

The impact of audit data analytics on audit quality and audit review continuity in Thailand

Impact of audit data analytics

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Abstract

Purpose – The main objective of this study is to examine the impact of audit data analytics (ADA) on audit quality (AQ) and audit review continuity (ARC).

Design/methodology/approach – Using 452 CPAs in Thailand as samples, mail questionnaires were used and sent to collect the data. Descriptive analysis, correlation matrix and path analysis were used to analyze the data.

Findings – The results of this study indicated that audit data analytics had a positive impact on AQ and ARC. Cybersecurity, used as a moderator in this study, was found to be the interaction between ADA, AQ and review continuity.

Practical implications – Auditors and audit firms can consider using big data in their data analytics to improve AQ and ARC.

Originality/value – Resource advantage theory has been used in this study to explain the impact of ADA on AQ and ARC in Thailand.

Keywords Audit data analytics, Audit quality, Audit review continuity, Thailand, CPAs

Paper type Research paper

1. Introduction

Due to exponential improvements in digital technology, large amounts of data are continuously generated every second. Most of these data are created by billions of individuals worldwide on mainstream social media platforms, such as Facebook, YouTube, Twitter, Google and Line. In addition, to enter the era of the digital economy and society, where technology is an integral element of daily life, communication and information exchanges are quick and diversified. A massive volume of data known as “big data” is now in play. Consequently, all sectors and organizations have adapted and prepared big data to boost their competitiveness and maintain organizational sustainability (Brown-Liburd *et al.*, 2015). Therefore, if big data can play a significant role in business organizations, auditors must adapt to and attain the same goals and level of efficiency as other professionals. In terms of auditors and the audit profession, big data are used to connect organizational transactions. It includes information from partners and other stakeholders, as well as environmental elements that affect the accuracy of corporate financial statements (Deloitte, 2016). Audit data analytics (ADA) can benefit from the measurement of transactions that auditors can use from



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many perspectives such as planning, analysis, tests of control and substantive tests (Barr-Pulliam *et al.*, 2022).

One benefit of ADA is an increase in audit quality (AQ) and audit review continuity. ADA can (1) verify 100% of business transactions, (2) reduce the limitations and risks of sample selection based on traditional audit methods and (3) improve inspection quality (Stefan, 2019). For example, Ernst & Young (2015) introduced ADA to assist auditing services because it can improve AQ and review continuity. Several studies have examined the impact of ADA on increasing AQ and audit review continuity (ARC). In addition, ADA can enhance auditors' judgments and decision-making by improving the identification of errors, which may warrant further investigation (Ernst & Young, 2015). For example, Mustapha and Lai (2017) found that the information technology of ADA can (1) help decrease the audit period, (2) improve audit review continuity and (3) make the auditors' work more efficient and of better quality. Omonuk and Oni (2015) find that computer-assisted auditing is positively related to AQ and review continuity. The impact of ADA is to increase AQ, which can be explained by the resource advantage theory. AQ and ARC are valuable intangible resources and capabilities that depend on audit data analysis (Klinsukhon *et al.*, 2018).

However, there are several studies of ADA, AQ and ARC in developed countries (Stefan, 2019; Mustapha and Lai, 2017; Omonuk and Oni, 2015), there are small numbers of literature in emerging economic countries especially in Thailand. Moreover, the results on the impact of ADA on AQ and ARC are inconclusive and mixed. For example, many studies have found a positive impact of ADA on AQ and ARC (Barr-Pulliam *et al.*, 2022; Mustapha and Lai, 2017; Omonuk and Oni, 2015; Cao *et al.*, 2015; Brown-Liburd *et al.*, 2015), while some studies found no impact of ADA on AQ and ARC (Barr-Pulliam *et al.*, 2022). The benefit of audit data analytics on both AQ and ARC should increase the actual perceived level of assurance provided by engagement (Deloitte, 2016).

Thailand was used as the context to investigate ADA for several reasons. First, although Thailand is one of the countries that has dramatically developed its digital economy by using big data from 2020 to 2022, Thailand is still an emerging economic country. Second, digital economic development in Thailand can affect all elements of business processes because the recording of business transactions is run by big data analytics; therefore, the auditing process must be developed together. However, there are differences between auditing firms in Thailand. On one hand, the ADA is common auditing process for the international auditing firms such as Big-4 auditing firms. On the other hand, ADA may be too new an auditing process for Thai national auditing firms. Thus, an investigation of ADA in Thailand must be conducted.

