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The Impact of Business Intelligence Systems on Management Accounting in Companies: Literature Review

L'Impact de la Business Intelligence sur le Contrôle de Gestion des Entreprises : Revue de littérature

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Abstract

The aim of this paper is to summarise the current knowledge regarding the impacts of business intelligence systems (BI Systems) on management accounting (MA) in companies. To this end, analyse of relevant literature was deemed appropriate given the scarcity of this type of research and the lack of holistic evidence addressing the relationship between BI systems and MA.

The literature explored suggests that BI systems, as analysis-oriented solutions, appear to support existing MA tasks, such as reporting, analysis and budgeting. Additionally, BI systems appear to stimulate companies to adopt advanced MA techniques, such as key performance indicators, balanced scorecard, activity-based costing, benchmarking, customer satisfaction survey, target costing, lifecycle costing, etc. The role of management accountants also continues to evolve in parallel, moving from that of a technical expert to that of a business partner supporting decision making.

On the basis of the analysis carried out, it can be argued that the support of MA continues to improve with the advent of BI systems. This trend may increase in the coming years. It is also important to note that, compared to ERP systems, BI systems offer better access to information and better information analysis capabilities. As such, a BI solution could be introduced to complement and leverage the performance of ERP systems, within integrated information systems.

Keywords: Business Intelligence; Management Accounting; Management Accountant; Performance Measurement; Literature review

Résumé

L'objectif de cet article est de résumer les connaissances actuelles concernant l'impact des systèmes de business intelligence (BI) sur le contrôle de gestion (CG) des entreprises.

Pour ce faire, l'analyse de la littérature pertinente a été jugée appropriée étant donné la rareté de ce type de recherche et le manque de preuves holistiques traitant de la relation entre les systèmes BI et le CG.

La littérature explorée suggère que les systèmes BI, en tant que solutions orientées vers l'analyse, sont bien en mesure de soutenir les tâches existantes du CG, telles que le reporting, l'analyse et la budgétisation. De plus, les systèmes BI semblent stimuler l'adoption de techniques avancées de CG, telles que les indicateurs clés de performance, le tableau de bord prospectif, le coût à base d'activité, le benchmarking, l'enquête de satisfaction clients, le coût cible, le coût de cycle de vie, etc. Le rôle des contrôleurs de gestion continue d'évoluer parallèlement, passant de celui d'un expert technique à celui d'un "business partner" soutenant la prise de décision.

Sur la base de l'analyse effectuée, on peut avancer que la prise en charge du CG continue de s'améliorer avec l'avènement des systèmes BI. Cette tendance pourrait s'accentuer dans les années à venir. Il importe aussi de souligner que, par rapport aux systèmes ERP, les systèmes BI offrent un meilleur accès à l'information et de meilleures capacités d'analyse. Ainsi, une solution BI pourrait être introduite pour compléter et exploiter les performances des systèmes ERP et ce, dans le cadre des systèmes d'information intégrés.

Mots-clés : Business Intelligence ; Contrôle de Gestion ; Contrôleur de Gestion ; Mesure de performance ; Revue de Littérature

Introduction

Information technology has advanced rapidly in recent years and has revolutionised several areas of business management (Rom & Rohde, 2006), including management accounting (MA).

Given the influence of these evolutions, an increasing number of companies have invested in new technologies to improve the effectiveness and efficiency of their information generation processes (Olsen & Sætre, 2007). This trend has ultimately benefited these companies in terms of more effective decision-making (Moorthy et al., 2012).

As a result, companies have undergone major organisational changes, including at the level of the MA (Cavelius et al., 2018; Bennani et al.,2021), whose main role is to provide key information to both top and operational management (Cavelius et al., 2018). The changes observed were initially triggered with the advent of Enterprise Resource Planning (ERP) systems, and more recently, following the development of new analytical tools such as business intelligence (BI) systems.

In one of the pilot studies addressing these issues, Granlund and Malmi (2002) suggested a shift in the role of the management accountant, from "bean counter" to "business advisor". Several studies have subsequently addressed the impact of ERP systems upon MA.

In this regard, Vakalfotis et al. (2011) highlighted two main findings in their study regarding the ERP systems:

-ERP systems can improve the accuracy and completeness of accounting data (Spathis, 2006), as well as the flexibility of the related information.

-Management accountants are losing control of their traditional responsibilities (Newman & Westrup, 2005; Caglio, 2003) as activities involving the collection and provision of data are increasingly undertaken by ERP systems and non-accountants. Therefore, the end users (decision makers) are no longer dependent on the reporting systems designers (Rikhardsson & Yigitbasioglu, 2018).

As management accountants tend to spend less time on routine tasks with the advent of ERP systems, they are more likely to be involved in value-added responsibilities (Granlund & Malmi, 2002), and in some cases, involved in managing the deployment of the ERP system themselves. It was therefore expected that the job of the management accountants would evolve into that of a business partner.

The literature on the ERP systems has also shown that, thanks to the transactional capabilities of these systems, traditional MA practices, such as annual budgeting,

(Granlund & Malmi, 2002) have increased within companies, and are now becoming more integrated, detailed, accurate, automated and timely (Vakalfotis et al., 2011).

However, only a few studies have been able to demonstrate the value of ERP systems for the adoption of advanced MA techniques, (e.g. activity-based costing, target costing, etc.) (Doran & Walsh, 2004; Spathis & Constantinides, 2004; Jackling & Spraakman, 2006).

With regard to strategic business management systems (SEM systems), involving new analysis-oriented solutions such as BI systems (the topic of the current article), it was thought that they would be more suitable for advanced tasks (e.g. analysis and reporting) (Booth & Matolcsy, 2000; Rom & Rohde, 2006).

Thus, as MA have been changing alongside with ERP system adoption (Rom & Rohde, 2006), the introduction of BI systems is also expected, by analogy, to bring notable changes in MA and thereby, offer opportunity for wider management control system.

However, although the emergence of BI solutions in companies, academic research remains still limited in the field of MA.

All the considerations outlined in the previous paragraphs motivate a review of the available literature around the following questions: What is the effect of the adoption of BI systems on MA and how do they affect it?

Indeed, literature synthesis facilitates the development of new concepts and the identification of future research directions (Webster & Watson, 2002). It can also result in a holistic evidence on a specific topic.

In order to map the areas of the MA that are likely to change as a result of the introduction of BI systems, it was deemed appropriate to focus on areas identified through studies conducted on the relationship between ERP systems and MA, as both ERP and BI systems are complementary IT tools and providing useful information for MA purposes (Chou et al., 2005; Rom & Rohde, 2006; Wieder et al., 2012; Vakalfotis et al., 2011; Gullkvist, 2013).

