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The Pros and Cons of Business Intelligence Applications in Auditing

Denetimde İş Zekâsı Uygulamalarının Artı ve Eksileri

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ABSTRACT

Businesses have changed dramatically in recent decades, with continuous advancements in new technology business-oriented strategies. Research has shown that the phenomenon that started with basic programming has now expanded to smart software tools that affect nearly all functions. Auditing is one of the functions affected by newly emerging technologies. This paper is based on a literature review that the pros and cons of applying business intelligence, which is an important emerging technology, in auditing. The results of the literature review have shown that the advantages of using business intelligence in auditing outweigh the disadvantages. Accordingly, the business intelligence system provides several benefits that are reflected as an opportunity to improve the performance of auditing functions.

ÖZ

İşletmeler, son yıllarda işletme odaklı yeni teknolojilerin sürekli gelişmesiyle önemli ölçüde değişmektedir. Yapılan araştırmalar, temel programlama diliyle başlayan olayların artık neredeyse tüm işletme fonksiyonlarını etkileyen akıllı yazılım araçlarına doğru genişlediğini göstermektedir. Denetim, bu gelişen teknolojilerden etkilenen fonksiyonlardan biridir. Bu çalışma, gelişen önemli teknolojilerden biri olan iş zekâsı uygulamalarının işletmelerin bağımsız denetimlerinde uygulanmasının artı ve eksi yönlerine dikkat çekmeyi amaçlamaktadır. Çalışma bu kapsamda, denetimde iş zekâsının uygulanmasına ilişkin bir literatür taramasına dayanmaktadır. Yapılan literatür taraması, iş zekâsı uygulamalarının denetimde kullanımının avantajlarının dezavantajlarından daha ağır bastığını ve bu dezavantajların birçoğunun da önlenilecek şekilde olduğunu göstermektedir. Bu doğrultuda, iş zekâsı sisteminin denetim fonksiyonunun performansını iyileştirmek için çeşitli faydalar sağlayan bir fırsat sunduğu görülmektedir.

1. Introduction

Auditing can create tremendous economic value for a company by maintaining an effective internal control system, providing accurate financial data on its activities, avoiding fraud and embezzlement of its resources, and reducing capital costs. The emergence and development of technology are some of the critical arguments that support a paradigm shift in audit missions (Cristea, 2020). Association of Chartered Certified Accountants (ACCA) (2019) stated that technology has the power to reshape auditing, the use of

electronic devices, and the increasing complexities of computerized accounting systems such as Enterprise Resource Planning (ERP) have led to the phenomena of data explosion. The vast number of transactions reported and the need of financial experts and auditors to access all of this data (Rouhani et al., 2016) and acquire real-time information to make efficient decisions have contributed to the gradual substitution of traditional “manual” audit methods with new Computer Assisted Audit Techniques (CAAT) supported with business intelligence (BI) systems.

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BI is often recognized as a set of software solutions that allow organizations to collect, integrate and evaluate broad data in order to identify their capabilities and vulnerabilities (Harrison et al., 2015). The BI goals mentioned here seem very close to the auditing, whose objectives are aligned with these goals. Does this mean that the BI tool supports auditing? BI tools were isolated to users in the analyst or information technology (IT) community where, on request, reports, and analysis were produced. This knowledge was shared with administrators and senior management and was not available inside the company to financial, accounting, or auditing practitioners. Today, BI is more available and user-friendly, and many organizations are working to put these tools within the reach of business users, financial practitioners, and auditors. Big data and BI have been extensively debated in IT academia, but this topic has not sufficiently covered by academic financial accounting circles, and its impact in auditing is still not discussed, despite that BI solutions can be effectively combined into, and assisted by, accounting and financial frameworks to put together diverse data in a uniform framework for quick and accurate analysis and decision-making.

