An Exploratory Study into the Use of Audit Data Analytics on Audit Engagements

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SYNOPSIS: This study explores the use of audit data analytics (ADA) in current audit practice. First, we interviewed the heads of professional practice of five international public accounting firms in Norway. We find that they differ in strategies on how to implement ADA and the heads report significant uncertainty about the supervisory inspection authorities' response to the use of ADA. Second, we administered a questionnaire to 216 engagement partners and managers about their perceptions of ADA and their actual ADA use on 109 audit engagements. Overall, the attitudes toward ADA usefulness are positive. Analysis of the audit engagements suggests use of ADA is relatively limited and use of more "advanced" ADA is rare. More ADA are used for clients with integrated ERP/IT systems and for newly tendered audit engagements. We also provide details of ADA use on each phase of the audit. We discuss our findings from an institutional theory perspective.

Data Availability: The data used in this study are confidential by agreement with the participants.

Keywords: audit data analytics (ADA); audit engagements; auditors' perceptions about ADA; actual use of ADA.

Analytics is revolutionizing the audit and facilitating the introduction of disruptive technologies. Audit is undergoing a data revolution. There has been rapid expansion in the types and volumes of data that companies produce, providing richer sources of information to be used when conducting an audit. Digital analytics tools are enabling industry professionals to look at businesses in a different way by analyzing these bigger data populations. This provides a deeper understanding of risk, performance and opportunities.
 —Hermann Sidhu (2017)
  EY Global Assurance Digital Leader

I. INTRODUCTION

The objective of this study is to explore the use of audit data analytics (ADA) in current audit practice. Recently, the major international public accounting firms have invested heavily to advance their audit technology and moved to leverage the use of ADA for financial statement audits (Deloitte 2016; KPMG 2016; PwC 2017; EY 2017). ADA are defined as "the science and art of discovering and analyzing patterns, identifying anomalies, and extracting other useful information in data underlying or related to the subject matter of an audit through analysis, modeling, and visualization for the purpose of planning or performing the audit" (AICPA 2014).[1] Proponents of the use of ADA cite three potential benefits from their use: (1) improved understanding of an entity's operations and associated risks, including the risk of fraud; (2) increased potential for detecting material misstatements; and (3) improved communications with those charged with governance of audited entities (AICPA 2017). While a number of researchers have provided insight into the potential application of various ADA tools on the audit (for an overview see Griffin and Wright 2015; Appelbaum, Kogan, and Vasarhelyi 2017, 2018),[2] the availability and the actual use of ADA in audit practice remain largely unknown.

We apply a two-stage research approach.[3] First, we interviewed the heads of professional practice ("Heads") of five international public accounting firms in Norway[4] to get an understanding of the status of ADA in each firm. Second, we obtained responses to a detailed questionnaire from a large sample of 216 partners and managers who were in charge of 109 audit engagements about (1) their perceptions and insights on issues related to ADA and (2) extensive information on the actual use of ADA in those 109 engagements.[5]

Our results show the following. First, the Heads indicated that their firms do *not* require mandatory use of "advanced" ADA tools. This seems to be driven by the uncertainty about how the supervisory inspection authorities will evaluate and accept ADA generated audit evidence. Second, while ADA use is high on the firms' agenda and there is a global firm push for ADA to be used on audit engagements, actual use is limited in our sample, including even the audits that were identified by the Heads as expected to use ADA. Third, based on our discussions with the Heads, the firms differ in their strategies in how they implement the use of ADA in their organizations from, at one end of the spectrum, a "wait and see" approach to, at the other end of the spectrum, centralization of ADA functions and significant firm involvement to facilitate ADA use. Fourth, the partners and managers indicated that their knowledge and training with firm available ADA tools were sufficient to permit their use of ADA and their attitudes toward ADA usefulness are more positive for firm audits in general than for the sampled audit engagements. Fifth, as expected, more ADA are used on engagements where the client has an integrated ERP/IT system. Sixth, there is a higher frequency of ADA use on new audit engagements. Participants indicated that recent tender offers specifically asked about firms' use of new technology and ADA in audits, and that the audit firms promoted ADA use in the tender process.[6] Seventh, we identify the various phases of the audit where ADA are used. In the audit planning phase, ADA are used for overall assessment of the client's operations and performance, identifying and assessing key risks, and mapping of different business processes. In the substantive testing phase, ADA are used for journal entry testing, calculating sample-size, selection of random samples, and summarizing ledgers. In the completion phase of the audit, ADA are primarily used for reconciliation and control between final accounts and underlying ledgers, analytical procedures, and final review of financial statements. However, overall, the use of ADA in each phase of the audit is low and there is little use of what would be considered advanced ADA (i.e., statistical regressions, clustering techniques, statistical predictive analysis, computerized process-mapping, etc.). The use of Big Data and text-mining is almost non-existent. When ADA are used, ADA output is mostly used as supplementary

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[1] ADA are sometimes intertwined with the term "Big Data." Gartner (2019) defines Big Data as "high-volume, high-velocity, and high-variety information assets that demand cost effective, innovative forms of information processing for enhanced insight and decision making." Thus, Big Data extends the domain of data from financial data to non-financial data, from structured to unstructured data, and from inside the organization to outside of it (AICPA 2015). Our primary focus is on the use of ADA; i.e., analytical audit tools and techniques that may, or may not, use Big Data. This focus is supported by Walker and Brown-Liburd (2019) who find external auditors' definitions of data analytics most aligned with the AICPA's definition.

[2] Salijeni, Samsonova-Taddei, and Turley (2019) observe that to date research has devoted most attention to potential impact of data analytics on auditing conceptually. Likewise, Austin, Carpenter, Christ, and Nielson (2020, 4) state that "the existing literature on data analytics consists primarily of thought pieces." Walker and Brown-Liburd (2019, 2) observe: "Other than Austin et al. (2018), the literature addresses the potential of data analytics, as opposed to whether and how data analytics is used in the audit process."

[3] Under a four-year research project at the Norwegian School of Economics (NHH) funded by the Research Council of Norway on digital transformation of the audit process (Norwegian School of Economics 2020), the five largest international public accounting firms in Norway contracted to provide data and subjects for the research project. The research project was exempted for registration at the Norwegian Centre for Research Data (NSD).