Therefore, this study attempts to fill this research gap by investigating ADA in Thailand, as well as the impact of ADA on AQ and ARC.

This study makes the following expected contributions. In terms of the expected theoretical contributions, resource advantage theory can be tested to determine whether it can be used to explain the impact of ADA to increase AQ and ARC. In addition, this study can expand the knowledge of the audit literature in Thailand as a developing country as well as in developed countries. In terms of practical contributions expected, auditors and audit firms can use the ADA to develop and improve their AQ and ARC. Business organizations, as auditors' partners can obtain better auditing services, including quality and review continuity, from auditors and audit firms.

The remainder of this paper is organized as follows. Section 2 offers a literature review of ADA and its consequences. Section 3 presents the research method, including the population and sample, data collection, variable measurement and data analysis. Section 4 provides the findings and discussions. Section 5 concludes the paper with summary, contributions, implications, limitations and suggestions for future research.

2. Literature review and hypothesis development

There are three main topics in this section: the theoretical perspective of the resource advantage theory, the impact of ADA on AQ and ARC and the moderating effect of cyber security (CB) on ADA and consequences.

2.1 Theoretical perspective

This study applies resource advantage theory as the main theory to explain the impact of ADA on AQ and ARC. Resource advantage theory posits that corporate resources can build advantages for business positions and success by using resources appropriately (Hunt and Morgan, 1997). Organizational resources are regarded as a part of business strategies in both tangible and intangible assets, such as the distinctive potential of human resources, distinctive information systems and modern innovation. These resources have brought about corporate competitive advantages, image and reputation and sustainability (Klinsukhon et al., 2018). Therefore, resource advantage theory is used to explain that AQ and ARC are valuable intangible resources and capabilities that depend on audit data analysis. For example, Mustapha and Lai (2017) found that information technology of ADA can (1) help to decrease the audit period and (2) make the auditors' work more efficiently with better quality.

2.2 The impact of audit data analytics on audit quality and audit review continuity

The American Institute of Certified Public Accountants (2015) defines ADA as "the science and art of detecting and analyzing patterns as well as examining deviations and inconsistencies". This includes and extracts other useful information from information referenced or related to audit matters through analysis, modeling and visualization, which combines both financial and nonfinancial information to identify and assess audit risks, as well as planning and performing additional audits. ADA can now be utilized in four audit procedures according to publications from the AICPA (2015) and the Assurance Standard Board's ADA Working Group: risk assessment, internal control evaluation, comparative analysis and substantive testing of transactions and balances.

However, even though there were several previous related studies of ADA, most literature were pinched in developed countries rather than emerging developing countries. For example, in developing countries, Marei et al. (2022) investigated the benefits of big data analytics of audit works in Canada finding that ADA can improve both efficiency and effectiveness of firm risk evaluations substantially. In New Zealand, Farid (2020) found that although the level of ADA was low, the large audit firms perceived ADA as enjoyable and fulfilling to them. Using data from developed countries, Barr-Pulliam et al. (2022) found that ADA can increase the perception of AQ. On the other hand, in emerging economic countries, Yeo and Carter (2017) found that ADA can help Malaysian auditors to improve AQ on their works as well as competencies. In Thailand, Janchai et al. (2021) found a positive relationship between ADA and tax performance of tax departments in Thailand.

To test the impact of ADA on AQ and review continuity, there are some empirical evidence. For example, Kend and Nguyen (2020) found that the use of big data analytics had a favorable effect on auditing systems because it frees auditors' attention from manual duties so that they can concentrate on more crucial ones such as assessment and judgment. Stefan (2019) found that audit data analysis can verify a business transaction, reducing the limitations and risks of sample selection based on traditional audit methods, while also improving inspection quality. Mustapha and Lai (2017) found that the information technology of ADA can (1) help decrease the audit period, (2) improve ARC and (3) make the auditors' work more efficient and of better quality. Omonuk and Oni (2015) found that computer-assisted auditing is positively related to AQ and review continuity. However, Barr-Pulliam et al. (2022) found no impact of ADA on AQ and ARC. This may be because

the benefit of ADA on both AQ and ARC should increase the actual perceived level of assurance provided by the engagement (Deloitte, 2016). Therefore, to obtain unconcluded results, this study examines the impact of ADA on AQ and ARC as follows:

H1a. ADA has positively impact on AQ.