In this regard, it should be noted that in the literature, the relationship between ERP systems and MA has been approached mainly through the tasks (e.g. Rom & Rohde, 2006 ; Vakalfotis et al., 2011), techniques (e.g. Doran & Walsh, 2004 ; Spathis & Constantinides, 2004 ; Jackling &Spraakman, 2006 ; Vakalfotis et al., 2011) and role of management accountants (e.g. Granlund & Malmi, 2002 ; Vakalfotis et al., 2011).

The paper is divided into five main sections. The first section describes the literature search method. Section two provides an overview of BI technology. The third section discusses

relevant empirical studies that have addressed the effect of BI systems upon MA under the dimensions suggested (the tasks, techniques of MA and the role of management accountants). The paper ends with a number of conclusions drawn from the review.

1. Literature search method

In order to carry out a comprehensive literature search on the subject of MA and BI systems, the search strategy was adapted from the recommendations of Webster and Watson (2002):

1. Keyword search in widely recognized databases, namely "Scopus", "Web Of Science" and "Cairn Info", for the period between 2005 and 2021;

-The main keywords searched for literature included:

- For English databases:

-("Business Intelligence" OR "Business Analytics") AND ("Management Accounting" OR "Performance Measurement").

- For French databases:

-("Business Intelligence" OR "Business Analytics" OR "Informatique Décisionnelle") AND ("Contrôle de Gestion " OR "Mesure de Performance") ;

2. Selection of empirical studies (articles or conferences) published in English or French;

3. Assessment and inclusion of relevant papers on the basis of titles and/or abstracts;

4. Assessment and inclusion of relevant papers on the basis of full text;

5. Review of key references in the included papers;

6. Inclusion of additional papers identified in the previous step;

7. Identification and inclusion of additional papers mainly using the search engine "Google scholar" and the social networking service for researchers "Research Gate".

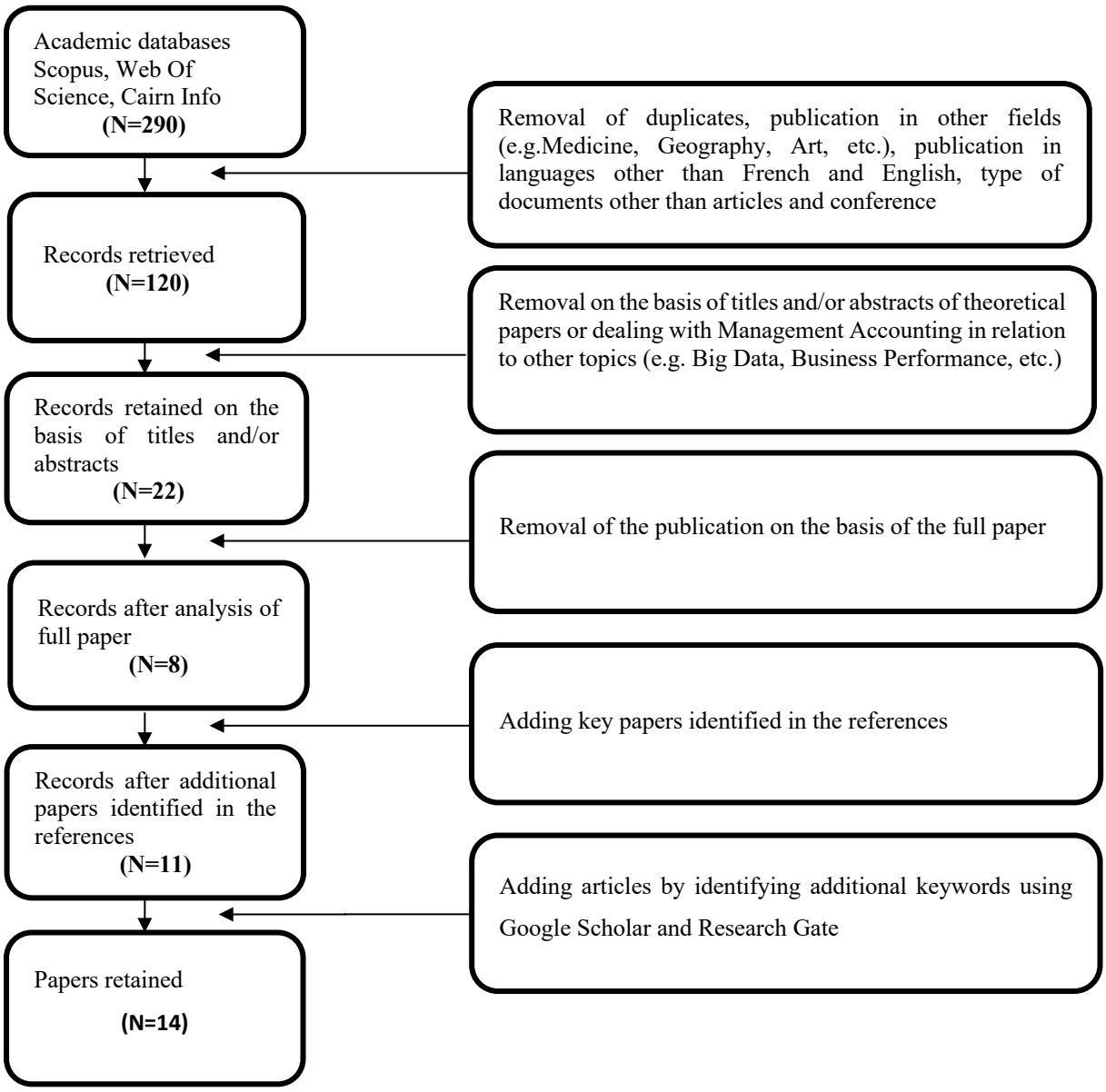
Research saturation was deemed to have been reached once the analysis of the available papers provides a comprehensive response for each of the themes studied (Webster & Watson, 2002).

In other words, saturation was achieved when the inclusion of a new paper does not appear to provide any additional key information, which implies stopping the inclusion process .

The search method for the literature review is summarised in the Figure 1 below.

As a result of this search process, 14 key articles on the impact of BI systems on MA were identified for inclusion in this study (see Table 1 related to papers included in the literature review).