[4] Similar to the U.S., high investor protection and strong legal enforcement characterize the Norwegian financial reporting and auditing environment (e.g., Leuz, Nanda, and Wysocki 2003; Choi and Wong 2007; Hope, Kang, Thomas, and Yoo 2009). In addition, Norway is rated high in digital competitiveness (EC 2018) and auditor public oversight is considered less restrictive than in the U.S. Alles (2015) and Appelbaum et al. (2017) argue that public oversight may be an impediment to the adoption of ADA.

[5] For simplicity, we refer to the participants as partners and managers. However, some participants held different positions within the firm. See Table 1 for a detailed distribution of participants.

[6] After completing the questionnaire, open (semi-structured) discussions took place where participants were offered the opportunity to comment on the survey and otherwise express any views related to the study. In two of these firm sessions ADA usage in the tender process was mentioned.

evidence. In summary, our results suggest that the use of ADA within the firms is limited and at an early stage of implementation. Lastly, we believe that institutional theory provides a framework for explaining our findings. Institutional theory suggests that the limited use of ADA will persist until ADA usage is proved to be superior to the current evidence gathering process for audit team leaders and their use is supported by firms, regulators, and supervisors.[7]

This research makes a number of important contributions. First, little empirical research exists about ADA since they are relatively new technologies and gaining access to auditors is challenging (Austin et al. 2020). Gepp, Linnenluecke, O'Neill, and Smith (2018, 110) argue that qualitative, interview-based studies are needed to fill this knowledge gap. Our study provides insight into how firms' leadership, engagement partners, and managers perceive the prospects and impediments to ADA use. Second, we are the first study to systematically document the *actual* usage of ADA on current audit engagements. Auditors' actual use of ADA reflects auditors' judgments and decisions about the efficiency and effectiveness of ADA use. Third, we also provide information on the audit areas where ADA are being used (or not used) as an evidential source (i.e., sufficient and appropriate audit evidence) and the obstacles that impede their use. Fourth, we discuss our findings from the perspectives of institutional theory to better understand auditors' complex decision on ADA usage and the observed limited use of ADA in our sample. We suggest that the limited use of ADA will likely persist until its use is incorporated internally in the firms' methodology and reward systems; explicitly supported and accepted by standard-setters and supervisory bodies; and practitioners must find that ADA use proves efficient and effective in the evidence gathering process. Finally, our research provides a starting point for practitioners and researchers in validating the efficiency and effectiveness of the use (or non-use) of ADA. In sum, our study documents the current status of auditors' use of ADA at the engagement level and develops an understanding of why ADA use has not yet fulfilled its promised potential.

The reminder of the paper is organized as follows. Section II provides the background and overview for the study. This is followed by Section III, which describes the first stage of the research—interviews with heads of professional practice. Section IV presents the second stage of the research—a questionnaire about auditor perceptions of ADA and actual use of ADA at the engagement level. Section V covers concluding comments and implications for future research.

II. BACKGROUND AND OVERVIEW

Background

In recent years the major international public accounting firms have invested heavily in ADA to transform their audit practice (Deloitte 2016; KPMG 2016; PwC 2017; EY 2017). For example, EY reports investment in new technologies in the total amount of $1 billion (EY 2019). Deloitte CEO Cathy Engelbert states: "Clearly all the audit firms are investing heavily in innovation, transforming their audit business . . . In the next five or six years I think that the accounting and auditing profession will change more than it has in the last 30 [years]" (Cohn 2016). Similarly, Leonard Combs, PwC U.S. Chief Auditor and Leader of Auditing Services, Methodology & Tools reports: "Data analytics is changing both the way we conduct our audits and what those audits deliver. It allows us to extract and analyze ever-larger data sets. Further use of data analytics will allow us to deliver effective audits more efficiently" (PwC 2017).

Additionally, there is a growing body of research that recognizes that ADA are likely to significantly transform the conduct of the audit (e.g., Cao, Chychyla, and Stewart 2015; Schneider, Dai, Janvrin, Ajayi, and Raschke 2015; Austin et al. 2020; Barr-Pulliam, Brown-Liburd, and Sanderson 2020; Salijeni, Samsonova-Taddei, and Turley 2019). For example, Barr-Pulliam et al. (2020, 12) note: "The use of advanced testing methods such as ADAs can occur at any stage of the audit and can significantly transform the process of auditing financial statements, resulting in enhanced audit effectiveness and audit efficiency—both elements and signals of audit quality." Likewise, Austin et al. (2020, abstract) state: "Data analytics is transforming our global markets. Auditors, CFOs, standard-setters, and academics recognize this phenomenon and generally agree that data analytics will fundamentally change financial reporting and auditing processes." In the same vein, Salijeni et al. (2019, 115) conclude that although "there is a danger of disappointment if Big Data Analytics developments are seen as the golden ticket which is going to solve audit problems and lead to a future in which audit services are universally valued. Equally, however, these developments may provide real tools to reconfigure, refocus and potentially reposition (within the firms' business models) contemporary audit practice."

As a response to the firms' emerging use of ADA, professional accounting bodies have established task forces, issued position papers and alerts, and provided guidance for the growing use of ADA on audits (e.g., AICPA 2014, 2015, 2017;

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[7] Theoretical perspectives are conceived as cones of light directed on a phenomenon that exert influence (1) on the framing of research questions, and (2) guide data collection and analysis (O'Dwyer 2010). Given our *ex ante* beliefs about the use of ADA in current audit practice we found it premature to develop research questions.

IAASB 2016; ICAEW 2016; CPA Canada 2017; IBR 2018). For example, the International Auditing and Assurance Standards Board (IAASB 2016, 7) states: "In an increasingly complex and high-volume data environment, the use of technology and data analytics offers opportunities for the auditor to obtain a more effective and robust understanding of the entity and its environment, enhancing the quality of the auditor's risk assessment and response." Additionally, the Chartered Professional Accountants of Canada (CPA Canada 2017, 1) argue: "Auditors need to respond to ever-increasing and diverse uses of information technology by audited entities. More use by auditors of technology-enabled data analytics is an important aspect of that response."