H1b. ADA has positively impact on ARC.

2.3 Moderating effect of cyber security on audit data analytics and consequences

Owing to the requirement for quick processing of high-velocity, high-volume data from various sources to discover anomalies and/or attack patterns as quickly as possible to limit the vulnerability of the systems and increase their resilience, big data analytics will be a necessary component of any effective cybersecurity solution (Angin *et al.*, 2019). CB refers to technology tools, processes and procedures to prevent and respond to potential assaults on network equipment, information infrastructure, systems or programs. This can be harmed by unauthorized third-party access. Therefore, all government and private organizations are increasingly focusing on cybersecurity. The targets of attacks have become broader; thus, the forms of cyberattacks have become more varied, causing increasing damage to the company (National Institute of Standards and Technology, 2018). Moreover, auditors and CB are procedures that must be followed to keep the company safe from threats and damages that could compromise the security of electronic data, as well as the security of the systems and networks that are used to access, process and disseminate data online (The Federation of Accounting Professions, 2018). CB also encompasses the safeguarding of information systems from threats and espionage. Corporate CB allows businesses to predict, prevent, detect and respond to threats swiftly and systematically, while keeping their operations running (National Institute of Standards and Technology, 2018).

An analysis and synthesis of cybersecurity in accounting research by Haapamäki and Sihvonen (2019) indicates that the advantages and challenges of information exchange from cybersecurity in the accounting area have substantial consequences for research and practice. This synopsis also emphasizes the value of the model for investments in cybersecurity, internal auditing, cybersecurity controls, the disclosure of cybersecurity activities, security risks and security breaches. CB has been used in previous related studies on ADA. For example, Yunis *et al.* (2021) found that ADA with a high level of CB can increase the quality and value of financial statements that benefit policy-setters and users. Moreover, ADA with a high level of CB can increase AQ and ARC. Waldron and Hallstrom (2013) found that cybersecurity can protect information leaks from ADA that influence AQ. Therefore, in this study, CB is used as a moderator variable for the impact of ADA on AQ and ARC.

H2a. CB moderates the impact of ADA on AQ.

H2b. CB moderates the impact of ADA on ARC.

3. Research method

Certified public accountants (CPAs) in Thailand were used to investigate the level of ADA, as well as to examine the impact of ADA on AQ and ARC. A total of 2,133 CPAs in Thailand who were willing to share contact information from the Federation of Accounting Professions of Thailand's database were chosen as the study population. This is because they offer different contributions and implications to the existing auditing literature. Regarding questionnaire mailing, 452 respondents out of 2,133 were received (21.19%). The response rate for a mail questionnaire with an appropriate follow-up procedure, if greater than 20%, is considered acceptable, according to Aaker *et al.* (2001).

The mail questionnaire used in this study was adapted from prior related studies by [Barr-Pulliam et al. \(2022\)](#), and the [NIST Cyber Security Framework \(2018\)](#). There were five main parts of the questionnaire: (1) demographic information of CPAs, such as gender, age, education and auditing experience; (2) ADA divided into four sub-topics: audit data management, analysis, visualization and insight; (3) AQ divided into three sub-topics as auditors perform processes, functions and activities; (4) ARC divided into four sub-topics: controlling audit engagement, reviewing pertinent reports, validating the accuracy of information and monitoring audit performance; (5) CB divided into four sub-topics: secrecy, correctness, completeness and availability. From the second to the last part of the questionnaire, a five-point Likert scale was used.

To test for nonresponse bias, a comparison of the first- and second-wave data, as advised by [Armstrong and Overton \(1977\)](#), is used to verify and test any nonresponse bias and to detect and protect probable problems with nonresponse mistakes. Gender, age, education and audit experience were the factors used to test for nonresponse bias in this study. A *t*-test was used to confirm the differences between the variables. In this regard, neither procedure revealed significant differences because gender ($t = 0.153, p > 0.05$), age ($t = 0.145, p > 0.05$), education ($t = 0.105, p > 0.05$) and experience in audits ($t = 0.133, p > 0.05$) were not statistically significantly different between the first and second groups at the 95% confidence level.

To analyze data of this study, the descriptive analysis by mean and standard deviation (SD) was used to investigate the level of ADA, AQ, ARC and CB by using mean and standard deviation. The correlation matrix was assessed to detect potential multicollinearity among all the variables used in this study. Finally, path analysis, including factor confirmation of the structural equation model using the AMOS Statistics Software Program, was used to analyze the data of this study.