In this paper, we aim to advance management information research in general and auditing in particular through a scholarly investigation concerning big data and BI. In more depth, this paper seeks to reveal the usefulness of BI in supporting auditing process by presenting the pros and cons of BI application in auditing. The rest of the paper is organized as follows. Section 2 presents the link between auditing and BI. Section 3 addresses the methods used in this research. Section 4 discusses the results, and finally, section 5 concludes the paper and offers suggestions for further study.

2. Background: Links Between Business Intelligence and Auditing

In accordance with Popa and Toma (2009), the idea of audit implies a systematic, objective, and recorded procedure to obtain audit evidence and their examination with impartiality to assess the degree to which the audit standards are met. Simply, auditing is the tool used to determine whether the overall financial statements of a company (balance sheets, benefit, and loss statements, cash flow statements, and retained earnings statements) conform with the Generally Accepted Accounting Principles (GAAP). As confirmation of the company's financial statements, auditors use auditing techniques. The auditor's report is referred to as the written report. The auditor report is a disclaimer provided by an internal or external auditor or an independent external auditor, allowing an interested user to decide on the basis of the audit findings (Chen et al., 2014).

Regular audits are vital to enhancing corporate efficiency in all sectors and may promote the accomplishment of several other objectives that a particular organization might have in its sights. Therefore, applying auditing procedures in a company is important to raise the trust of persons who rely on financial reports such as creditors and investors, decrease the risk of investments.

In general, the auditing process can be split into five phases: 1) Client acceptance decision 2) Planning on audit 3) Gathering audit evidence 4) Completing the audit and 5)

Reporting. The first principle is that the audit company's customer approval judgment is to determine whether to provide a service to a new customer. A growing body of literature provides evidence of how auditors settle on consumer approval. The previous investigation shows that auditing firms accumulate and analyze client risk information and that risky consumers from the list of potential clients are less likely to be taken into account (Johnstone & Bedard, 2004). A written confirmation, usually on an annual basis, of the terms of the agreement between the client and the audit firm, is provided once the client is approved. Secondly, the audit plan. The auditor should develop a detailed audit schedule during the planning process, mapping out the audit's scope, schedule, and orientation and guiding the progress of the audit plan. After the auditor prepares the audit plan, the auditor needs to find acceptable auditing evidence sufficient to justify his opinion on the audit, and thus the auditor has moved to the third phase. Once the auditor has completed gathering evidence regarding the financial statement assertions, the audit reaches completion phase. The sufficiency and validity of the evidence collected are measured. If the auditor decides that adequate evidence has not been collected, additional substantive protocols must be followed. The final phase is reporting. Reporting is meant to assess the results of the audit facts and to choose the relevant audit judgment to be delivered. The auditor's report is the main product or performance of the audit, which communicates the auditor's findings to the customer.

Financial reports are prepared based on financial sources, due to the intense advancement of technologies, traditional financial sources such as sales orders, invoices, and checks are substituted with electronic means, and the accrual basis data are stored in digital formats or archives (Rezaee et al., 2001). The majority of the company transactions now are carried out in electronic form, allowing companies to generate financial reports on a real-time, online basis. Today, several companies reveal their quarterly and annual accounts on the Internet. Changes in business practices that replace the traditional source of records with e-documents require the implementation of modern audit methods in order to carry out financial audits. A variety of new audit technology can be used to conduct electronic online auditing such as Audit analytics, Robotic Process Automation (RPA) and machine learning. Some research has demonstrated the potential of RPA in audit tasks based on Audit Data Standards. (Cohen et al., 2019; Huang & Vasarhelyi, 2019). Machine learning and AI can assist auditors in making professional decisions, but these systems cannot yet completely replace human auditors because machine learning algorithms are incapable of making such decisions. (European Court of Auditors, 2020).