Figure N°1: Paper selection process



Source: Authors

Table N°1: Papers included in the literature review

Relevant research papers						
Author/Year	***Country***	***Study title***	***Journal/conference***	***Study Method***		
				Quantitative (Survey)	*Qualitative*	
					Interview	*Case Study*
(Rom & Rohde, 2006)	**Denmark**	**Enterprise resource planning systems, strategic enterprise management systems and management accounting: A Danish study**	**Journal of Enterprise Information Management**	✓		
(Gullkvist, 2013)	**Finland**	**Drivers of change in management accounting practices in an ERP environment**	**International Journal of Economic Sciences and Applied Research**	✓		
(Candiotto & Gandini, 2013	**Italy**	**Strategic enterprise management in the taps and fittings sector: Application of the balanced scorecard methodology to business intelligence systems**	**Accounting information systems for decision-making**			✓
(Al-Zubi & Shaban, 2014)	**Jordan**	**Accounting, The Effect of Business Intelligence Tools on Raising the Efficiency of Modern Management**	**International Review of Management and Business Research**	✓		
(Peters et al., 2016)	**Australia**	**Business intelligence systems use in performance measurement: Implications for enhanced competitive advantage**	**International Journal of Accounting Information Systems**	✓		
(Vallurupalli & Bose, 2018)	**India**	**Business intelligence for performance measurement: A case based analysis**	**Decision Support Systems**			✓
(Nespeca & Chiucchi, 2018)	**Italy**	**The Impact of Business Intelligence Systems on Management Accounting Systems: The Consultant's Perspective**	**The 2016 Annual Conference of the Italian Chapter of the Association for Information Systems (AIS)**		✓	
(Ocañas & Cruz, 2018)	**Mexico**	**Redesign of the monthly report of key performance indicators of a Mexican brewery plant**	**Proceedings of the International Conference on Industrial Engineering and Operations Management**			✓
(Pervan & Dropulić, 2019)	**Croatia**	**The impact of integrated information systems on management accounting: Case of Croatia**	**Journal of Contemporary Management Issues**	✓		
(Nawawi et al., 2020)	**Iran**	**Controlling the changing of management accounting practices in the enterprise resources planning environment**	**Jurnal Manajemen dan Bisnis**	✓		
(Suša et al., 2020)	**Croatia& Slovenia**	**Business intelligence and organizational performance: The role of alignment with business process management**	**Business Process Management Journal**	✓		
(Spraakman et al., 2021)	**Canada**	**Data analytics by management accountants**	**Qualitative Research in Accounting and Management**		✓	
(Reutter et al., 2021)	**Not specified**	**L'évolution Des Rôles Du Contrôleur De Gestion A l'ère De La Business Intelligence**	**Association Francophone de Comptabilité**			✓
(Youssef & Mahama,2021)	**UAE**	**Does business intelligence mediate the relationship between ERP and management accounting practices?**	**Journal of Accounting & Organizational Change**	✓		

Source: Authors

2. Business intelligence

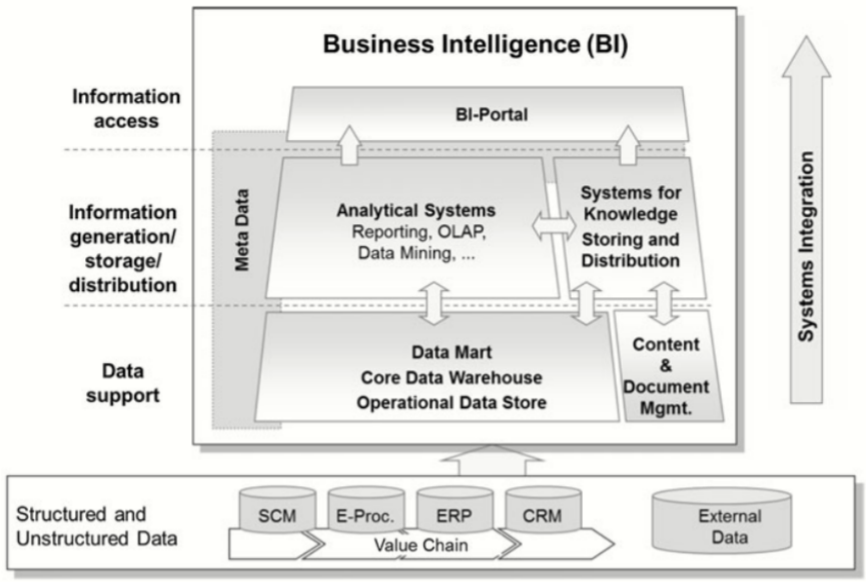
In the current decade, modern IT solutions for business have increasingly turned to business intelligence technology. However, academic research in this area remains limited.

As a concept, BI system refers to the processes and tools collecting and analysing data for decision-making purposes (Chen et al., 2012). BI technology enables multidimensional data analysis providing high information quality. Such evidence has been provided by several studies (e.g. Wieder &Ossimitz, 2015; Ghasemaghaei et al., 2018; Chummun & Singh, 2019).

In practice, BI system is a key component of decision support systems (DSS), querying and reporting, online analytical processing (OLAP), statistical analysis, text mining, data mining and visualisation (Gullkvist, 2013). These processes can be applied in many industry sectors, such as e-commerce, retail, finance, tourism, healthcare, security, etc. (Chen et al., 2012).

BI systems provide major benefits across a broad range of business activities, particularly in the field of accounting, finance, marketing and logistics (Chen et al., 2012). The figure 2 below shows a typical BI system architecture integrating 3 layers, namely Data support, Information Generation, and Information Access (Kemper et al., 2013). The BI system components normally sit on top of operational sources layer, incorporating both structured and unstructured data (SCM, ERP, CRM, E-Procurement, External data sources, etc.).

Figure N°2: Typical BI system architecture



Source: (Kemper et al., 2013)

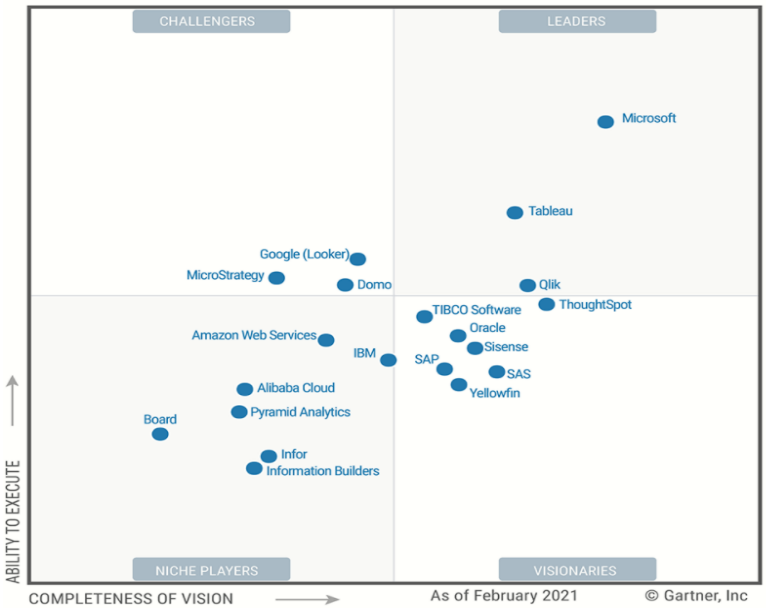
More specifically, BI system analyses historical and real-time data to solve complex problems (who, what, when, how much, etc.) and thus optimise operational and strategic decision-making

in the present. In this way, BI system allows companies to identify what works and what does not work for each of the business processes, and then decide on the basis of this information how best to proceed.

