Impact of cognitive technologies on selecting and processing samples in financial statements audit

Dunja Dobrinić

AD AKTIVA d.o.o. for auditing, financial, accounting and tax consulting

Zagrebačka 25, Varaždin

dunja.dobrinic@adaktiva.hr

Abstract: Auditing of financial reports is an activity that implies verification of compliance of financial reports with applicable laws and financial reporting standards. As such, it is based on the opinions that auditors form independently on the basis of complex analyzes and verifications. Higher quality and accuracy depend on the amount of data being considered and included in the sample. This goal can be reached fast with the use of "smart computers" that use cognitive technology. This paper aims to point to the importance of applying cognitive technology in the process of auditing financial report. Research of the views of auditors on the territory of the Republic of Croatia has been linked to the perception of the application of new technologies with the aim of producing better and more accurate final results of the audits.

Keywords. audit, financial reports, sample, digital technology, cognitive technology

1 Introduction

Cognitive technologies represent an area of artificial intelligence whose purpose is to imitate the work of the human brain. Data mining, pattern recognition, and natural language processing technologies are used. (Schmelzer, 2018) (Whitler, 2016) These technologies represent self-learning systems that, through machine-learning techniques, perform tasks that only people have been able to perform until now. (A Medium Corporation (US), 2018) In other words, cognitive technology will enable smart computers to think in a way similar to human thinking. (Whitler, 2016) (Schatsky, Muraskin, & Gurumurthy, 2015) (High, 2012) (Borek & Reinold, 2016)

According to Kline, 2016, smart computers, with help from cognitive technology, conduct sample-based and not pre-written based computer code analyses, and their accuracy and quality will depend on the size of the database that the computer has. The larger the base and the larger and more varied sources of the bases are, the higher the accuracy of the analyses. (Kline, 2016) The particularity of cognitive technology is that it has the possibility of "learning" on the basis of "experience". The computer will store all of its previously performed analyses and apply the acquired knowledge at each new analysis. (Borek & Reinold, 2016) Adapting a smart computer with cognitive technology to a particular industry depends on the amount, type, and source of the base that the computer will get. (Borek & Reinold, 2016)

According to PWC[1] cognitive technologies already support or replace some of the decisions instead of serving as a substitute for human effort. (PricewaterhouseCoopers, 2018)

The changes this technology brings will be visible and will affect all industries and even the audit profession itself. It will surely change the way in which the audit is conducted and the process of its implementation. Auditing of financial reports implies verification of compliance of financial reports that are being audited with applicable laws and financial reporting standards. The subject matter of audit is the Company's financial reports that are audited, while the product of audit is auditor's opinion about financial reports that may be positive, negative, or qualified. (Tušek & Žager, 2007)

For the auditor to form an opinion or to make a correct conclusion on the financial reports, it must collect a sufficient amount of relevant evidence using different audit procedures. (Tušek & Žager, 2007) When designing audit procedures, the auditor must also take into account their economic viability. Economic viability is the main reason for establishing and conducting audits using samples, meaning that the auditor does not express an absolute conviction on the reality and objectivity of the

---

[1] PWC – PricewaterhouseCoopers, one of the four biggest global companies (so-called The Big Four) providing audit, insurance, financial, tax, and legal consulting services.

report, but an acceptable and reasonable assurance. A sample-based audit implies "applying audit procedure to less than one hundred percent of items from the account balance or transaction type so that each sample unit has the option of being selected. The sample can be selected statistically or non-statistically. With the non-statistical selection, the auditor relies on its professional judgment when selecting the sample size and quality while the statistical method implies a selection by the method and the use of statistical and mathematical calculations. (Tušek & Žager, 2007) Duminčić states that errors in the use of samples are possible and they can be sampling errors or non-sampling errors. (Duminčić & Cvetkovič, 2007) Sampling errors occur when the auditor uses a small sample and the wrong conclusions are more probable. The too small sample causes an error that can be avoided by using a larger sample or by testing the entire population. The second type of error is a non-sampling error which Duminčić states appears independently of the size of the sample. (Duminčić & Cvetkovič, 2007)

It is obvious that the quantity and quality of the sample have a major impact on the opinion of the auditor. By using cognitive technology, it is possible to increase the size of the sample or even test the entire population without the extra time spent on auditing. Cognitive technology will provide the auditor with a better sample based on which they will be able to give their opinion. (KPMG, 2018) (Tušek & Žager, 2007)