Supervisory bodies are also increasingly directing attention to the emerging use of ADA by the firms (e.g., FRC 2017; PCAOB 2018). For example, the U.S. Public Company Accounting Oversight Board (PCAOB) recognizes that auditors are rapidly expanding their use of technology to plan and perform audits and one of its main goals in its "Strategic Plan 2018–2020" is: "Anticipate and respond to the changing environment, including emerging technologies and related risks and opportunities" (PCAOB 2018, 9). Similar to this paper's focus, the U.K. Financial Reporting Council (FRC 2017) undertook a review of the use of ADA on 19 2015 audits for the six largest U.K. audit firms. Overall, they found that firms relied on basic ADA tools and found little or no use of advanced ADA tools.

Several researchers observe that little is known about the extent of ADA usage in audit practice and how ADA affect the conduct of audits (e.g., Gepp et al. 2018; Austin et al. 2020; Salijeni et al. 2019). Available research is mainly based on interview data. For example, Salijeni et al. (2019) obtained evidence through semi-structured interviews conducted with regulators and partners with significant experience in developing, implementing, or assessing the impact of ADA in auditing. Their evidence indicates that ADA are utilized in areas of risk assessment, journal testing, and full population testing. Similarly, Austin et al. (2020) interviewed managers, external auditors, and standard-setters and found that companies and their auditors have introduced data analytics to the benefit of financial reporting and audits, but lack of regulatory guidance and implementation costs present considerable hindrances to implementation. Walker and Brown-Liburd (2019) interviewed 27 experienced internal and external auditors and found that ADA usage is low given the arguments that ADA have the potential to increase audit quality. Finally, CPA Canada (2017) surveyed the use of ADA from 394 auditors in the practice (49 percent audit partners) covering large and small/medium-sized audit firms in Canada. Although the use of advanced ADA was not common (20 percent of the respondents have used advanced ADA), larger firms used more ADA than smaller firms, and some types of ADA were used in all major phases of the audit, with the highest frequency of use in the planning/risk assessment and in the substantive procedures phases (63 percent for large firms). Large firms' primarily used ADA as a corroborative source of audit evidence rather than as a primary source. Overall, the CPA Canada study concluded that the audit profession is in the early stages of mainstream adoption of ADA.

To summarize, audit firms, research scholars, accounting bodies, and regulators agree that ADA likely will significantly transform the conduct of the audit. Research findings based on interviews with managers, external and internal auditors, and standard-setters support this view but also give indications that the expectations may not yet be fulfilled. However, little is known about the stage of the ADA transformation in the field.[8] Given the dearth of research on the actual use of ADA in audit practice, we investigate its usage by gathering a rich data set from a sample of 216 audit partners and managers and 109 audit engagements. Our work examines factors related to the auditors' perceptions of the use of ADA both within their firm and on the sampled engagements, and ADA usage at the major phases of the audit. The research extends prior studies by providing the first large sample study of the insights of partners and managers on the use of ADA and extensive information on the actual use of ADA in the field.

Overview

The objective of the current research is to explore auditor perceptions of ADA and its usage in current audit practice. Research goals and data availability are important determinants for a preferred research method (Bloomfield, Nelson, and Soltes 2016). We use qualitative research methods and field data to generate a grounded understanding of the use of ADA in the field (Power and Gendron 2015). We felt that using both qualitative methods and field data were necessary given the limited information about (1) auditors' perceptions about ADA usage and (2) the use of ADA in practice. Our work responds to calls for research to examine these issues (e.g., Gepp et al. 2018; Salijeni et al. 2019).

Based upon our review of the academic and professional literature, we decided to take a two-stage approach to meet the study's objectives. In the first stage, we interviewed the heads of professional practice for the five largest international public accounting firms in Norway to get an understanding of the status of ADA within each firm. This stage of the study is described

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[8] The U.K. Financial Reporting Council (FRC 2017) reviewed the use of ADA using a small sample (19 engagements) of the 2015 audits from the six largest U.K. audit firms. Sixteen of these audits arose from their normal inspection process while a further three audits were nominated by audit firms to demonstrate a particular ADA tool in use.

in Section III. In the second stage, we obtained responses from the engagement partner and/or manager to a detailed questionnaire about their perceptions about the acceptance and application of ADA, including factors impeding the use of ADA and the use of ADA on the sampled engagements. This stage of the research is described in Section IV.

III. INTERVIEWS WITH HEADS OF PROFESSIONAL PRACTICE

Participants

Our contact person within each firm indicated that the national head of professional practice for the firms was the appropriate individual for the study, and each firm provided access to those individuals. These individuals have the responsibility for the appropriate use of the firm's audit methodology, including implementing and monitoring ADA usage within the firm. The Heads also work closely with groups within the firm's global organization responsible for the development of ADA tools. The five Heads were partners (three males and two females) with 15 to 34 years of audit experience. They had been with their firms for more than ten years and had been in their current position between three and ten years.

Method

The aim of this stage of the study was to develop first-hand knowledge about how the major international firms are adopting ADA within their practices. Given the exploratory nature of our research, we decided to do semi-structured interviews based on a script allowing for answering broad and open-ended questions with the opportunity to follow interesting paths as they develop during the interviews (Lillis 1999; Kenno, McCracken, and Salterio 2016). The interview script was developed based on prior research and professional literature, discussions with practitioners, and the considerable practice experience of one of the researchers as a prior national head of audit and assurance for a Big 4 firm in Norway. A copy of the interview script is provided in Appendix A. The interviews lasted from 48 to 92 minutes, with an average of 63 minutes. The interviews were audiotaped with permission of the interviewees.

Results

The interviews with the Heads indicated that major decisions on the extent of the use of ADA on a specific engagement are made by the engagement partner and/or manager.[9] Thus, those appropriate individuals served as participants for the second stage of our research.

The Heads confirmed what their firms' press statements and webpages expressed: that the use of ADA was high on their agendas and that there is a general global firm push for ADA to be used on audit engagements. However, the Heads also expressed that the use of ADA in the firms' audits and its implementation into the audit methodologies are at an early stage and that we should expect to observe varied use of ADA on the sampled engagements. None of the five audit firms had introduced mandatory use or mandatory pilot testing of advanced ADA tools.

The Heads indicated that they had not, on a general basis, approved ADA tools to be used to provide the only form of audit evidence. The engagement partner and the audit team decide whether the results from an ADA are sufficiently appropriate audit evidence depending on the circumstances. However, the Heads indicated that they frequently discussed with audit teams the usage of and acceptance of ADA generated audit evidence.