CAAT are one of the tools that must exist in order to conduct continuous auditing. The key difference between traditional audit techniques and CAAT is that traditional auditing allows auditors to draw conclusions based on a limited sample of the population, but computer-based auditing uses algorithms to draw conclusions based on all the relevant financial data. Financial audits are typically performed by accounting firms with experience in preparing financial reports, but the shift from using traditional audit techniques to computerized audits has imposed knowledge of new skills on audit teams. Certifications in Finance and Accounting

became insufficient and computer experience became a must. According to Information Systems Audit and Control Association (ISACA), the formation of audit teams would target a fair percentage of accounting practitioners, auditors, IT, and data processing specialists, contributing to the development of new positions and the redefinition of these careers (Brender & Gauthier, 2018).

In order to maximize the efficiency of the audit industry, the only practical approach seems to be the effective utilization of resources by skilled auditors. Many CAAT are now available on the market. The challenge for auditors is to pick the most useful solution for their jobs. The question is how BI technology is implemented into the auditing industry to support and improve auditing activities?

2.1. Business Intelligence

The idea of BI was around in the 1950s and was developed from a technology called decision support (Heang & Mohan, 2017). However, BI technologies did not emerge until the end of the 1990s as a result of developments in the field of information systems and technologies (Chen et al., 2012). As Heang and Mohan (2017) say, the increase in data collection and improved technologies with increased storage space have resulted in BI in recent years.

There are a variety of definitions of BI, some of which focus on BI purposes, others address BI architecture and processes, and others see BI more as an umbrella concept that should be interpreted to encompass all the elements that form the BI environment (Dedic & Stanier, 2017). Briefly, as several common terms, BI is not a clearly defined term. Some deem BI to be data reporting and visualization. Others include management of business performance. Database vendors spotlight the extraction, transformation, and processing of data. Analytics companies prioritize statistical processing and data mining.

According to Azvine et al. (2006), BI basically requires three main categories of technology: data warehouse technology, analytical technology, and reporting tools. Ain et al. (2019) claimed that BI architecture consists of a mix of technologies, for a structured and detailed search, data warehouse technology gathers reliable, correct, and relevant data from various resources. Whilst online analytical processing technology supports real-time multi-dimensional analysis and enables servants to perform data and pivoting operations. Additionally, dashboard technology is the front-end tool for graphical interface and performance monitoring.

Furthermore, Grublješić and Jaklič (2015) represent BI as a decision-maker knowledge system that enable more comprehensive collection of data, handle unstructured and organized data, operate in enormous amount of data, supply end-users with improved computer capacities.

BI can be tested from both an organizational and technical perspective (Isik et al., 2011). To achieve organizational benefit, organizations need to make effective and timely decisions. That is why the decision maker wants the right data at the ideal moment to make the right decision (Farjami & Molanapour, 2015). Technically speaking, the technological capabilities of BI apply to data consistency, and technical platforms. That can be combined with other enterprise applications.

There are 13 factors that lead to enhancing the performance of the implementation of BI solutions in the study conducted by García and Pinzón (2016). These factors include: (1) Top-lead management assistance, (2) Business linkage, (3) Project leadership (4) Business planning, (5) Change administration, (6) Project delivery, (7) People and human expertise teams, (8) Study and expertise, (9) Information and technology, (10) Technical networks, (11) Economic and technological resources, (12) Metrics and (13) Environment. There are several BI products available today. The product of SAP, Oracle, IBM, Microsoft, SAS, the 5 big multinational BI providers is however the leading product, based on the size, market knowledge and development momentum (Che et al., 2017).

The purpose of BI tools is to take as input huge amounts of business-generated data from sales, financial, consumer experiences, and then use this data to detect trends and extract valuable business information. BI tools have some main functions: 1. Roll-down, 2. Linear representation, 3. Abnormal displaying, 4. Rows and columns, 5. Drag and drop, 6. Special computing, 7. Questioning, 8. Commentary, 9. Combo views, 10. Control panel, 11. Web portals, 12. Reports, 13. Analytical functions (Muhammad et al., 2014). An auditor, among other tasks, looks at transactions and analyzes them in order to give an opinion in a form of a report. Thereby, BI with the above-mentioned features seems extremely useful for the auditing process. When the CAAT combines with advanced, easy-to-use BI tools, continuous auditing is becoming more open and feasible for implementation (Rezaee et al., 2001). In the next section, we describe the adopted research methodology.