2 Conceptual framework of research

According to the research Audit 2025 by Forbes Insights/KPMG, 80% of respondents believe that auditors need to increase their samples and that it is necessary to use sophisticated technology in auditing. Furthermore, 58% of respondents believe that the development of technology will have one of the biggest impacts on auditing over the next few years and that smart computers, i.e. computers equipped with artificial intelligence, will be in the top 5 investments within a company. According to the same research, 59% of respondents believe that the use of computers with cognitive technology will enable auditors to conduct deeper analysis and more detailed data testing. (Macaulay M. T., 2017) (Macaulay M. , 2017) (KPMG, 2018)
Companies whose reports are subject of audit influenced by digitalization and advanced technologies generate large amounts of both

structured and unstructured data. The auditor's task is to evaluate the truthfulness of these data, i.e. the correctness and accuracy of the financial reports, through as big a sample as possible. Bigger samples require greater engagement and therefore higher costs. Smart computers that use cognitive technology can help in reducing costs and maintaining auditing cost-effectiveness. Computers equipped with cognitive technology will allow auditors to increase their sample and analyze a large amount of structured and unstructured data. Algorithms in cognitive technologies will process the data in a similar way to the human brain.
A quick and accurate analysis of the collected financial and non-financial data will provide a sufficient level of conviction and audit evidence to form an opinion. (Macaulay M. T., 2017) (KPMG, 2018) (Macaulay M. , 2017) (Wuerfel, 2017)

Cognitive technologies will also enable the collection and analysis of data from non-traditional environments, such as social networks and the internet, and as such overlap them with information gathered in the company's business environment. This will allow for a wider picture of possible risks of impact on the financial reports. (Whitler, 2016) (Wuerfel, 2017) (Macaulay M. T., 2017) In addition, cognitive technologies will also enable extraction of large sample data from an audited enterprise program system and complex analysis to detect potential anomalies. (Macaulay M. T., 2017) (KPMG, 2018) The effectiveness of cognitive technology in the audit implies great investments in its adaptation. This would mean "training" the system for audit work and the creation of custom audit database for the audit of the financial report. (High, 2012) (A Medium Corporation (US), 2018)

Noting the importance of new technologies, large auditing companies (so-called The Big Four) also set up separate departments whose interest is cognitive technology. In collaboration with IBM and their Watson software, KPMG[2] develops software that will be tailored to auditing. Macaulay states that "IBM Watson has the ability to significantly improve the amount of data that auditors can process as well as the quality of analysis and insight they can provide in terms of speed and quality of data processing." (Macaulay M. , 2017)

Auditing companies will have to invest substantial resources to adapt to the digital revolution. It is to be expected that willingness to adapt will be first shown by large auditing companies operating globally who will not see investment in technology as a big burden. It remains to be seen how small and medium-sized audit firms will behave and react, and

---

[2] KPMG – is one of the four biggest global companies (so-called The Big Four) providing audit, insurance, financial, tax, and legal consulting services.

whether they will be able to adjust in time. (Macaulay M. , 2017) (KPMG, 2018) (Wuerfel, 2017)

In order to investigate the attitudes of authorized auditors and auditors' assistants in the Republic of Croatia on cognitive technology and the appropriateness of its use in auditing, research has been carried out. The conceptual model of research is shown in Figure 1.
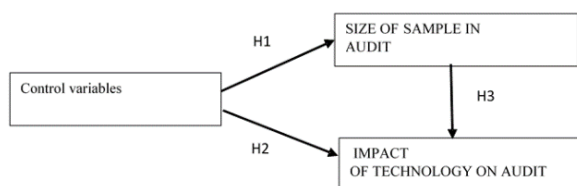

Figure 1. Conceptual model of research

Based on the conceptualization set up, the following hypotheses were formed:

H1 - Control variables (*age, status in auditing company, years of audit experience, number of employees, size of clients, use of primary digital technologies, use of secondary digital technologies, use of computer programs in audit, method of sample definition in audit, knowledge of cognitive technology terms, investments in digital technology, use of primary digital technology by clients, use of secondary digital technologies by clients*) affect the attitudes about the size of the sample in the audit. The auxiliary hypotheses were formed H1.1 H1.2 ...... .H1.13 to observe the influence of each of the control variables.