Business analytics, as complementary analytical tool to BI, is particularly useful for solving explicative and predictive questions, based on correlations, simulations, and trends calculated from the available data.

Based on Gartner (2021) reports (leading research and advisory company), major providers in BI systems industry include, among others, Microsoft Power BI, Tableau, Qlik, IBM, SAP, Oracle, etc. (see Magic quadrant for BI and analytics platforms in Figure 3 below).

Figure N°3: 2021 Magic quadrant for BI & analytics platforms



Source:(Gartner, 2021)

Depending on the BI solution deployed, a broad range of features can be offered. These include advanced analytics, interactive dashboards, extensive queries, customised reports, rich visualisation and a cloud-based infrastructure. There are also niche providers such as "Board" solution, which offers a BI system that is integrated with corporate performance management, thus supporting one of the most important tasks in MA.

Many companies still struggle to obtain relevant information from their ERP systems, which often leads them to rely on BI tools (Rom & Rohde, 2006). BI systems are then introduced to complement the reports generated by existing ERP systems in order to meet the relevant and comprehensive needs of decision makers (Wieder et al., 2012).

Indeed, the BI dashboard presents visual information in an effective and interactive way to make sense of the data to be used in decision-making, instead of presenting cluttered, scattered and meaningless numbers.

Given the above considerations and the fact that MA has been changing alongside with ERP system adoption within companies (Rom & Rohde, 2006), the introduction of BI technologies is also likely to bring notable changes in MA and offer the opportunity for a wider management control system.

3. Business intelligence and management accounting: Literature review

3.1. Impact of BI systems on existing management accounting tasks

In this section, the impact of BI systems on existing MA tasks is discussed using the classification approach of Rom and Rohde (2006), namely data collection, reporting, data analysis and budgeting.

The search process resulted in the identification of the following 11 articles dealing with this dimension: (Rom & Rohde, 2006); (Candiotto & Gandini, 2013); (Al-Zubi & Shaban,2014); (Peters et al. ,2016) ;(Nespeca & Chiucchi ,2018) ; (Ocañas & Cruz, 2018); (Vallurupalli & Bose, 2018); (Pervan & Dropulić, 2019); (Suša et al. 2020); (Spraakman et al. ,2021); (Youssef & Mahama ,2021).

In one of the pilot studies, Rom and Rohde (2006) analysed data collected from 401 Danish companies and highlighted the differences between ERP and SEM systems in terms of MA.

Indeed, the former have an impact on data collection and the organisation of MA tasks, while the latter have relatively more implications upon the related analysis and reporting tasks.

Regarding BI systems (considered an important part of the SEM), the findings of the study indicate that they can further enhance the collection of MA information and support strategic tasks (e.g. reporting and analysis). However, only a limited impact on budgeting activities was revealed. In fact, some companies that were still using spreadsheets were just beginning to revise their budgeting process.

Al-Zubi and Shaban (2014) investigated the effect of BI systems on the efficiency of modern MA in 32 industrial companies listed at Amman Stock Exchange.

The features related to key components of BI systems were studied, namely DWH (data warehouse), ETL (extract, transform, and load) and OLAP (online analytical process).

The study pointed out that BI can absorb massive volumes of valuable information for budgeting tasks.

Overall, there was significant support for the working hypothesis that the use of BI tools would have a positive influence on improving modern MA. The benefits of BI systems were highlighted in terms of decision-making efficiency, time saving and budget economy.

Nespeca and Chiucchi (2018) undertook a field study on a sample of 10 Italian consultants and confirmed the impact of BI systems upon budgeting and reporting. The study then attempted to explain how these changes occurred within the companies involved (consultants' clients).

Indeed, the workflow embedded in BI systems makes budgeting processes more structured, more rational and faster than before, although according to the authors' interpretations, their fundamental philosophy does not appear to evolve.

With regard to changes observed in the reporting, the report content has become more dynamic and flexible to meet specific end-user needs, and better enriched with new dimensions of analysis.

The study by Pervan and Dropulić (2019) also investigated the same issues through the analysis of data from 108 Croatian companies.

The findings confirmed that the implementation of integrated information systems, through the dimension of analytical capabilities (main functionality of BI systems), induces significant changes in MA, particularly in terms of reporting and budgeting.

More specifically, and in line with the assumptions, the benefits of improved analytical capabilities were noted in several aspects, namely expanding reporting choices, increasing the frequency of reporting, reducing the time required for data collection, reporting and budgeting.

The importance of the quality of the integrated information system was also highlighted as it leveraged data collection and reporting.

Recently, the research by Youssef and Mahama (2021) has also explored the role of BI systems in mediating the relationship between ERP systems and a set of MA tasks, namely costing, budgeting and performance measurement.

The study analysed data collected from a survey of 82 companies in the United Arab Emirates.

In contrast to the available research, which supports the hypothesis of a direct effect, the result of this study shows that the use of BI systems partially mediates the relationship between the use of ERP systems and each of the three tasks studied.

Furthermore, despite the low level of use of predictive analytics, as revealed in the 20 Canadian organisations studied by Spraakman et al. (2021), the data analytics (major feature of BI

systems) could facilitate inference, prediction and assurance tasks. Indeed, the analytical capabilities result in improved techniques involving drill-down, variance analysis, comparison analysis, regression, reporting, etc.

In a different vein, several studies have examined the usefulness of BI systems for performance measurement purposes.

Indeed, through an analysis of the taps and fittings sector of North-Eastern Piedmont in Italy, Candiotto and Gandini (2013) proposed that the introduction of BI systems into existing balanced scorecards can have a leverage effect on the strategic management process.

Peters et al. (2016) also demonstrated a positive impact of the quality of BI systems on performance measurement using a quantitative approach (Data collected from 324 Australian CEOs and CFOs).This ultimately benefited the companies studied in terms of competitive advantage.

