies used in different countries, the findings largely reflect the perspective of developed economies.

Some regions, especially those developing, face other problems e.g. limited access to technology, lack of infrastructure and low levels of digital competence. The universality of the findings presented may be restricted by specific regional circumstances, such as local regulations, cultural differences and the level of technological advancement in each country.

### **Orientation Towards Selected Technologies**

The monograph focuses primarily on the impact of technologies including blockchain, artificial intelligence and big data, which indeed play a key role in digital transformation, yet the omission of other technologies, namely robotic process automation (RPA), cloud computing and the Internet of Things (IoT) narrowed the research perspective. These technologies also have a significant impact on the transformation of accounting and financial management, especially in areas such as the optimisation of operational processes and the integration of financial systems.

### **No Long-term Perspective**

The analyses mainly focus on the current state of technology and its applications in accounting and financial management. The study lacks detailed forecasts for the development of the technology in the longer term. Digital transformation is a dynamic process that is constantly evolving, hence assessing its future impact, including the risks associated with the implementation of advanced technologies, would require a more comprehensive forecasting approach.

### **Limitations to the Consideration of Ethical Aspects**

Although the monograph addresses ethical issues such as responsibility for decisions made by algorithms or the dilemmas of process automation, not all aspects were covered in detail. In particular, the study included an in-depth analysis of the following issues.

- The impact of decision-making algorithms on social inequalities.
- Responsibility for errors resulting from the actions of autonomous systems.
- Ethical implications of report data manipulation. Overlooking these issues may limit a full understanding of the challenges of digitalisation.

### **No Cost-Benefit Analysis**

The monograph focuses on the potential benefits of digital technologies, namely increased efficiency and transparency, however it does not provide a detailed analysis of the costs of implementing and maintaining these solutions, which makes it difficult to assess their practical feasibility. Such costs include not only investments in technology infrastructure, but also staff training, adaptation of organisational processes and data security risks.

The limitations of the study point to the need to broaden the perspective to include empirical studies, detailed regional analyses, long-term forecasts and a wider coverage of less expounded technologies. The inclusion of additional aspects, e.g. cost-benefit

analysis and an in-depth reflection on ethical dilemmas, would enable a more comprehensive coverage of the topic and increase the practical usefulness of the results. Despite these limitations, the monograph makes an important contribution to the literature on digital transformation in accounting and finance, pointing out directions for further research and practical implementations.

To sum up, the monograph not only provides valuable theoretical conclusions, but also offers practical guidance for managers, regulators and researchers. Its scientific value lies in the integration of different perspectives, i.e. technological, ethical and managerial, which makes it an important contribution to the development of contemporary accounting and financial management sciences. The results provide a solid basis for further research and set the stage for the development of accounting in an era of digital transformation. The digital transformation in accounting and financial management plays a key role in contemporary economic, social and technological transformations, redefining both the theories and practice of these fields. The integration of advanced technologies including artificial intelligence, blockchain and big data is helping to increase operational efficiency, reduce costs and improve the quality of decision-making processes, whilst it also opens up new scientific perspectives by combining different disciplines such as economics, computer science, ethics and management, and thus laying the groundwork for interdisciplinary research.

Automation and robotisation are transforming the labour market, reducing traditional jobs but generating demand for new skills such as data analytics and technology management. The transparency that blockchain introduces increases public trust in financial institutions, although it comes with challenges related to regulation and standardisation. The rise of data as a key resource for organisations requires responsible information management and the development of advanced methods for their analysing and interpreting.

The development of AI is leading to the automation of complex decision-making processes, which requires defining human responsibility for decisions made by algorithms. At the same time, technologies supporting ESG reporting can contribute to global sustainability goals, but uniform reporting standards need to be developed that take into account regional and cultural diversity.

A key challenge of the future will be the harmonisation of international regulations that take into account the technological and ethical aspects, preventing the potential abuse of process automation. Digital transformation also requires the adaptation of education and competence development of employees to meet the challenges of new technologies.

Digital transformation also holds great potential for accounting and finance, but its effectiveness depends on the skilful implementation of technologies that comply with ethical and social standards. A balanced approach that combines technological development with social responsibility and international cooperation will become a key element of success, allowing the opportunities offered by technological innovation to be fully exploited in the future.



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