H2 - control variables affect attitudes about how technology affects the audit. The auxiliary hypotheses were formed H2.1 H2.2 ...... .H2.13 to observe the influence of each of the control variables.

H3 - Attitudes of audit employees on the size of the sample in audit affect the attitudes about how technology affects the audit.

3 Research methodology

In order to prove the hypotheses a research was carried out among authorized auditors and audit assistants in the Republic of Croatia.

Questionnaire was used as a research instrument. Part of the statements in the questionnaire used the statements from the 2016 research in the USA by KPMG and Forbes Insights "Audit 2025: The future

is now", where 46 auditor boards president, 62 financial directors, 19 auditors, 18 tax consultants, 21 controllers, and 34 financial managers were questioned. The questionnaire consists of three parts, the first part includes the control variables, the second part includes 3 statements to examine the attitudes about sample size used for auditing the financial reports, and the third includes 12 statements to examine the impact of technology on the process of selecting and analyzing the sample in the audit of the financial reports. Claims related to the determination of attitudes were measured by Likert five-point scale. According to the Registry of the Croatian Chamber of Auditors in the Republic of Croatia, 496 active authorized auditors and 26 audit assistants are registered. Questionnaire was sent out to a total of 486 e-mail addresses in March 2019, 55 responses were collected, out of which 49 were related to authorized auditors, 3 to auditors' assistants and 3 to other audit employees.

4 Research results

4.1 Research goal

Companies whose reports are subject of audit influenced by digitalization and advanced technologies generate large amounts of both structured and unstructured data. The auditor's task is to evaluate the truthfulness of these data, i.e. the correctness and accuracy of the financial reports, through as big a sample as possible. Bigger samples require greater engagement and therefore higher costs. Smart computers that use cognitive technology can help in reducing costs and maintaining auditing cost-effectiveness. A quick and accurate analysis of the collected financial and non-financial data will provide a sufficient level of conviction and audit evidence to form an opinion. (Macaulay, 2017) (KPMG, 2018) (Macaulay M. , 2017) (Wuerfel, 2017) The research aims to investigate attitudes of auditors on the territory of the Republic of Croatia on the application of new technologies in the audit process.

4.2 Research results

The analysis of the collected data used several statistical methods with the statistical tool IBM SPSS Statistics 23. Descriptive and inferential statistics and bivariate statistical methods (ANOVA and correlation analysis - Pearson correlation) were used. In order to examine more comprehensively the attitudes of respondents, the questionnaire contained thirteen control variables. Table 1 presents the results of examining the attitudes about the sample size in the audit and the attitudes about the impact of the technology on the audit in relation to the control variables.

Table 1. Results in relation to the control variables

Variables	Size of the sample in audit		Impact of technology on the audit	
	Anova (F)	Sig.	Anova (F)	Sig.
1. Age	0.53	0.591	0.36	0.694
2. Status in audit company	0.95	0.423	**2.95**	**0.041**
3. Years of experience in audit	2.25	0.094	0.99	0.405
4. Number of employees	1.41	0.250	1.98	0.128
5. Size of clients	1.72	0.147	1.96	0.131
6. Use of primary digital technologies	0.93	0.400	0.53	0.588
7. Use of secondary digital technologies	2.14	0.128	0.24	0.782
8. Use of accounting programs in audit	0.03	0.974	1.41	0.253
9. Sample definition	2.03	0.142	0.14	0.864
10. Knowledge of the term cognitive technology	0.56	0.573	1.84	0.168
11. Investments in digital technology	0.32	0.860	2.51	0.053
12. Use of primary digital technologies by clients	0.24	0.787	1.21	0.305
13. Use of secondary digital technologies by clients	0.88	0.421	0.75	0.478

The results of the study of the attitudes about the sample size in the audit and the attitudes about the impact of the technology on the audit in relation to the control variables show that there is no statistically significant difference between them. The exemption is the impact of respondent's status in the audit company (*p<0,05)* where partners and authorized auditors have better attitudes about the impact of technology in audit than the others. Following the above, H1 hypothesis is completely rejected and in the H2 hypothesis the auxiliary hypothesis H2.2 is accepted and the other twelve are rejected.