4. Findings and discussion

4.1 Factor confirmation

The discriminant validity of the variables as ADA, quality, review continuity and CB is investigated using confirmatory factor analysis in this study ([Sujati et al., 2020](#)). Confirmatory factor analysis was used to evaluate the underlying linkages of a large number of items and determine whether they might be reduced to a smaller number of factors. All factor loadings with values of 0.631–0.927 are statistically significant and above the 0.40 cutoff ([Nunnally and Bernstein, 1994](#)). As a result, this study suggests that the four main variables are empirically distinct from one another, indicating four separate constructs. Additionally, the measurement's dependability is based on a measure of internal consistency or how closely a group of items is related. Cronbach's alpha is the most commonly used for internal consistency metric ([Taber, 2017](#)). It is most typically used when researchers have many Likert items that form a scale in a survey or questionnaire and want to see if the scale is dependable. Cronbach's alpha coefficients of 0.855–0.937 are greater than 0.70 in scale dependability ([Nunnally and Bernstein, 1994](#)). As a result, the scales of all the measures in this study had adequate validity and reliability. The results for the factor loadings, item-total correlation and Cronbach's alpha for the multiple-item scales utilized in this investigation are presented in [Table 1](#).

4.2 Correlation matrix

The results of the correlation matrix analysis of the variables are presented. Multicollinearity might occur when the intercorrelation in each predicted variable is greater than 0.80, which is a strong relationship ([Hair et al., 2010](#)). The correlations ranged from 0.323 to 0.729 for CPA samples at the $p < 0.01$ level. Therefore, multicollinearity may have occurred in this study.

Thus, this study also tested the variance inflation factor (VIF). The results show that the VIF is less than 10. Multicollinearity is not a serious problem if the VIF is less than 10 on the scales (Hair *et al.*, 2010). Therefore, the conceptual model could be tested.

4.3 Path analysis

Table 2 presents the results of path analysis and hypothesis testing. The results show that ADA plays a significant role in determining and driving AQ and review continuity. This is positively related to AQ ($\beta = 0.428, p < 0.01$) and review continuity ($\beta = 0.619, p < 0.05$). The results indicate that auditors ensure that big data analytics increase audit efficiency and capacity, as well as the ability to identify important hazards, meet audit goals and effectively mitigate potential risks (see Figure 1).

Table 1.
Results of
measurement
validation

Variables	Factor loadings	Cronbach's alpha
Audit Data Analytic (ADA)	0.774–0.897	0.935
Audit Quality (AQ)	0.679–0.906	0.931
Audit Review Continuity (ARC)	0.766–0.898	0.937
Cyber Security (CB)	0.693–0.927	0.855

Table 2.
Results of path
analysis

Hypotheses	Relationship	Standardized coefficients	Standard error	t-value
H1a	ADA → AQ	0.438***	0.042	10.335
H1b	ADA → ARC	0.538***	0.040	13.554
H2a	ADA*CB → AQ	0.584**	0.166	6.998
H2b	ADA*CB → ARC	0.562***	0.586	5.658
Note(s): *** is significant at 0.01 level, and ** is significant at 0.05 level				