3. Research Methodology

The article discusses the pros and cons of BI application on financial auditing, scientific articles indexed in international databases were consulted, such as Emerald Group Publishing, AESS, Web of Science, ScienceDirect, Elsevier, Taylor and Francis Online, Springer Science, MATEC Web of Conferences, the website of the American Accounting Association, the Social Network Research Gate, Financial Audit Magazine and Google Scholar search engines. An online search of results was done by keywords such as: "BI and audit", "BI application in the audit", "BI in the financial audit", "CAAT supported by BI for financial audit". However, by using the aforementioned keywords 68 academic publications were reached. And for this paper, only 37 academic publications (books, articles, dissertations, case studies and conference papers) which concerned the impact of BI in the auditing process from 2005-2020 were included in the analysis.

BI primarily focuses on how to obtain, organize, and analyze the data to the appropriate departments in order to reach a successful decision to accomplish the organizational purpose under the confusion. The goals of the BI must be highly well known to the auditors, whose objectives are in line with those objectives. Does this mean that the BI is an accurate auditor tool? This paper attempts to explore the pros and cons of BI application in the auditing process which is a matter of global economic concern.

4. Results and Discussion

The core objective of this paper is to identify the main advantages and disadvantages that enterprises can derive from the implementation and usage of BI tools in auditing operations. Literature-based analysis was undertaken to accomplish this purpose.

Due to the growing complexity of ERP accounting systems and the vast number of transactions being done, the classical audit techniques were substituted with audit software or CAAT (Stanciu et al., 2009). With the use of CAAT, the auditors found that their work became more effective since it has many benefits over the traditional system of documentary and financial statement verification (Zuca & Tinta, 2018). Davis and Woratschek (2015) indicate that the usage of a BI tool for continuous auditing has a significant effect on the business entity as the tool effectively offers the opportunity to substitute periodic/annual audits in favor of a continuous auditing procedure. Further, Ali (2020) assures that the structure of the BI tool can be helpful in continuous auditing since BI is based on a range of different KPIs (key performance indicators), which are a company's traditional financial ratios and financial performance metrics such as cash flow forecasting, accounts payable (AP) turnover ratio, AP aging, etc.

In today's quickly evolving digital economy, auditors cannot continue to bear the consequences of delays, inaccuracies, or missing records. Berberich (2005) claims that the use of BI tools dramatically decreases the time taken to acquire audit-proof by offering fast, in-time access to audited data. Since these tools allow for drag-and-drop reporting, auditors do not even have to wait for IT to produce and deliver reports. They can develop on-the-fly reports to address the requirements of a particular audit request or generate specific periodic automatic delivery reports. The method of finding anomalies and exceptions is accelerated, leading to the simplification of audit work and also to the automated production of such reports (Zuca & Tinta, 2018). Under this context, Zraqat (2020) states that BI software, which is a core tool of the modern economy, is able to register more specifically the details of corporations' financial and economic activities, thereby enhancing record production speed and verification.

Besides, the report's quality is as important as the speed of their preparation. Obviously, a valid report requires valid data sources. A BI tool can be structured in such a way that it can shape a pattern for the quality and integrity of data entered into organization systems and generate warnings if new data is not on track with the usual data quality level (Ali, 2019). In parallel, the BI tool can receive different types of data (real-time, unstructured, and structured data) and can transform them into useful information that is then processed and transformed into knowledge (Chaudhuri et al., 2011).

Duan and Xu (2012) state that BI methods contribute towards the optimization and consistency of financial reports. Likewise, Zraqat (2020) proposed that because of its important role in enhancing financial reports efficiency and thereby support the decision-making functions of a large group of users, it should focus on the usage of BI tool.