The Head of Firm 1[10] said that the firm's strategy for implementing ADA was extensive training of the audit teams on the use of ADA tools where the teams locally would perform the ADA. In contrast, the Head of Firm 2 reported that the firm had set up a specialist team, separate from the audit teams, that collected, cleaned, and structured client data and provided a set of standardized ADA analyses for the audit teams. Firm 3 had a similar arrangement as Firm 2 for some large engagements. The Head of Firm 4 explicitly indicated that the firm was waiting before actively pushing for implementation of new ADA tools in Norway because they felt it was too costly to pilot new tools on engagements. They preferred to wait until other firm countries had tested the new tools, found them workable, and could provide guidance on how to efficiently use them on engagements. Further, the Head of Firm 4 did not experience strong pressure from clients to use ADA. The Head of Firm 5 admitted that they had not come far in ADA implementation, but were working hard on developing national tools that could extract data from external databases and make automated, standardized analysis.

All the Heads reported that there was significant uncertainty about how the supervisory authorities responsible for inspecting audit engagements (i.e., The Financial Supervisory Authority of Norway [FSA] and PCAOB) would evaluate and

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[9] This was confirmed with the partners and managers who participated in the second stage.
[10] In reporting the results, we have labeled the Firms 1 through 5 to maintain anonymity.

accept ADA generated audit evidence.[11] The FSA has been rather passive and silent on the issue. The Heads' understanding is that the FSA has not yet taken any position on the use of ADA on audits, including not signaling or providing any guidance of appropriate ADA usage. The FSA had informed several of the audit firms that their strategy is to inspect completed audit engagements and then form their own opinion on the appropriateness of the ADA usage. This made several of the Heads skeptical to use evidence generated from ADA as the only form of evidence to support assertions. For audit engagements subject to PCAOB supervisory authority, inspection risk has led all the firms to inform the audit teams not to use evidence generated from ADA as the only form of audit evidence.

IV. AUDITOR PERCEPTIONS OF ADA AND USAGE ON AUDIT ENGAGEMENTS

Methods

The methods used in the second stage involved completion of a detailed questionnaire addressed to the engagement partners and managers followed by an open (semi-structured) discussion of the issues. We first developed a preliminary questionnaire based on the responses from the interviews with the Heads and our understanding of the literature, including prior studies of ADA use[12] and the more general studies about the acceptance and adoption of emerging technologies. We then discussed the preliminary questionnaire with the Heads and made any necessary adjustments. Pilot testing resulted in some minor adjustments to the questionnaire.[13] The questionnaire consisted of three parts and was administered using Qualtrics.[14] The first part of the questionnaire included instructions and questions to be answered *separately* by the engagement partner and manager. The instructions outlined the purpose of the study, explained the structure of the questionnaire, referred to the definition of ADA (AICPA 2014), and specified the scope of ADA for the purpose of the survey.[15] The first set of questions related to participants' demographic data. Next, the participants were asked to rate on a seven-point Likert scale (1—Strongly Disagree, 4—Neutral, 7—Strongly Agree) their competence in information technology (IT) systems and ADA tools overall. This was followed by a set of statements about (1) perceived competency (knowledge of and training in use of firm available ADA) and (2) perceived usefulness of ADA. The participants were asked whether they disagreed or agreed with the statements on a seven-point Likert scale (1—Strongly Disagree, 4—Neutral, 7—Strongly Agree) for (1) audits generally within their firm and (2) the specific audit engagement selected.[16] Participants were also asked about their perceived influence on the decisions of ADA use for the selected engagement and whether the ADA use differed relatively to the ADA use for their other audit engagements.

The second and third parts of the questionnaire related specifically to the selected engagement and were answered by the engagement partner and/or manager. Note that these two parts of the questionnaire were completed by the participants who had direct access to the audit workpapers. The second part collected general information about the client (type of entity, industry, size, audit hours used, etc.), details of the client's accounting information systems, and if and how data from the client's systems was extracted and used in the audit, including any application of ADA in this process. This part of the questionnaire also included questions related to the use of ADA on the engagement selected on the client acceptance and continuance decisions, and fraud risk assessments.

The third part of the questionnaire covered the use of ADA in each phase of the audit, from planning to completion for the selected engagements. For each phase where ADA use was reported, a number of follow-up questions were posed. These questions included details of the types of ADA used, hours used for the ADA, whether the ADA relied on client or other external sources for data, whether the usage of the ADA implied a change in audit procedures compared to prior year, whether the use of the ADA was mandatory or not, whether the ADA used were firm global tools or developed nationally, whether the

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[11] The Financial Supervisory Authority of Norway (FSA) is the governmental agency in charge of inspections and enforcement for statutory audits in Norway, but FSA is not a standard setter. The EU's accounting and auditing regulations apply in Norway, and all Norwegian audits should comply with the IAASB International Standards on Auditing (ISAs). The PCAOB and FSA have a formal cooperative arrangement where they carry out inspections jointly on accounting firms located in Norway that audit, or participate in audits, of companies whose securities trade in U.S. markets.

[12] We thank Clark Hampton for providing us with the survey instrument for investigating the use of ADA within the Canadian auditing profession (CPA Canada 2017).

[13] Five audit managers with an average of seven years of audit experience and three master students with audit experience took part in the pilot testing.

[14] The study was approved by the Norwegian Centre for Research Data (NSD). The instructions to the questionnaire made it clear that the survey was voluntary and that participating individuals, the specific engagement(s), and firm will remain anonymous in reporting the results of the study. A copy of the questionnaire is available from the authors.

[15] We provided examples of where ADA could be used. These included ratio analysis, trend analysis, regression analysis, general ledger/account reconciliation and analysis, journal entry analysis, segregation of duties analysis, three-way match procedure, cluster analysis, and data mining. We excluded manual analysis, simple Excel calculations, auditors' tests of the client's systems or tools, tools that only automate a process at the audit firm, and the process of extracting, securing, preparing, and storing client or external data at the audit firm.

[16] The statements were randomized to control for order effects.

applied ADA were used in other audit engagements, which team members primarily performed the ADA, and whether the use of the ADA was considered to affect the efficiency and/or effectiveness of the audit.