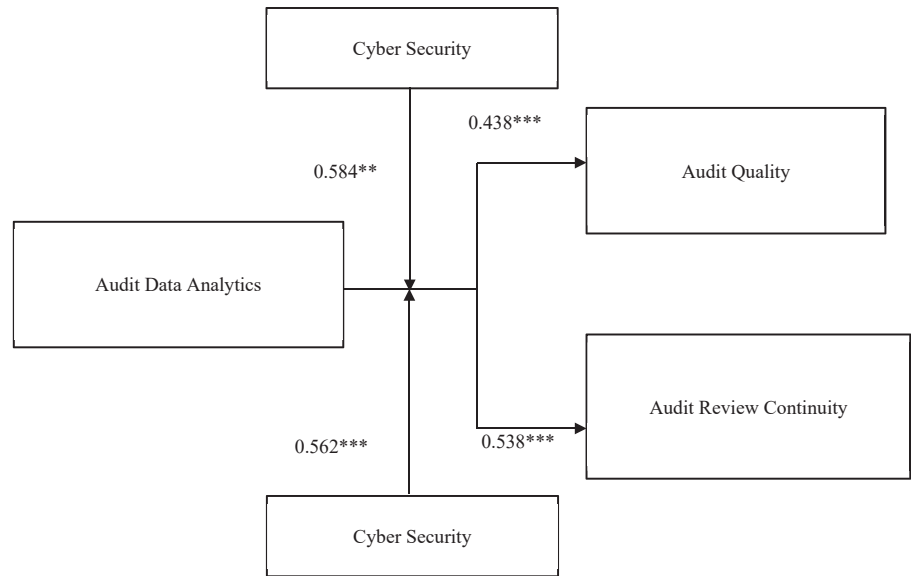


Figure 1.
The summary of audit
data analytics-audit
quality-audit review
continuity

In terms of discussion, data analytics can be used to design and define audit scopes and activities that focus on high-risk regions and uncover new hazards for audit effectiveness. Auditors can access a variety of up-to-date, complete data for critical analysis. Deep into the outcomes of data analytics to accurately communicate opinions in financial statements. Data analysis also aids in the presentation of data in an easy-to-understand fashion by adding relevant information to financial statements and data opinions. To improve AQ and review continuity, ADA provides a more convenient and efficient approach to auditing complex transactions. For example, [Ernst & Young \(2015\)](#) introduced ADA to assist in auditing because it is a method of evaluating data to determine exactly what the information collected means. Therefore, the results of this study on the impact of ADA on AQ and ARC are consistent with those of [Stefan \(2019\)](#), [Mustapha and Lai \(2017\)](#), [Omonuk and Oni \(2015\)](#), [Cao et al. \(2015\)](#) and [Brown-Liburd et al. \(2015\)](#). This is because the information technology of ADA can (1) help to decrease the audit period and (2) make the auditors' work more efficient and of better quality. In addition, resource advantage theory can be used to explain that AQ and ARC as valuable intangible resources and capabilities that depend on ADA. Therefore, [Hypotheses 1a and 1b](#) are fully supported.

[Table 2](#) also indicates that cybersecurity as a moderator and the coefficient of interaction between ADA and cybersecurity (ADA*CB) have a positive significant effect on AQ ($\beta = 0.584$, $p < 0.10$) and review continuity ($\beta = 0.562$, $p < 0.01$). In the disruptive technological era, data security is so important that ADA must run concurrently with CB. Work on security and auditing to identify the system's users makes the information in the system more secure for auditing purposes. Safeguards are also in place to prevent equipment alterations. The presence of harmful code detection tools to help maintain confidentiality, as well as antivirus monitoring and preventive programs to help protect against cyber threats, are examples of unauthorized programs and systems. Most importantly, the prevention process to prepare for cybersecurity intrusion incidents helps ensure readiness and security in the use of information systems for audit work. Having an incident response system when a person involved is exposed to a cyber-attack or threat can help restore the integrity of an audit information system. As mentioned, CB must be combined with ADA to create AQ and continuity. In accordance with the US National Institute of Standard and Technology (2014), which identifies, protects, detects, responds and recovers many companies have used this framework to cope with cyber risks. The framework outlines risk management concepts and best practices for strengthening companies' security. Thus, [Hypotheses 2a and 2b](#) are fully supported.

The results of this study show that the aspects of both AQ and audit review continuity can be enhanced by using ADA. This is because ADA can cover better auditing data, quickly identify risks and complete auditing processes with higher levels of AQ and ARC. Therefore, this can be a big change in auditing in Thailand from a manual auditing process to ADA.

5. Summary and contribution

ADA is a key determinant of the increased success of audit outcomes. Thus, this study aims to examine the impact of ADA on AQ and ARC of CPAs in Thailand and through cyber security as a moderating effect of ADA on AQ and review continuity. The results of the path coefficients and hypothesis testing show that ADA play a positive and significant role in determining and driving AQ and review continuity. Moreover, cybersecurity was a moderator effect, and the coefficient of interaction between ADA and cybersecurity had a positive significant effect on AQ and ARC. In the disruptive technological era, data security is so important that ADA must run concurrently with cyber security.