Accessibility is another notable advantage. Webb (2012) express that the BI tool allows audits to interact with the separate business units within an organization so that they provide a detailed overview to establish risk analyzes,

validate main unit success metrics, learn about the risk management strategy of the enterprise and are able to show how the roles of each business are incorporated within the governance framework of an enterprise. This allows users to view information from any mobile device with the right BI tool regardless of location and time of day (Kamordzhanova & Selezneva, 2019). Thus, via mobile and digital dashboards and features like main KPIs, balance scorecards, comparative analysis, and layered security, auditors are able to generate and uncover outcomes whenever possible (Chaudhuri et al., 2011). The BI suite's visualization component also offers an intuitive and very advanced method to keep track of patterns in organizational roles and operations that are easy to quantify and compare in this way (Trigo et al., 2014).

Moreover, the research by Wong and Venkatraman (2015) has established a modern forensic accounting method using BI that provides a three-stage model via new information discovery methodology to perform financial pattern analysis of fraudulent financial data in a feasibility study environment and according to that study, adopting BI approach allows auditors or forensic accountants to achieve a high level of accuracy in the detection of accounting fraud with a minimal time and skills needed. As well, Ali (2020) mentions that using Benford's Law or a similar other theory, a BI tool can reveal suspicious activities based on monitoring of the first digits of the numbers and amounts in records. After flagging by the BI tool, these dubious activities can be double-checked by an auditor to detect fraud.

Beyond that, Vercellis (2009) used a pyramid consist of six layers to describe the architecture of BI. The layers are data sources, data warehouse, data exploration, data mining, optimization, and decision. wherefore, any plus offered by those layers can count as a plus for BI. According to Che et al. (2017) based on data mining models such as clustering, classification, and prediction technology, association analysis, outlier detection, and text mining technologies, some computer audit problems can be solved. These models are briefly described below (Che et al., 2017):

- (1) Using *clustering model*, auditors can define the characteristics of the problem they are checking by grouping the data and then mastering the rules between the data for each group.
- (2) Using *classification and prediction model*, auditor can find the questionable points of the audit by identifying the internal correlation between the input data and the output data and by using the established rules for analyzing the historical data.
- (3) Using *association models*, auditors can extract the frequent data pattern and compile the hidden items in the data.
- (4) Auditors can collect discrete information points using the *outlier identification model*, with the goal of increasing the chance of detecting anomalous data and discovering any regulatory violations.
- (5) The audit database within each company may be evaluated in terms of *text mining technology*, that is used for the interpretation of the languages and management knowledge, thus facilitates the

enhancement of the efficiency of auditing processes.

While BI tools have a wide range of features and functionalities to allow auditing, there are many limitations to their functionality. Kascelan (2011) reported that the introduction of the BI tool takes a long time (6 months – many years) which reflects negatively on the business with small financial assets. He also points out the ambiguity surrounding the performance of the implementation. Research by Gartner shows that in 2,000 data warehouse projects, only 20% were successful. Additionally, the adoption of BI for any business requires a very high amount of financial commitment and making a wrong decision in choosing a BI tool would incur severe financial and strategic penalties if it is to be replaced (Ali, 2019).

Therefore, many BI tools are not programmed to successfully organize—and reorganize—data that is common to the finance office. For instance, with a standard BI application, it is very difficult to establish various profit & loss schemes (such as IFRS, local GAAP, or management schemes) with different timelines (monthly, quarterly, half-year, 12-month, or year-to-date while maintaining the flexibility to drill by product, geography, channel or some other related dimension. Many BI systems do not have also the drill-through capability to directly view transactional system-level data to explain how the data originated. The dashboard is a valued, user-friendly feature of many BI tools, showing analysis from views that are more easily interpreted and thus more feasible, particularly for people without high-level programming or analytics experience. However, in most cases, the BI data visualization tools do not easily integrate multiple general ledgers, different legal entities within the group, and the cross-company data required for auditing into a single unified view (Board International).