After completing the questionnaire, participants present at the firm sessions (see below) were asked some semi-structured follow-up questions. This offered the participants an opportunity to comment on the survey and otherwise express any views related to the study. One or two of the researchers were present and the discussions were audiotaped.

Sample Engagements

The firms agreed to provide a sample of audit engagements with participation of the engagement partner and manager. Each firm was asked to select six engagements within each of the following four categories:[17]

- **ADA:** Engagements where the audit firm expected high ADA use.[18]
- **Listed:** Largest engagement entity (a parent company or a subsidiary) based on revenues of a listed company (group).
- **Large_NL (non-listed):** Largest engagement entity (a parent company or a subsidiary) based on revenues of a non-listed (NL) group with group revenues above $100 million.
- **Small_NL (non-listed):** Engagement entity of a non-listed (NL) group with group revenues below $10 million, or a non-listed (NL) entity not part of a group with revenues below $10 million.

With the exception of the high ADA use engagements, which were identified by the Heads, engagements were selected randomly by each firm from an alphabetized list of audit clients. Of the 120 engagements selected, our final sample includes 109 engagements.[19] Ninety-six of the 109 questionnaires were completed in sessions held for each firm (12 engagement teams participated by Skype or similar communication platforms at the firm regional office location), and 13 questionnaires were completed outside of the firm sessions. Table 1 provides the distribution of the number of engagements across categories of engagements.

Table 2 (Panel A) provides descriptive information about the 109 sample engagements representing a large variety of industries with retail/wholesale (19); transportation, shipping, distribution (13); and manufacturing (10) as the three most represented industries. For industries with more than five selected engagements in total (N), engagements with expected high ADA use have the highest relative representation in financial services (50.0 percent), software (42.9 percent), retail/wholesale (42.1 percent), and manufacturing (40.0 percent).

Table 2, Panel B presents information on the size of the engagements based on revenues in 2017, and the entities' group affiliation. Large_NL (non-listed) engagements have the highest average revenues followed by ADA engagements. Listed engagements are more evenly distributed across revenue brackets while Small_NL (non-listed) engagements, with one exception,[20] have less than $10 million in revenues. Group affiliations are: 14 entities not part of a group (ADA or Small_NL engagements), 37 parent companies, 32 subsidiaries of a Norwegian parent company, and 26 subsidiaries of a non-Norwegian parent company.

Table 2, Panel C presents the average audit hours for the 109 engagements (mean = 891 hours). Average audit hours used for Listed and Large_NL engagements (mean = 936 hours, mean = 958 hours, respectively) are slightly above the sample average. The average audit hours used for Small_NL engagements (mean = 95 hours) were approximately one tenth of the sample average. In contrast, ADA engagements' average audit hours (mean = 1,575 hours) were 77 percent more than the sample mean. Although the majority of the engagements with expected high ADA use were clients with relatively high revenues, a much lower number of audit hours were reported for Large_NL engagements with the highest average revenues.

Participants

Our sample includes 216 participants. For 92 of the 109 engagements both the partner and manager completed all parts of the questionnaire; the first part of the questionnaire individually and the second and third parts together. For 15 of the engagements, the first part of the questionnaire was completed individually by the partner and the manager, while the manager

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[17] The audit firms were clear that the selected unit for investigation of ADA use should be individual entities rather than a group. Although the group engagement team establishes the overall group audit strategy that may involve decisions about the use of ADA for entities in the group, ADA use for entities within a group may differ due to entity differences such as for example entities' ERP systems. The Listed and Large_NL engagement entities are the largest (by revenues) Norwegian entity (a parent company or a subsidiary) within a group. The ADA and Small_NL engagement entities include the largest (by revenues) Norwegian entity within a group and "stand-alone" entities not part of a group (see Table 2, Panel B).

[18] Of the 28 ADA engagements, 8 were listed (4 of 8 were newly tendered audits) and 20 were non-listed. Of the non-listed companies, 16 were "Large" and 4 were "Small."

[19] Three engagements did not participate, and eight engagements were excluded due to incomplete questionnaire responses.

[20] The selection of engagements was in some cases based on the 2016 revenues since the 2017 revenues number had not been prepared at the date of engagement selection. One engagement in the Small_NL category reported more than $10 million in revenues for 2017.

TABLE 1

Engagements per Audit Firm

	Category of Engagements[a]				
Firm	**ADA**	**Listed**	**Large_NL**	**Small_NL**	**Total**
1	6	6	6	6	24
2	6	5	5	4	20
3	6	6	5	6	23
4	5	5	5	4	19
5	5	6	6	6	23
Totals	28	28	27	26	109

[a] ADA = engagement entity where the audit firm expected high ADA use. Of the 28 ADA engagements, eight were listed (four of eight were newly tendered audits) and 20 were non-listed. Of the non-listed companies, 16 were "Large" and four were "Small";

Listed = largest engagement entity (a parent company or a subsidiary) based on revenues of a listed company (group);

Large_NL = largest engagement entity (a parent company or a subsidiary) based on revenues of a non-listed (NL) group with group revenues above \$100 million; and

Small_NL = engagement entity of a non-listed (NL) group with group revenues below \$10 million, or a non-listed (NL) entity not part of a group with revenues below \$10 million.

completed the second and third part of the questionnaire that was later reviewed by the partner. Two engagements were completed only by the manager.

Table 3 presents the demographic data of the participants. 177 (82 percent) males and 39 (18 percent) females participated. Nighty-two percent of the participants were 30 years or older. Most participants (92 percent) held one or more master's degrees.[21] Ninety percent of the participants had more than five years of audit experience. The large majority of our participants were leaders of the audit engagement team. Eighty-six percent of the participants had the rank of manager or higher, and the remaining 14 percent had the rank of senior or lower. Seventy-eight percent of the participants' overall audit time was allocated to listed companies (34 percent) and large (23 percent) or medium sized non-listed entities (21 percent).

Auditor Perceptions of ADA

We gathered a substantial amount of information about the participants' perceptions of ADA. The first part of the questionnaire asked the partner and manager to separately respond (1) to a number of questions about their competence in IT systems and ADA tools overall and (2) to a series of statements related to perceived competency (knowledge and training) and perceived usefulness of ADA, both for audits in general within their firm and the specific audit engagement selected. In addition, we asked about the participants' perceived influence on the decisions to use ADA on the selected engagement.