Another study conducted by Ocañas and Cruz (2018) on the case of a Mexican brewery plant, also showed the value of BI systems in improving its monthly key performance indicators reporting. The authors also emphasised the role of strategic dashboards in communicating these indicators in a clear and concise manner. This study was conclusive regarding the ability of BI systems to reshape performance measurement reporting.

In the study by Nespeca and Chiucchi (2018), the authors observed significant changes in the performance measurement system (PMS) and attempted to explain how BI systems contribute to the improvement of calculating process of the PMS indicators.

Indeed, BI systems improve, on the one hand, the calculation process by automating the calculation of PMS indicators and the updating of balanced scorecard data and, on the other hand, the quality of data used in the calculation process by integrating real-time data.

Similarly, Vallurupalli and Bose (2018) suggested an innovative BI-based PMS for a large manufacturing company in India.

One of the key motivations for this project was the difficulty of using traditional dashboards. These were based on data tables with multiple rows and columns that made decision-making difficult.

The changes brought about by the new PMS have proved effective, as employees can now monitor and track their performance using BI-based dashboards. Managers can also ask employees about deviations and manage their actions through the dashboard itself in an interactive way.

Moreover, thanks to the new BI systems, the overall transparency in setting performance targets has facilitated comparison analysis.

The authors also found that there was a significant improvement in the productivity of management meetings. This was, in fact, one of the key motivations for implementing the new PMS.

In addition, the rich visualisation features have also improved analysis and communication between employees, which is now faster and easier thanks to interactive visualisation of graphs, maps, etc. The usefulness of these features was particularly evident in the marketing and sales areas.

Recently, in a study of 185 Croatian and Slovenian companies, Suša et al. (2020) highlighted the importance of aligning BI systems with business process management (BPM) initiatives in order to achieve the full business value of BI systems in terms of organisational performance.

The study explained this association by the role of BI systems in process performance measurement and management (PPM) and, as a result, BI systems become more business-oriented.

In practice and in order to coordinate the two initiatives (BI and BPM), the authors suggest the use of common procedures and emphasise the importance of communication between the experts, managers and teams involved in both initiatives.

Overall, the review in this section reveals the MA tasks most impacted by the deployment of BI systems, namely reporting, data analysis and budgeting.

In addition, unlike ERP systems, BI systems offer better access to information, greater functionality for improved reporting and analysis of information. As such, BI solutions can be introduced to leverage the performance of existing ERP systems.

3.2. Impact of BI systems on the adoption of advanced management accounting techniques

In this section, the ability of BI systems to support the adoption of advanced MA techniques is examined.

These refer to the advanced techniques that are used to perform MA tasks(Rom & Rohde, 2006; Rikhardsson & Yigitbasioglu, 2018), such as balanced scorecard, activity-based costing, key performance indicators, benchmarking, etc. (Doran & Walsh, 2004; Spathis & Constantinides, 2004; Jackling & Spraakman, 2006; Vakalfotis et al., 2011);

In this sense, the research process identified the following 5 articles: (Rom & Rohde, 2006); (Gullkvist, 2013); (Nespeca & Chiucchi, 2018); (Pervan & Dropulić, 2019); (Nawawi et al., 2020).

Although Rom and Rohde (2006) did not specifically explore whether advanced MA techniques were adopted with the advent of BI systems, their study is one of the pioneers in predicting the role of BI systems in the adoption of such techniques.

In the study by Gullkvist (2013), conducted on 70 large and medium Finnish companies, "BI tools" were found to be an important factor stimulating companies to adopt new MA techniques, particularly in terms of key performance indicators, benchmarking, customer satisfaction survey, activity-based costing, target costing and balanced scorecard.

The study indicated that 45 of the 70 organisations surveyed (64.3%) were using a BI system integrated with their information system.

Gullkvist (2013) attributed the usefulness of BI systems for MA to the functionalities of statistical analysis and data visualisation. These functionalities contribute to the shaping and valorisation of data for decision-making purposes.

It has also been argued that recent adopters of ERP and BI systems, in contrast to early adopters, derive more benefit from them and, as a result, the change in MA is assumed to be greater when it comes to recently adopted BI solutions (Gullkvist, 2013).

The study by Nespeca and Chiucchi (2018) also confirmed the same results, except that in the sample of this study, the balanced scorecard was the most adopted following the implementation of BI systems.

It should be noted that the deployment of BI systems preceded the introduction of the balanced scorecard in the companies concerned (clients of the consultants interviewed), which proves to some extent, a causal relationship between BI systems and MA techniques adoption.

Although the authors did not attribute the observed changes exclusively to the adoption of BI systems, they argued that the introduction of these systems can contribute to a shift towards strategic MA.

Recently, Pervan and Dropulić (2019) confirmed that the implementation of an integrated information system leads to the adoption of advanced techniques through the dimension of analytical capabilities, which is the main characteristic of a BI system. However, the adoption of these techniques was negatively impacted by constraints related to the uncertainty of the business environment. This dimension has been addressed in this study through several

indicators, namely the competitor's actions, technology, buyer's preferences, globalisation and deregulation.

Although the dimension of analytical capabilities was not approached with the same philosophy in comparison to Gulkvist (2013) study, both studies obtained almost the same results with regard to the aspect investigated (ability to foster the adoption of advanced MA techniques).

Recently, by replicating a similar study design on a sample of 29 Iranian manufacturing companies, Nawawi et al. (2020) also reached the same conclusions as Gullkvist (2013). The research revealed that the use of BI systems and the introduction of ERP systems as a whole lead to significant changes in MA practices, especially when it comes to companies that have recently adopted BI systems.

The authors concluded that the most frequently MA techniques adopted following the implementation of the new system as a whole are the key performance indicators. The least used are, in order of importance, target costing, lifecycle costing, activity-based costing, benchmarking, balanced scorecard and customer satisfaction survey.

In summary, the literature explored confirmed the usefulness of BI systems not only for existing MA tasks, but also for sophisticated MA techniques.

3.3. Impact of BI systems on management accountant's role

Given the evolution of MA practices under the influence of BI systems, the role of management accountants is also expected to change (Granlund & Malmi, 2002; Vakalfotis et al., 2011).

In this regard, the search process identified the following 4 articles: (Nespeca & Chiucchi ,2018); (Pervan & Dropulić, 2019); (Sprakman et al. ,2021); (Reutter et al., 2021).

Nespeca and Chiucchi (2018) argued that, with the advent of BI systems, management accountants tend to spend less time on mundane tasks, allowing them to develop business-focused skills and spend more time on data analysis and interpretations (more "value-added" tasks).

In conclusion, the authors suggested that the role of the management accountant is evolving towards that of a "business partner", serving both top management and operational management.