The result of positive impact of ADA on AQ and ARC in this study is consistent and similar with the previous related studies in developed and developing economic countries such as [Marei et al. \(2022\)](#), [Barr-Pulliam et al. \(2022\)](#) and [Yeo and Carter \(2017\)](#), even though

those literature used qualitative research and collect data from small sample size. It is because Thailand by the Federation of Accounting Profession is worked under the International Auditing and Assurance Standards Board as same as the other countries in developed and developing economic markets. Thus, this study's finding can demonstrate the benefit of ADA on AQ and ARC in quantitative research as well as the results of qualitative research. In addition, to compare uses of ADA between private and government organizations in Thailand, this study's result is also similar with [Janchai et al. \(2021\)](#) who found a positive relationship between ADA and tax performance of tax departments. This is because Thailand has dramatically developed its digital economy by using big data in both private and government organizations since 2020 under Thailand Digital Government. Therefore, if digital economic development in Thailand can affect all elements of management processes because the recording of management transactions is run by big data, the auditing process used by ADA is developed together.

The results of this study provide some contributions and implications. In terms of practical contributions, auditors with greater focus and skill in data analytics can achieve outcomes, success, survival and sustainability in auditing success. Additionally, the Federation of Accounting Professions in Thailand needs to promote ADA by requiring participation in professional training. Future research should be analytic by linking the success elements in developing data analytics because data analytics are also based on planning, doing, check and act (PDCA). Second, we added testing moderator interaction, and third, sought to raise response rates in the study by searching for and implementing a method of follow-up and extending the period for data collection. Finally, ADA can be an important key to Thai audit firms' survival in the future because it provides better and higher AQ as well as ARC. Moreover, such capabilities increase the quantity and diversity of information, and ADA can improve auditors' efficiency and effectiveness.

In terms of theoretical contributions, this study focuses on presenting data that are analytics in the auditor's context for each audit process to allow the auditor to change, so that the performance process meets its goals and is as effective as any other profession. However, no investigation into the subject of ADA has been conducted in Thailand; therefore, this study attempted to integrate the concepts of ADA, quality and review continuity in the same conceptual model and investigate the relationships between these concepts. This study also verified and confirmed that pragmatic resource advantage theory is used to explain AQ and review continuity as valuable intangible resources capable of producing audit sustainability that depends on ADA.

Although this study confirms that ADA are a key determinant of audit planning, quality and review continuity, there are some future research needs. First, analytics are linked to the success elements in developing data analytics because they are also based on the PDCA process of data. Second, testing moderator interactions, such as technology turbulence, may be added to determine whether it has an impact on the relationship according to the conceptual model. Third, while the response rates in this study are acceptable, future research may seek to raise response rates by searching for and implementing a method of follow-up and extending the period for data collection.

References

- Aaker, D.A., Kumar, V. and Day, G.S. (2001), *Marketing Research*, John Wiley & Sons, New York.
- Angin, P., Bharat, B. and Ranchal, R. (2019), "Big data analytics for cyber security", *Security and Communication Networks*, Vol. 2019, pp. 1-2.
- Armstrong, J.S. and Overton, T.S. (1977), "Estimating nonresponse bias in mail surveys", *Journal of Marketing Research*, Vol. 14 No. 3, pp. 234-243.