Table 4 presents the auditors' responses on a seven-point Likert scale (1—Very Low, 7—Very High)[22] to four questions related to their perceived competence with IT systems and ADA tools: (1) IT systems and Enterprise Risk Planning (ERP) systems, (2) data programming, data handling, and data storage, (3) interpreting the results form data analytics in general, and (4) ADA tools that are available to you within the firm. We tested the responses by comparing the mean ratings against the midpoint (4) of the scale and by comparing partners with managers.

The overall perceived competence (4.09) with ERP/IT systems was not significantly different than the midpoint while the partners' perceived competence was significantly lower and the managers' significantly higher than the midpoint ($p < 0.05$). The partners' perceived competence was significantly lower than the managers (3.82 versus 4.27; $p < 0.05$). The overall perceived competence with data programming, data handling, and data storage was significantly lower than the midpoint overall (3.43, $p < 0.05$) and for the partners and managers individually (3.27 and 3.60; $p < 0.05$). The partners' and managers' perceptions did not differ significantly from each other. In contrast, the overall (4.80), and partners' (4.70) and managers' (4.89) perceptions of competence with interpreting the results from data analytics were significantly higher than the midpoint ($p < 0.05$) while the partners' and managers' perceptions did not significantly differ. For perceived competence with ADA tools

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[21] State authorization is the highest level of auditor certification in Norway and requires a master's degree in accounting and auditing. It is not uncommon that a state authorized public accountant holds a second master's degree in business administration or another discipline.

[22] On the questionnaire, the scale used for these questions was (1—Very High to 7—Very Low). We reversed it to make the presentation of the results easier to understand.

American Accounting Association

TABLE 2
Engagement Statistics

Panel A: Industries [number (%)]

Industry	n	Category of Engagement[a]			
		ADA	**Listed**	**Large_NL**	**Small_NL**
Agriculture, forestry, fishing	6	2 (33.3)	0 (0.0)	4 (66.7)	0 (0.0)
Construction	6	0 (0.0)	3 (50.0)	1 (16.7)	2 (33.3)
Entertainment, leisure	1	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Financial services	6	3 (50.0)	2 (33.3)	0 (0.0)	1 (16.7)
Holding company (in a group), investment entity, conglomerates	7	0 (0.0)	3 (42.9)	0 (0.0)	4 (57.1)
Manufacturing	10	4 (40.0)	4 (40.0)	2 (20.0)	0 (0.0)
Media, communications, publishing	1	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)
Not for profit	2	1 (50.0)	0 (0.0)	1 (50.0)	0 (0.0)
Hospital, health organizations, social services	4	0 (0.0)	0 (0.0)	4 (100.0)	0 (0.0)
Oil & gas services	3	0 (0.0)	2 (66.7)	0 (0.0)	1 (33.3)
Pharmaceuticals and chemicals	3	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)
Real estate	6	1 (16.7)	2 (33.3)	1 (16.7)	2 (33.3)
Retail, wholesale	19	8 (42.1)	2 (10.5)	3 (15.8)	6 (31.6)
Software	7	3 (42.9)	0 (0.0)	0 (0.0)	4 (57.1)
Telecommunications	4	1 (25.0)	2 (50.0)	1 (25.0)	0 (0.0)
Transportation, shipping, distribution	13	2 (15.4)	5 (38.5)	5 (38.5)	1 (7.7)
Utilities	3	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)
Other	8	2 (25.0)	1 (12.5)	2 (25.0)	3 (37.5)
Total	109	28 (25.7)	28 (25.7)	27 (24.7)	26 (23.9)

available within the firm, the overall and managers' perceptions were significantly above the midpoint ($p < 0.05$) while the partners' perceptions were not. The managers' perceptions were significantly higher than those of the partners ($p < 0.05$).

Table 5 presents the participants' ratings on a seven-point Likert scale (1—Strongly Disagree, 4—Neutral, 7—Strongly Agree) for a series of statements related to their perceived competency (Panel A), the usefulness of ADA for audits in general within their firm (Panel B), and for the selected engagements (Panel C).[23] Table 5, Panel A shows that the partners and managers perceive that they have sufficient knowledge to use the ADA tools available to them within their firm (4.42; $p <$

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[23] We do not tabulate the means for the statements for the individual firms and partners and managers but report significant differences ($p < 0.05$) in the text.

TABLE 2 (continued)

Panel B: Size and Group Affiliation [number (%)]

	n	Category of Engagement[a]			
		ADA	**Listed**	**Large_NL**	**Small_NL**
Total Revenues (2017)					
Less than $10 million	37	2	9	1	25
		(5.4)	(24.3)	(2.7)	(67.6)
$10–$100 million	19	9	8	1	1
		(47.3)	(42.1)	(5.3)	(5.3)
$100 million–$1 billion	36	11	7	18	0
		(30.6)	(19.4)	(50.0)	(0.0)
Greater than $1 billion	17	6	4	7	0
		(35.3)	(23.5)	(41.2)	(0.0)
Total	109	28	28	27	26
Group Affiliation					
Entity not part of a group	14	3	0	0	11
		(21.4)	(0.0)	(0.0)	(78.6)
Parent company of a group	37	8	19	8	2
		(21.6)	(51.4)	(21.6)	(5.4)
Subsidiary of a Norwegian parent company	32	11	4	10	7
		(34.4)	(12.5)	(31.3)	(21.9)
Subsidiary of a non-Norwegian parent company	26	6	5	9	6
		(23.1)	(19.2)	(34.6)	(23.1)
Total	109	28	28	27	26

Panel C: Audit Hours

	Category of Engagement[a]				
	Overall	**ADA**	**Listed**	**Large_NL**	**Small_NL**
Average audit hours per engagement (n = 108)[b]	891	1575	936	958	95
Range		50–12,000	100–2500	150–7,000	10–500
SD		2575	1457	675	105

[a] ADA = engagement entity where the audit firm expected high ADA use;
   Listed = largest engagement entity (a parent company or a subsidiary) based on revenues of a listed company (group);
   Large_NL = largest engagement entity (a parent company or a subsidiary) based on revenues of a non-listed (NL) group with group revenues above $100 million; and
   Small_NL = engagement entity of a non-listed (NL) group with group revenues below $10 million, or a non-listed (NL) entity not part of a group with revenues below $10 million.
[b] One engagement failed to report audit hours.