On the other hand, the absence of the auditor's involvement in constructing the data warehouse is one of the drawbacks of the use of BI in the audit trail since the auditor may need to look at transactions reported in the source systems. The data warehouse that is generated as a sub-set of the database of the source systems is generally based on management and executives' reporting requirements. This is where the terms of the auditor have to be taken care of. In most of the data warehouses, this requirement is not taken care of and the auditor has to use his tools and techniques from outside the system (Murali, 2010). According to Webb (2012), once the BI tools are identified, the auditor should establish a business claim for the acquisition of certain licenses as the deployment and maintenance of the tool can be challenging as the services for data analysis are limited and in request.

While the rise of big data and data mining could offer an incentive for auditors to enhance their competences (Alles, 2015), most of them have little familiarity with databases and spreadsheet applications and can manage only basic analysis procedures (Yadav & Yadav, 2013). Table 1 below briefly shows the pros and cons of business intelligence application in auditing process that we identified as a result of our study.

Table 1. The Pros and Cons of Business Intelligence Application in Auditing Process

The Pros	The Cons
<ul style="list-style-type: none"> • BI system accepts different types of data sources which is count good for the auditing process as auditors deal with data from different types and sources. • The integrity and accuracy of the financial data that represent evidence for the audit process can be assured due to the structure of the BI tool. • BI tools included in any major BI system share a common server for all information collected, and this information is shared with other software packages. Therefore, this process helps the application of automatic continuous audits to be enhanced. • BI systems are valued for the potential to reduce the time to get pertinent information and let effective employment. using a BI tool, an auditor is able to capture pertinent information easily and allocate enough time to analyze data and express his opinion. • BI tool's features (KPI, graphs, visualization...) optimize financial reports and improve their quality. • BI tools provide a dashboard with a database of all actions to let continuous automated administration of all financial activities to recognize any anomaly in the KPI report, an exceptional situation, or suspicious activities. • Using a BI tool, auditors can access data from any device anytime. • Data mining modes can help auditors examine massive volumes of electronic data from audited organizations to define the audit course in order to spot audit uncertainties. Also, data extraction techniques and methods improve the auditor's ability to analyze the audit data and to boost the reliability of audit process. 	<ul style="list-style-type: none"> • The implementation of a BI system is costly, takes a long time and there is a possibility to fail. • The standard structure of BI lacks some required themes for the financial process. • Data mining tools use sophisticated tools, and they require the company to give additional training or even hire external consultant which increase the costs of implementation.

5. Conclusion

Auditor who usually views the organizational data from control and compliance aspects need to give an opinion based on valid evidence, that's why it is really important to make the correct decision on the selection of suitable

technology. In our research that was based on analyzing the literature, we found that the advantages of implementing BI in the auditing process exceed its disadvantage. Also, we noted that the majority of the cons can be overcome if consultation is made between IT and the auditor before BI implementation.

Indeed, auditing is about obtaining audit evidence for a specific company and examining it objectively to assess the degree to which audit standards are being met. The auditor seeks to find a tool that allows him to obtain the financial statements, analyze the data without losing the original copy, and provide the audited company with an objective and comprehensive report about its financial status. In this paper, we selected and examined the use of BI tools in the audit process. BI has not been for hardware or software, we have concluded. It is a matter of recognizing at the organization level that organizational data is a significant strategic tool and can lead to useful insights for management and improvement to enhance decision making. Which is in line with the audit objectives. We have noted that using BI in the audit process produces multiple benefits and has some shortcomings, most of which can be overcome if consultation is made between IT and auditor before implementing the BI tool.

In order to leverage the advantages identified in this study, users of the business intelligence tool in the audit process should be aware that the business intelligence tool is an assistant to them and cannot replace them completely. Using the BI tool and its features in the audit process allows auditors to devote sufficient time to analyze the data and express their opinions as BI features can do all the other tasks from gathering audit evidence to preparing reports. Furthermore, a deep and detailed consultation between IT department and auditing responsible before choosing (spending money) and implementing any BI platform in the business could assist to overcome the beforementioned identified shortcomings.