Pervan and Dropulić (2019) also reached similar conclusions as they confirmed that integrated information systems implementation, induced significant changes in management accountant's role, again through the dimension of analytical capabilities.

Similarly, although the study carried out by Spraakman et al. (2021) did not observe any radical changes in the role of the management accountant following the advent of "business analytics", it was found that the responsibilities of the management accountant have been expanded in several tasks, namely the preparation of data analysis, and the presentation and communication of the results of the prepared data for decision-making purposes.

Contrary to expectations, the implementation of BI tools in the study by Reutter et al. (2021) does not appear to cause a major change to the role of the management accountant.

Based on 18-months action research during which a company has introduced a BI system and started using it, the Reutter et al. (2021) study assessed the manner in which the management accountant has exploited the introduction of a BI system in order to keep and strengthen its roles within the company.

The study also highlighted the effort needed to find the right balance between the two roles examined: on the one hand maintaining the role of data reliability (technician expert) and, on the other hand, supporting decision-making (business partner role) in a BI context that accelerates information generation.

However, according to the authors' interpretation, the technician expert role remains predominant compared to the business partner role. It even seems that BI systems amplify some of the conflicts between these two roles.

In practice, although BI systems facilitate access to data and the velocity of information generation, enabling the management accountant to better fulfil his role as a business partner, the creation of new BI reports requires procedures to ensure the reliability and accuracy of the data (expert technician), which is likely to slow down the information gathering process.

Overall, with the exception of the study by Reutter et al. (2021), the literature reviewed in this section confirms the gradual evolution of management accountants towards a business partner role.

In summary, with the exception of this study, no negative effects were reported in the review section under the dimension studied (see the effect dimensions of BI systems on MA: Summary of the literature reviewed in table 2 below). Indeed, BI system appears to induce notable changes in terms of tasks, techniques of MA and role of management accountants.

Table N°2 :Effect dimensions of BI systems on MA: Summary of the literature reviewed

BI systems					
	Changes	**Details**	**Positive effect (Usefulness Of BI systems)**	**Negative effect**	**No effect**
MA changes	**Existing MA tasks**	**Data collection**	(Pervan & Dropulić, 2019)		
		Reporting	(Rom & Rohde, 2006);(Candiotto & Gandini, 2013);(Al-Zubi & Shaban, 2014) ; (Peters et al., 2016) ; (Nespeca & Chiucchi, 2018) ;(Vallurupalli & Bose, 2018) ; (Ocañas & Cruz, 2018);(Pervan & Dropulić, 2019);(Suša et al., 2020) ; (Spraakman et al.,2021) ; (Youssef & Mahama, 2021) ;		
		Budgeting	(Rom & Rohde, 2006);(Al-Zubi & Shaban, 2014);(Nespeca & Chiucchi, 2018) ; (Pervan & Dropulić, 2019) ; (Youssef & Mahama, 2021)		
		Data Analysis	(Rom & Rohde, 2006);(Al-Zubi & Shaban, 2014); (Nespeca & Chiucchi, 2018); (Vallurupalli & Bose, 2018);(Spraakman et al.,2021)		
	Adoption of advanced MA techniques	**Activity Based Costing**	(Gullkvist, 2013); (Pervan & Dropulić, 2019); (Nawawi et al., 2020)		
		Target Costing	(Gullkvist, 2013) ; (Pervan & Dropulić, 2019) ; (Nawawi et al., 2020)		
		Lifecycle Costing	(Gullkvist, 2013) ; (Pervan & Dropulić, 2019) ; (Nawawi et al., 2020)		
		Balanced ScoreCard	(Gullkvist, 2013); (Nespeca & Chiucchi, 2018); (Pervan & Dropulić, 2019); (Nawawi et al., 2020)		
		Customer Satisfaction Surveys	(Gullkvist, 2013) ; (Pervan & Dropulić, 2019) ; (Nawawi et al., 2020)		
		Benchmarking	(Gullkvist, 2013); (Pervan & Dropulić, 2019); (Nawawi et al., 2020)		
		Key Performance Indicators	(Gullkvist, 2013) ; (Pervan & Dropulić, 2019); (Nawawi et al., 2020)		
	Management Accountant's Role	**Shifting towards Business Partner role**	(Nespeca & Chiucchi, 2018); (Pervan & Dropulić, 2019) ; (Spraakman et al.,2021)	(Reutter et al.,2021)	

Source: Authors

On the basis of the review carried out, the following hypotheses could be formulated:

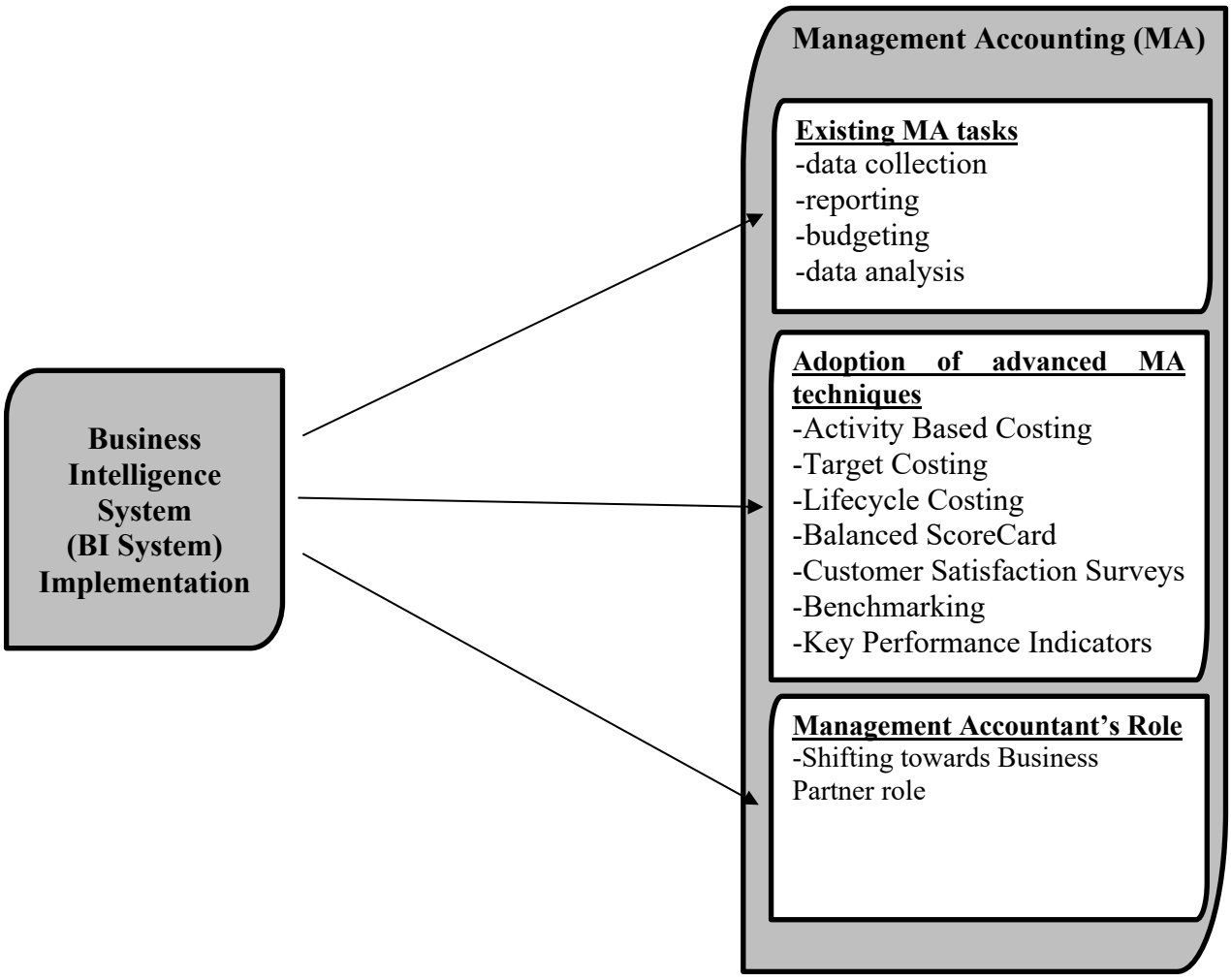
Hypothesis 1: The adoption of BI systems induces improvements in existing MA tasks in terms of data collection, reporting, budgeting and data analysis;