- Barr-Pulliam, D., Brown-Liburd, H.L. and Sanderson, K. (2022), "The effects of the internal control opinion and use of audit data analytics on perceptions of audit quality, assurance, and auditor negligence", *Auditing: A Journal of Practice and Theory*, Vol. 41 No. 1, pp. 25-48.
- Brown-Liburd, H.L., Issa, H. and Lombardi, D. (2015), "Behavioral implications of big data's impact on audit judgement and decision making and future research direction", *Accounting Horizon*, Vol. 29 No. 2, pp. 451-468.
- Cao, M., Chychyla, R. and Stewart, T. (2015), "Big data analytics in financial statement audits", *Accounting Horizon*, Vol. 29 No. 2, pp. 423-429.
- Deloitte (2016), "Quality and innovation: enhancing the audit", available at: <http://www2.deloitte.com/global/en/pages/about-deloitte/articles/gr14-audit.html>
- Ernst & Young (2015), "How big data and analytics are transforming the audit", available at: http://ey.com/en_vn/assurance/how-big-data-and-analytics-are-transforming-the-audit.pdf
- Farid, N. (2020), "Audit data analytics: current practice and determinants among audit firms in New Zealand", The Master Degree Thesis of the University of Canterbury, New Zealand.
- Haapamäki, E. and Sihvonen, J. (2019), "Cybersecurity in accounting research", *Managerial Auditing Journal*, Vol. 34 No. 7, pp. 808-834.
- Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010), *Multivariate Data Analysis: A Global Perspective*, 7th ed., Person Prentice Hall, NJ.
- Hunt, S.D. and Morgan, R.M. (1997), "Resource-advantage theory: a snake swallowing its tail or a general theory of competition", *The Journal of Marketing*, Vol. 12 No. 1, pp. 74-82.
- Janchai, S., Poonpool, N. and Laonamtha, U. (2021), "Effect of audit data analytics on tax performance: evidence from tax departments in Thailand", *Songklanakarin Journal of Management Sciences*, Vol. 38 No. 2, pp. 54-81.
- Kend, M. and Nguyen, L.A. (2020), "Big data analytics and other emerging technologies: the impact on the Australian audit and assurance profession", *Australian Accounting Review*, Vol. 30 No. 4, pp. 269-282.
- Klinsukhon, S., Phornlaphatrachakorn, K. and Wongkhae, K. (2018), "Internal audit intelligence orientation and firm value: an empirical investigation of listed firms in Thailand", *Srinakharinwirot Business Journal*, Vol. 9 No. 2, pp. 30-43.
- Marei, Y., Afifa, M.A., Abdallah, A., Ayoush, M. and Amoush, A. (2022), "Big data and big data analytics in audit brainstorming sessions: a Canadian qualitative research", *Digital Economy Business Analytics, and Big Data Analytics Application*, Vol. 1010 No. 5, pp. 657-671.
- Mustapha, M. and Lai, S.J. (2017), "Information technology in audit processes: empirical evidence from Malaysian audit firms", *International Review of Management and Marketing*, Vol. 7 No. 2, pp. 53-59.
- National Institute of Standards and Technology (2018), "Framework for improving critical infrastructure cyber security", available at: <https://nvlpubs.nist.gov/nistpubs/cswp/nist.cswp.04162018.pdf>
- Nunnally, J.C. and Bernstein, I.H. (1994), *Psychometric Theory*, 3rd ed., McGraw-Hill, New York, NY.
- Omonuk, J.B. and Oni, A. (2015), "Computer assisted audit techniques and audit quality in developing countries: evidence from Nigeria", *Journal of Internet Banking and Commerce*, Vol. 20 No. 3, pp. 1-18.
- Stefan, D. (2019), "Audit analytics: is sampling enough for internal controls testing?", available at: <http://www.teammatesolutions.com/audit-analytics-is-sampling-enough-for-internal-controls-testing.aspx>
- Sujati, H., Akhyar, M. and Gunarhadi (2020), "Testing the construct validity and reliability of curiosity scale using confirmatory factor analysis", *Journal of Educational and Social Research*, Vol. 10 No. 4, pp. 229-237.
- Taber, K.S. (2017), "The use of Cronbach's alpha when developing and reporting research instruments in science education", *Research in Science Education*, Vol. 48 No. 12, pp. 1273-1296.

- The American Institute of Certified Public Accountants (2015), "Audit analytics and continuous audit looking toward the future", available at: https://us.aicpa.org/content/dam/aicpa/interestareas/frc/assuranceadvisoryservices/downloadabledocuments/auditanalytics_lookingtowardfuture.pdf
- The Federation of Accounting Professions (2018), "Cyber security for auditors and accountants in 4.0", available at: <http://www.fap.or.th/upload/9414/dCaojwp6tk.pdf>
- Waldron, A. and Hallstrom, D. (2013), "A breach of client data: risks to CPA firms", *Journal of Accountancy*, Vol. 21 No. 1, pp. 18-32.
- Yeo, A.C. and Carter, S. (2017), "Segregate the wheat from the chaff enabler: will big data and data analytics enhance the perceived competencies of accountants/auditors in Malaysia?", *Journal of Self-Governance and Management Economics*, Vol. 5 No. 3, pp. 28-51.
- Yunis, M.M., El-Khalil, R. and Ghanem (2021), "Towards a conceptual framework on the importance of privacy and security concerns in audit data analytics", *Proceedings of the International Conference on Industrial Engineering and Operations Management Soa Paulo, Brazil, April 5-8*, pp. 1490-1498.

Further reading

- Lokanan, L., Tran, V. and Vuong, N.H. (2019), "Detecting anomalies in financial statements using machine learning algorithm: the case of Vietnamese listed firms", *Asian Journal of Accounting Research*, Vol. 4 No. 2, pp. 181-201.

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