The main limitation of this study is the use of the literature only to assess BI implementation techniques in financial audit process. Of course, the study's findings cannot be generalized to all organizations that have used BI tools in their auditing process. Additional research could interview companies that use BI in their auditing process to assess the validity of the advantages and disadvantages that resulted from this research.

References

ACCA. (2019). Audit and technology. Retrieved from https://www.accaglobal.com/content/dam/ACCA_Global/professional-insights/audit-and-tech/pi-auditand-technology.pdf

Ain, N., Vaia, G., DeLone, W. H., & Waheed, M. (2019). Two decades of research on business intelligence system adoption, utilization and success – A systematic literature review. *Decision Support Systems*, 125, 113113, 1-13.

Ali, W. A. (2019). Effects of business intelligence on the continuous auditing process. *International Journal of*

Innovative Science and Research Technology (IJISRT), 4(3), 377–383.

Alles, M. G. (2015). Drivers of the use and facilitators and obstacles of the evolution of big data by the audit profession. *Accounting Horizons*, 29(2), 439-449.

Azvine, B., Cui, Z., Nauck, D. D., & Majeed, B. (2006, June). Real time business intelligence for the adaptive enterprise. In *The 8th IEEE International Conference on E-Commerce Technology and the 3rd IEEE International Conference on Enterprise Computing, E-Commerce, and E-Services (CEC/EEE'06)*, 29-29. IEEE.

Berberich, G. (2005). The effects of audit methodology and audit experience on the development of auditors' knowledge of the client's business (Unpublished PhD dissertation). University of Waterloo, Ontario, Canada. Retrieved from <http://hdl.handle.net/10012/740>

Board International. *Business Intelligence for the office of finance*. Retrieved from <https://www.board.com/en/document/business-intelligence-finance-ebook>.

Brender, N., & Gauthier, M. (2018). Impacts of blockchain on the auditing profession. *ISACA Journal*, 5, 27-32.

Chaudhuri, S., Dayal, U., & Narasayya, V. (2011). An overview of business intelligence technology. *Communications of the ACM*, 54(8), 88–98.

Che, L., Yang, X., & Jiang, F. (2017). Application and research on business intelligence in audit business. In *MATEC Web of Conferences*, 100, 1-6. EDP Sciences.

Chen, C.J.P., Srinidhi, B. & Su, X. (2014). Effect of auditing: Evidence from variability of stock returns and trading volume. *China Journal of Accounting Research*, 7(4), 223–245.

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.

Cohen, M., Rozario, A., & Zhang, C. (A.) (2019). Exploring the use of robotic process automation (RPA) in substantive audit procedures. *The CPA Journal*, 89(7), 49–53.

Cristea, L. M., (2020), Innovations in financial audit based on emerging technologies. *Audit Financiar*, XVIII, 3(159), 513-531.

Davis, G. A., & Woratschek, C. R. (2015). Evaluating business intelligence/business analytics software for use in the information systems curriculum. *Information Systems Education Journal*, 13(1), 23.

Dedić, N., & Stanier, C. (2017). Measuring the success of changes to business intelligence solutions to improve business intelligence reporting. *Journal of Management Analytics*, 4(2), 130–144.

Duan, L., & Xu, L. D. (2012). Business intelligence for enterprise systems: A survey. *IEEE Transactions on Industrial Informatics*, 8(3), 679–687.