Hypothesis 2 : The adoption of BI systems stimulates the implementation of advanced MA techniques used to perform the above tasks, incorporating balanced scorecard, activity-based costing, target costing, key performance indicators, benchmarking;

Hypothesis 3: The adoption of BI systems induces the evolution in the role of management accountants towards a "business partner role".

The resulting proposed conceptual model is shown in Figure 4 below:

Figure N°4: Conceptual model illustrating the potential changes of MA following the adoption of BI systems



Source: Authors

Conclusion

The current article analysed 14 empirical studies in order to achieve a comprehensive evidence on the interface between BI systems and MA.

On the basis of the papers reviewed, it can be concluded that BI systems have a notable impact on the analytical tasks of MA, especially in terms of data reporting, analysis and budgeting, while the effect upon the transactional level (e.g. data collection) seems to be relatively limited.

This conclusion is largely consistent with the inference suggested earlier by Rom and Rohde (2006) and Booth and Matolcsy (2000), according to which BI systems are more useful for strategic planning than for transactional efficiency.

It has also been argued that, in contrast to ERP systems, BI systems offer better access to information and better analysis capabilities. In fact, a BI solution can be introduced to complement and leverage the performance of existing ERP systems (Chou et al. 2005; Gullkvist, 2013; Nawawi et al., 2020; Pervan & Dropulić, 2019). Such results are likely to encourage companies to apply more BI modules in order to obtain full benefits from their ERP systems.

Specifically, the literature has highlighted the rich visualisation and analysis aspects built into modern BI dashboards, which make analysis as well as user interaction faster and easier (Gullkvist, 2013; Vallurupalli & Bose, 2018). These features ultimately aim to transform data into a usable and valuable form.

In contrast to traditional dashboards, which consist of data tables with multiple rows and columns, BI-based dashboards force users to observe what they can otherwise hardly observe (Vallurupalli & Bose,2018). In other words, the BI dashboard presents visual information in an efficient and interactive way to make sense of the retrieved data, instead of presenting cluttered, scattered and meaningless numbers.

In conclusion, BI systems tend to improve the use of existing MA tasks, particularly in terms of reporting, analysis and budgeting.

In addition to existing MA tasks, it was found that BI systems drive companies to adopt the most common advanced MA techniques such as key performance indicators, activity-based costing, target costing, balanced scorecard, customer satisfaction surveys, benchmarking and lifecycle costing.

As a result, and given that management accountants are the most affected by the changes in MA practices (Granlund & Malmi, 2002), the literature review confirms the progressive influence of BI systems on the role of the management accountants.

More specifically, by devoting more time on business analysis and developing more skills in this field, the management accountants can achieve more "added value" and thus their role is transformed into that of a "business partner".

In summary, with the exception of the study by Reutter et al. (2021) which found a conflict in the role of the management accountant due to BI systems (to find a right balance between technical expert and business partner), no negative effects were reported in the other 13 studies reviewed (see Table 2). This review therefore provides evidence on the value of BI systems for MA purposes. However, as with any scientific research, the paper has some limitations:

- The limitation to certain search keywords within the paper's selection process could result in the exclusion of relevant results;
- The evaluation of papers for inclusion may also result in the elimination of relevant contributions, although great effort has been made to ensure that the most relevant papers are included;
- The review is subject to the influence of the authors' interpretation, particularly in the identification of the impact dimensions retained for analysis of the review. Thus, other relevant dimensions may be omitted;
- The resulted proposed conceptual model has not been empirically validated.

In order to overcome these limitations, several emerging research areas can be identified due to the lack of empirical evidence:

- Addressing empirical research on the relationship between BI systems and MA under the preliminary conceptual model suggested;
- Exploring factors influencing changes in MA following BI systems implementation to better understand the context of this relationship;
- Conducting further research on the impact of BI systems on the role of management accountants in order to better determine their true current status and trend for the years to come , given, on the one hand, the lack of research carried out to date (4 addressed in this study Nespeca & Chiucchi, 2018; Pervan & Dropulić, 2019; Spraakman et al.,2021 and Reutter et al. 2021) and, on the other hand, the role of the conflicting management

accountant revealed in the study by Reutter et al. (2021) to ensure a right balance between technical expert and business partner;

- Addressing the interface between business analytics and MA given the limited empirical research available in this area, as only the study by Spraakman et al. (2021) was retrieved and examined in the review.

Overall, the paper aims to contribute to contemporary research on information technology applied to business. Following a holistic approach, the article focuses on the specific changes in the field of MA as a result of the adoption of BI technologies.

The study can help both academics and professionals to improve the performance of existing ERP systems and to fully exploit the capabilities of BI systems for MA purposes.