0.05). For the other three statements on competence their ratings are basically neutral (not significantly different from the midpoint).

An overall examination of the participants' responses to the statements about the usefulness of ADA (Table 5, Panel B) indicates positive perceptions of the usefulness of ADA for firm audits in general. For example, the participants tend to disagree that ADA tools are complex and difficult to use and are neutral toward the statement that the ADA tools are very time-consuming to use on engagements. They generally agree more than they disagree that their firms have incentives and/or pressure to use ADA instead of traditional audit tools, that current auditing standards accept the use of audit evidence from ADA, their firms' methodology accepts ADA evidence, supervisory bodies accept ADA as audit evidence, ADA are useful for risk identification and substantive testing, and they are not hesitant to use ADA. In addition, they agree that their firms have adequate ADA tools, that these ADA tools improve the quality of audits, and that ADA tools are efficient. In line with the partners' and managers' confidence in their own knowledge of firm ADA tools and their usage, they disagree that their audit teams lack technical competence to use ADA tools, and agree that their firms have sufficient specialist support. Finally, participants agree that clients have a positive attitude toward the use of ADA but are neutral toward the statement that it is easy to collect sufficient data for ADA purposes. Overall, we observe a higher perceived competence and usefulness of ADA for

TABLE 3

Participant Demographics (n = 216)

	Number	Percent
Gender		
Male	177	82
Female	39	18
Age		
Under 30	17	8
30–39	88	41
40–49	70	32
50–59	36	17
60 or older	5	2
Education		
Bachelor's in accounting and auditing	18	8
Master's in accounting and auditing, master's in business administration or similar[a]	198	92
Years of audit experience		
Less than 5 years	21	10
5–10 years	54	25
11–15 years	41	19
16–20 years	26	12
More than 20 years	74	34
Position within your firm		
Partner	103	48
Director	24	11
Senior manager	22	10
Manager	36	17
Senior associates	22	10
Other (supervisor, associate, staff)	9	4
Average percentage of participants' time allocated to types of audit clients		
Listed company		34
Governmentally owned (non-listed)		4
Non-listed large entities (greater than $100 million in revenues)		23
Non-listed medium entities ($10 million to $100 million in revenues)		21
Non-listed small entities (less than $10 million in revenues)		16
Other		2

[a] Ninety-seven hold two master's degrees; one master's in accounting and auditing plus one master's in business administration or similar.

TABLE 4

Participants' Perceived Competence with IT Systems and ADA Tools (n = 216)

	Average Ratings[a]		
Perceived Competence with	**Overall**	**Partner**	**Manager**
IT systems and ERP systems	4.09	3.82*	4.27*,[#]
Data programming, data handling, and data storage	3.43*	3.27*	3.60*
Interpreting the results from data analytics in general	4.80*	4.70*	4.89*
ADA tools that are available to you in your firm	4.46*	4.14	4.77*,[#]

* Indicates $p < 0.05$ (one-tailed). Mean ratings are tested for significant difference (greater/less) from the midpoint (4) of the rating scale.
[#] Indicates significance at $p < 0.05$ (two-tailed). Mean ratings are tested for significant difference between partners and managers.
[a] The rating scale is 1—Very Low to 7—Very High.

TABLE 5

Perceptions of Competency and Usefulness of ADA (n = 216)

Panel A: Perceived Competency of ADA

	Overall Mean[a]
I have sufficient knowledge of ADA tools and procedures available in our firm to use them appropriately.	4.42*
I have been given sufficient training of usage of ADA tools available in our firm.	4.08
I have sufficient knowledge of the ADA statistical methods and their interpretation.	4.20
I have been given sufficient training of the usage of ADA statistical methods and their interpretation.	4.00

Panel B: Perceived Usefulness of ADA for Audits in General within Their Firm

	Overall Mean[a]
The ADA tools that I have seen, tested, or used in our firm are complex and difficult to master and apply in audits.	3.67*
The ADA tools that I have seen, tested, or used in our firm are very time-consuming to implement on my engagements.	4.07
Our audit firm gives incentives and/or exerts pressure to use ADA instead of traditional audit tools and procedures.	4.88*
Current auditing standards accept the use of audit evidence derived from ADA.	4.54*
Our firm's audit methodology accepts the use of audit evidence derived from ADA.	5.33*
Supervisory bodies inspecting audit engagements accept audit evidence derived from ADA.	4.59*
In my opinion. ADA are currently useful for risk identification.	5.27*
In my opinion. ADA are currently useful for substantive testing to obtain audit evidence.	5.13*
I am personally hesitant to use ADA with the ADA tools and procedures currently available in our firm.	2.93*
Our firm has adequate ADA tools.	4.85*
Compared to traditional audit tools and procedures, the ADA tools and procedures currently available in our firm are improving the quality of audits.	5.44*
Compared to traditional audit tools and procedures, the ADA tools and procedures currently available in our firm are efficient (time, effort, or cost in generating the result) to use in audits.	4.40*
In our firm, we lack technical competence on the audit teams to use ADA tools.	3.70*
In our firm, we have sufficient specialist support (outside the core teams) for data-gathering, handling and/or ADA when needed on engagements.	5.15*
Our firm's clients have a positive attitude to our collection of client data for ADA purposes.	5.19*
It is easy to collect sufficient data for ADA purposes from our firm's clients.	3.86

Panel C: Perceived Usefulness of ADA for the Selected Engagements

	Overall Mean[a]
In my opinion. ADA are currently useful for risk identification on this engagement.	4.62*
In my opinion. ADA are currently useful for substantive testing to obtain audit evidence on this engagement.	4.68*
I am personally hesitant to use ADA in this engagement with the ADA tools and procedures currently available in our firm.	2.79*
Our firm has adequate ADA tools for this engagement.	4.79*
Compared to traditional audit tools and procedures, the ADA tools and procedures currently available in our firm are improving the quality on this engagement.	4.85*
Compared to traditional audit tools and procedures, the ADA tools and procedures currently available in our firm are efficient (time, effort, or cost in generating the result) to use on this engagement.	4.30*
We lack technical competence on the audit teams to use ADA tools on this engagement.	3.07*
We have sufficient specialist support (outside the core teams) for data-gathering, handling and/or ADA when needed on this engagement.	4.62*
On this engagement, the client has a positive attitude to our collection of client data for ADA purposes.	4.68*
It is easy to collect sufficient data for ADA purposes from the client on this engagement.	3.99

* Indicates $p < 0.05$ (one-tailed). Mean ratings are tested for significant difference (greater/less) from the midpoint (4) of the rating scale.
[a] Average score by rating scale: 1—Strongly Disagree, 4—Neutral, 7—Strongly Agree.

participants of Firm 1 and Firm 2 compared to the other three firms. This may relate to the fact that these firms have a more "active" approach to the implementation of ADA. Firm 1 trains audit team members extensively in ADA use while Firm 2 has set up a general function of specialists that prepare data and provide a set of standardized ADA analyses for the audit teams.