In order to verify the reliability of the scale used, the Cronbach α coefficient shown in Table 2 is used.

Table 2. Reliability of scales determined by Cronbach α coefficient

Statement	Cronbach α (if the statement is omitted)
Attitudes about the audit sample size (α = 0.756)	
The sample we use should be larger	0.759
Use of larger sample would result in a better audit...	0.509
Sample size affects the audit quality	0.718

Statement	Cronbach α (if the statement is omitted)
Attitudes about the impact of technology on audit (α = 0.927)	
Progress in technology results in an increase in the quantity of information that affects the formation of an auditor's opinion	0.922
The development of technology has an impact on the way auditing is carried out	0.921
The development of technology affects the size of the sample that the auditor uses in auditing	0.923
AI computer can replace a person in auditing for sample selection tasks	0.920
AI computer can replace a person in auditing for sample analyses tasks	0.922
AI computer can replace a person in auditing for the detection of anomalies in a sample	0.919
AI computers can help an auditor to form attitudes	0.921
AI computer will enable an auditor to process a larger sample	0.921
AI computer will enable an auditor to process data better	0.917
AI computer will enable an auditor to process data faster	0.916
In 2036, companies will be managed by smart computers using artificial intelligence	0.929
In the next 5 years, auditors will have to invest in artificial intelligence computers to be able to use larger samples and test them in a faster way	0.920

The analysis of reliability shows that Cronbach coefficient values for both attitudes are satisfactory (Nunnally & Bernstein, 1994.). A correlation analysis was carried out to check the H3 hypothesis. (Figure 2)

H1 hypothesis	Pearson correlation	Sig. 2-sided
Attitudes about the audit sample size Attitudes about the impact of technology on the audit	0.594	0.000*

Significance at level 0.01, Source: Author's research

Figure 2. Correlation analysis - checking of H3 hypothesis

The correlation analysis results show a statistically significant (medium strong)[3] correlation between attitudes about the size of the audit sample and attitudes about the impact of technology on audit (r=0.594, where $p < 0,01$), which confirms the H3 hypothesis.

4.3 Discussion and concluding considerations

The research in this paper aims to investigate attitudes of auditors on the territory of the Republic of Croatia on the application of new technologies in the audit process. As the introduction of new technologies primarily binds to the size of the sample used by auditors to form an opinion, attitudes on the size of the sample and the necessity of its increase have been explored in order to carry out a better quality audit. According to the results of the research between attitudes on sample size and attitudes on the introduction of new technologies, there is a positive correlation link.

Previous researches, which, because of the specific area are sporadic, point to the awareness of the existence of new technologies that can make auditors work better and faster. KPMG and Forbes Insights' research (KPMG, 2018) thus also points to the question of determining the sample in the audit, stating that as many as 80% of the respondents think the size of the sample should be increased. The research for the purpose of this paper shows that 49.10% of respondents believe that the size of the sample affects the audit process and 36.30% of them believe that applying a larger sample would result in better quality auditing. Furthermore, only 20% of respondents believe that the sample currently used in the audit process is too small, while 49.10% of them think that the sample size they use is sufficient to

form their opinion. The assumption is that the different results of these research arise from the target population. The research in this paper focuses on the population of audit staff (authorized auditors and audit assistants) while KPMG's research mostly involved audit service users (out of 200 respondents only 9.5% were auditors). (KPMG, 2018) Expanding research on the population of auditing services users in the Republic of Croatia would certainly contribute to a better understanding of the subject.

The research shows that only 18% of auditors and audit assistants encompassed in the research are familiar with the term cognitive technology as a branch of artificial intelligence, while 41.80% believe smart computers can help form auditor's opinion. Relatively few respondents who are not familiar with the term can be explained by the size of the company they work for. To put that in perspective 32% of them work in companies with up to 5 employees (so-called small companies). The assumption is that small companies do not consider monitoring progress in digital technology is of great importance which is shown by the research where 25% of them are about to spend only up to 10,000 kunas on digital technology in the next 5 years, 34% up to 20,000 kunas and only 19% up to 50,000 kunas. The readiness of small and medium-sized auditing companies to make changes that the use of secondary digital technologies brings is an area that the next research should cover. Adapting their business to new technologies is also important for maintaining and gaining a competitive edge on a market that is dominated (by their size and strength) by The Big Four auditors.