REFERENCES

Booth, P., Matolcsy, Z., & Wieder, B. (2000). The impacts of enterprise resource planning systems on accounting practice–the Australian experience. *Australian Accounting Review*, 10(22), 4-18.

Bennani, H., Rechidi, N., & Nafzaoui, M. A. (2021). ERP, un pilier incontournable de la fonction contrôle de gestion en temps de crise: Cas Covid 19. *Revue Internationale des Sciences de Gestion*, 4(2).

Caglio, A. (2003). Enterprise resource planning systems and accountants: towards hybridization?. *European Accounting Review*, *12*(1), 123-153.

Candiotto, R., & Gandini, S. (2013). Strategic enterprise management in the taps and fittings sector: Application of the balanced scorecard methodology to business intelligence systems. In *Accounting Information Systems for Decision Making* (pp. 175-183). Springer, Berlin, Heidelberg.

Cavelius F., & Endenich C., & Zicari A. (2018), L'impact de la digitalisation sur le rôle du contrôleur de gestion, *Transitions numériques et informations comptables*, May 2018, Nantes, France. pp.cd-rom. hal01907810f

Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly*, 36(4), 1165–1188.

Chou, D. C., Bindu Tripuramallu, H., & Chou, A. Y. (2005). BI and ERP integration. *Information Management & Computer Security*, 13(5), 340–349.

Chummun, B. Z., & Singh, A. (2019). Factors Influencing the Quality of Decision-Making Using Business Intelligence in a Metal Rolling Plant in KwaZulu-Natal. *Journal of Reviews on Global Economics*, *8*, 1108-1120.

Doran, J., & Walsh, C. (2004). The effect of enterprise resource planning (ERP) systems on accounting practices in companies in Ireland. *The Irish Accounting Review*, *11*(2), 17-34.

Ghasemaghaei, M., Ebrahimi, S., & Hassanein, K. (2018). Data analytics competency for improving firm decision-making performance. *The Journal of Strategic Information Systems*, *27*(1), 101-113.

Granlund, M., & Malmi, T. (2002). Moderate impact of ERPS on management accounting: a lag or permanent outcome?. *Management accounting research*, *13*(3), 299-321.

Gullkvist, B. (2013). Drivers of change in management accounting practices in an ERP environment. *International Journal of Economic Sciences and Applied Research*, *6*(2), 149-174.

Jackling, B., & Spraakman, G. (2006). The impact of enterprise resource planning systems on management accounting: an Australian study. *The European Journal of Management and Public Policy*, *5*(2), 69-90.

Kemper, H. G., Rausch, P., & Baars, H. (2013). Business intelligence and performance management: introduction. In *Business intelligence and performance management* (pp. 3-10). Springer, London.

Moorthy, M. K., Voon, O. O., Samsuri, C. A. S. B., Gopalan, M., & Yew, K. T. (2012). Application of information technology in management accounting decision-making. *International Journal of Academic Research in Business and Social Sciences*, *2*(3), 1.

Nawawi, M., Mulyadi, R., & Yunia, D. (2020). Controlling The Changing Of Management Accounting Practices In The Enterprise Resources Planning Environment. *Jurnal Manajemen dan Bisnis*, *9*(2), 119-132.

Nespeca, A., & Chiucchi, M. S. (2018). The impact of business intelligence systems on management accounting systems: The consultant's perspective. In *Network, smart and open* (pp. 283-297). Springer, Cham.

Newman, M., & Westrup, C. (2005). Making ERPs work: accountants and the introduction of ERP systems. *European Journal of Information Systems*, *14*(3), 258-272.
Olsen, K. A., & Saetre, P. (2007). IT for niche companies: is an ERP system the solution?. *Information Systems Journal*, *17*(1), 37-58.
Pervan, I., & Dropulić, I. (2019). The impact of integrated information systems on management accounting: Case of Croatia. *Management: Journal of Contemporary Management Issues*, *24*(1), 21-38.
Peters, M. D., Wieder, B., Sutton, S. G., & Wakefield, J. (2016). Business intelligence systems use in performance measurement capabilities: Implications for enhanced competitive advantage. *International Journal of Accounting Information Systems*, *21*, 1-17.
Reutter, J., Allain, É., & Landagaray, P. (2021). L'évolution des rôles du contrôleur de gestion à l'ère de la Business Intelligence. *ACCRA*, (2), 85-107.
Richardson, J. R., Schlegel, K., Sallam, R. L., Kronz, A. &Sun, J. (2021). *Magic Quadrant for Business Intelligence Platforms*. Stamford, CT: Gartner Group
Rikhardsson, P., & Yigitbasioglu, O. (2018). Business intelligence & analytics in management accounting research: Status and future focus. *International Journal of Accounting Information Systems*, 29, 37-58.
Rom, A., & Rohde, C. (2006). Enterprise resource planning systems, strategic enterprise management systems and management accounting. *Journal of Enterprise Information Management*, 19(1), 50–66.
Spathis, C. (2006). Enterprise systems implementation and accounting benefits. *Journal of Enterprise Information Management*.
Spathis, C., & Constantinides, S. (2004). Enterprise resource planning systems' impact on accounting processes. *Business Process management journal*.
Spraakman, G., Sanchez-Rodriguez, C., & Tuck-Riggs, C. A. (2021). Data analytics by management accountants. *Qualitative Research in Accounting & Management*, 18(1), 127-147
Suša Vugec, D., Bosilj Vukšić, V., Pejić Bach, M., Jaklič, J., & Indihar Štemberger, M. (2020). Business intelligence and organizational performance: The role of alignment with business process management. *Business process management journal*, *26*(6), 1709-1730.
Vakalfotis, N., Ballantine, J., & Wall, A. (2011, July). A literature review on the impact of Enterprise Systems on management accounting. In *Proceedings of the 8th International Conference on Enterprise Systems, Accounting and Logistics (ICESAL)* (pp. 11-12).
Vallurupalli, V., & Bose, I. (2018). Business intelligence for performance measurement: A case based analysis. *Decision Support Systems*, *111*, 72-85.
Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS quarterly*, xiii-xxiii.
Wieder, B., & Ossimitz, M. L. (2015). The impact of Business Intelligence on the quality of decision-making–a mediation model. *Procedia Computer Science*, *64*, 1163-1171.
Wieder, B., Ossimitz, M., & Chamoni, P. (2012). The impact of business intelligence tools on performance: a user satisfaction paradox?. *International Journal of Economic Sciences and Applied Research*, *5*(3), 7-32.
Youssef, M. A. E. A., & Mahama, H. (2021). Does business intelligence mediate the relationship between ERP and management accounting practices?. *Journal of Accounting & Organizational Change*, 17(5), 686-703.