- European Court of Auditors. (2020). Smart audit: the digital transformation of audit. *ECAjournal*. Retrieved from <https://medium.com/ecajournal/smart-audit-the-digital-transformation-of-audit-b283e1653bd4>
- Farjami, Y., & Molanapour, R. (2015). *Business intelligence (from idea to practice)*. Ati-Negar Press, 1st Edition.
- García, J. M. V., & Pinzón, B. H. D. (2017). Key success factors to business intelligence solution implementation. *Journal of Intelligence Studies in Business*, 7(1), 48–69.
- Grublješić, T., & Jaklič, J. (2015). Conceptualization of the business intelligence extended use model. *Journal of Computer Information Systems*, 55(3), 72–82.
- Harrison, R., Parker, A., Brosas, G., Chiong, R., & Tian, X. (2015). The role of technology in the management and exploitation of internal business intelligence. *Journal of Systems and Information Technology*, 17(3), 247–262.
- Heang, R., & Mohan, R. (2017). Literature review of business intelligence. School of Business and Engineering, Halmstad University, Sweden. Retrieved from <https://www.diva-portal.org/smash/get/diva2:1080911/FULLTEXT01.pdf>
- Huang, F., & Vasarhelyi, M. A. (2019). Applying robotic process automation (RPA) in auditing: A framework. *International Journal of Accounting Information Systems*, 35, 100433.
- Isik, O., Jones, M. C., & Sidorova, A. (2011). Business intelligence (BI) success and the role of BI capabilities. *Intelligent Systems in Accounting, Finance and Management*, 18(4), 161–176.
- Johnstone, K. M., & Bedard, J. C. (2004). Audit firm portfolio management decisions. *Journal of Accounting Research*, 42(4), 659–690.
- Kamordzhanova, N., & Selezneva, A. (2019). The impact of the digital economy on accounting, reporting and audit. *Advances in economics, business and management research*, 79. Proceedings of the International Science and Technology Conference “Far East Con”, 228–230.
- Kascelan, L. (2011). Advantages and limitations in implementation of business intelligence system in Montenegro: Case study Telenor Montenegro. *Economic Review: Journal of Economics and Business*, 9(2), 19–30.
- Muhammad, G., Ibrahim, J., Bhatti, Z., & Waqas, A. (2014). Business intelligence as a knowledge management tool in providing financial consultancy services. *American Journal of Information Systems*, 2(2), 26–32.
- Murali, R. S. (2010). Business intelligence as internal audit tool. *UAE Internal Audit Association*, 15, 1–5.
- Popa, M., & Toma, C. (2009). Stages for the development of the audit processes of distributed informatics systems. *Journal of Applied Quantitative Methods*, 4(3), 359–371.
- Rezaee Z., Elam, R., & Sharbatoghlie, A. (2001). Continuous auditing: the audit of the future. *Managerial Auditing Journal*, 16(3), 150–158.
- Rouhani, S., Ashrafi, A., Ravasan, A. Z., & Afshari, S. (2016). The impact model of business intelligence on decision support and organizational benefits. *Journal of Enterprise Information Management*, 29(1), 19–50.
- Stanciu, A., Mihai F., & Aleca, O. (2009). Business intelligence: Trends and evolutions in applications development. *Audit Financiar*, 7(6), 15–22.
- Trigo, A., Belfo, F., & Estébanez, R. P. (2014). Accounting information systems: The challenge of the real-time reporting. *Procedia Technology*, 16, 118–127.
- Vercellis, C. (2009). *Business intelligence: Data mining and optimization for decision making* (1st ed.). New York: Wiley.
- Webb, L. R. (2012). Business intelligence in audit. *International Journal of Business Intelligence Research*, 3(3), 42–53.
- Wong, S., & Venkatraman, S. (2015). Financial accounting fraud detection using business intelligence. *Asian Economic and Financial Review*, 5(11), 1187–1207.
- Yadav, S., & Yadav, S. (2013). Forensic accounting: A new dynamic approach to investigate fraud cases. *EXCEL International Journal of Multidisciplinary Management Studies*, 3(7): 1–9.
- Zraqat, O. M. (2020). The moderating role of business intelligence in the impact of big data on financial reports quality in Jordanian Telecom Companies. *Modern Applied Science*, 14(2), 71–85.
- Zuca, M., & Tinta, A. (2018). The contribution of computer assisted auditing techniques (CAAT) and of the business intelligence instruments in financial audit. *Academic Journal of Economic Studies*, 4(1), 183–191.