The main constraints of this research are a smaller number of returned polls (the sample encompassed 93% of the population) and the lack of participation of the employees of the so-called The Big Four. Despite the aforementioned shortcomings, the contribution of the paper is in new knowledge related to the application of digital technologies in specific audit activity. Research results can be a useful source of information for scientists, experts, and audit firms to prepare and cancel potential negative impacts of the necessary transformation of business brought by digital technology.

References

A Medium Corporation (US). (2018, March 20). *A Medium Corporation (US)*. Retrieved March 6, 2019, from https://medium.com/@northof41/what-is-

---

[3] The correlation is medium strong if the coefficient is greater than 0.40 and lower than 0.69. (Bryman and Cramer, 2005; 219)

cognitive-computing-and-why-you-need-to-know-about-it-bdd935204f9e

Borek, A., & Reinold, J. (2016). *Marketing with smart machines : customer interaction in the algorithmic economy.* North Charleston: CreateSpace.

Bryman, A., & Cramer, D. (2005). *Quantitative Data Analysis with SPSS 12 and 13: A Guide for Social Scientists.* Routledge, London, New York, SAD.

Duminčić , K., & Cvetkovič, B. (2007). Sample designs applicable in audit tests. *Publication of Faculty of Economics in Zagreb*, 314-330.

High, R. (2012). *IBM Watson: The Era of Cognitive Systems: An Inside Look at IBM Watson and How it Works.* Retrieved March 2019, from https://developer.ibm.com/watson/wp-content/uploads/sites/19/2013/11/The-Era-of-Cognitive-Systems-An-Inside-Look-at-IBM-Watson-and-How-it-Works.pdf

Kline, R. (2016, November 17). Retrieved from https://www.ibm.com/blogs/systems/behind-the-curtain-how-cognitive-computing-works/

KPMG. (2018, June 16). *Forbes*. Retrieved March 5, 2019, from https://www.forbes.com/sites/insights-kpmg/2018/07/16/three-technologies-that-will-change-the-face-of-auditing/#2551d5237544

Macaulay, M. (2017). *Audit Committee Institute.* Retrieved March 6, 2019, from http://auditcommitteeinstitute.kpmguae.com/KPMG/UploadeFiles/harnessingthepowerofcognitivetechnologytotransformtheaudit.pdf

Macaulay, M. T. (2017, January 18). *FINANCIAL EXECUTIVES INTERNATIONAL.* Retrieved March 6, 2019, from https://www.financialexecutives.org/Topics/Strategy/How-Cognitive-Tech-Is-Revolutionizing-the-Audit.aspx

Nunnally, J., & Bernstein, L. (1994.). *Psychometric theory.* New York: McGraw-Hill Higher, INC.

PricewaterhouseCoopers. (2018). *State of the Internal Audit Profession Study- Moving at the speed of innovation The foundational tools and talents of technology-enabled Internal Audit.* Retrieved March 2019, from PWC: https://www.pwc.co.uk/audit-assurance/assets/pdf/moving-at-the-speed-of-innovation.pdf

Schatsky, D., Muraskin, C., & Gurumurthy, R. (2015, January 26). *Deloitte Insights.* Retrieved March 5, 2019, from www2.deloitte.com: https://www2.deloitte.com/insights/us/en/deloitte-review/issue-16/cognitive-technologies-business-applications.html

Schmelzer, R. (2018, July 6). *Is Cognitive Technology a Better Term than Artificial Intelligence?* Retrieved March 5, 2019", from Cognilytica: https://www.cognilytica.com/2018/06/26/is-cognitive-technology-a-better-term-than-artificial-intelligence/

Tušek, B., & Žager, L. (2007). *Audit, II. amended edition.* Zagreb: HZRIFD.

Whitler, K. A. (2016, June 26). *https://www.forbes.com.* Retrieved March 2019, from Forbes: https://www.forbes.com/sites/kimberlywhitler/2016/06/26/cognitive-technology-what-it-is-and-why-marketers-should-care/#10b398e07195

Wuerfel, A. (2017, November 8). *NJCPA-New Jersey Society of Certified Public Accountants.* Retrieved March 9, 2019, from https://njcpa.org/stay-informed/topics/article/2017/11/08/cognitive-technologies-and-the-impact-on-audits