Table 5, Panel C presents the responses to a series of statements, similar to those in the last ten rows of Panel B related to the perceived usefulness of ADA for the selected engagements. Overall, participants perceived the usefulness of ADA for the selected engagements positively but to a lesser degree compared to firm audits in general. Also, for the selected engagements, Firm 1 and Firm 2 scored highest on perceived usefulness of ADA.

The partners and managers were also asked the following question: "How influential, in your own opinion, are your decisions of the actual usage of ADA on the specific engagement selected for this survey? [ ] Highly influential [ ] Very influential [ ] Somewhat influential [ ] Limited influence; other team members mostly decide [ ] Limited influence." Forty-five percent of the participants answered highly influential and 38 percent answered very influential. Thus, it is clear that the engagement team leaders (partner and manager) are very influential in the decision to use ADA on the selected engagements.

ADA Use on Audit Engagements

Client IT Systems and ADA Data Collection

Table 6 presents information about the entities' ERP/IT systems and a series of questions related to the collection of data for ADA use on the sampled engagements. We present the results by the type of engagement and report untabulated findings by firm when relevant. All engagements (109) report using some information from the entity's ERP/IT systems in the audit. Twenty-eight engagements did not use ADA in any phase of the audit, thus leaving 81 engagements that used ADA in the audit. The 28 engagements not using ADA include 10 Listed engagements, 8 Large_NL (non-listed) engagements, and 10 Small_NL (non-listed) engagements.

Table 6, Panel A shows that for Small_NL and to some degree Large_NL engagements the general ledger is far less integrated with other accounting systems compared to ADA and Listed engagements. The majority of the clients have highly integrated (41.3 percent) or partially integrated (37.6 percent) ERP/IT systems. Clients selected as ADA engagements have the most integrated ERP/IT systems followed by Listed and Large_NL engagements. On average ADA were used 11 times for engagements with highly integrated ERP/IT systems and six times for other engagements (untabulated). This suggests that a client needs to have a high degree of ERP/IT system integration to provide opportunities to use ADA. Outsourcing of the accounting system is most common for Small_NL engagements and in these cases the accounting system is typically highly integrated with other systems.

Table 6, Panel B reports the accounts or records where data were collected for ADA use for the 81 engagements where ADA were used. All but one of the eighty-one engagements collected data from the general ledger. Twenty-six and 25 engagements collected data from accounts payables and account receivables, respectively, while relatively few engagements collected data from other accounts. One hundred ninety total accounts or records were accessed for the 81 engagements using ADA.

Table 6, Panel C shows who collected the data for ADA use. The client collected the data based on instructions from the auditor on 35 engagements (43.2 percent). Firm IT specialists collected the data on 26 engagements (32.1 percent), audit team members for 17 engagements (21.0 percent), and others (e.g., external service providers) for 3 engagements (3.7 percent).

Table 6, Panel D reports who prepared that data for ADA use.[24] The vast majority of the data preparation (95.1 percent) was completed by firm IT specialists (58.0 percent) and audit team members (37.1 percent). In contrast to collection of data for ADA use, only for one engagement was the client involved in the data preparation process. Panel E shows that audit team members conducted the most ADA work (69.1 percent) complemented by IT specialists (29.7 percent). Finally, we observe that for Firm 1 (i.e., the firm that provided extensive training of ADA for audit team members) 95.8 percent of the engagements reported that the audit team members did the main part of the ADA work. Firm 2 (i.e., the firm that used a specialist team to assist the engagement team) reported that the specialist team did the majority of the ADA work on the engagements (62.5 percent).

ADA Usage in the Phases of the Audit

Table 7 reports on the use of ADA in the major phases of the audit engagements (i.e., client acceptance and continuance decisions, fraud risk assessment, internal controls, substantive testing, and final review) and the audit steps within each phase. We present the results by the category of engagement and by firm.

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[24] Untabulated results show that the number of hours used to collect client data was not very high. About 16 percent of the engagements that collected data from the client used more than 20 hours. Eighty-one percent of the engagements used less than 20 hours to clean, structure, and store the collected data.

TABLE 6

Client IT and ADA Data Collection

Panel A: What Best Describes the Entity's ERP/IT System Related to Accounting?

	n (%)	Type of Engagement[a]			
		ADA	Listed	Large_NL	Small_NL
General ledger is not or to a limited extent integrated with other accounting systems.	11 (10.1)	1 (9.1)	1 (9.1)	3 (27.3)	6 (54.5)
The accounting system is partially integrated.	41 (37.6)	8 (19.5)	13 (31.7)	12 (29.3)	8 (19.5)
The accounting system is highly integrated/highly integrated with other systems.	45 (41.3)	19 (42.2)	10 (22.2)	11 (24.4)	5 (11.1)
The accounting system is outsourced, and is not integrated with other systems.	3 (2.8)	0 (0.0)	2 (66.7)	0 (0.0)	1 (33.3)
The accounting system is outsourced, and is highly integrated with other systems.	9 (8.3)	0 (0.0)	2 (22.2)	1 (11.1)	6 (66.7)
Total	109	28	28	27	26

Panel B: Accounts or Records Where Data Were Collected for ADA Use

	n[b]	Type of Engagement			
		ADA	Listed	Large_NL	Small_NL
General ledger	80	25 (31.3)	21 (26.3)	23 (28.8)	11 (13.8)
Accounts payable	26	7 (26.9)	6 (23.1)	7 (26.9)	6 (23.1)
Accounts receivable	25	8 (32.0)	4 (16.0)	7 (28.0)	6 (24.0)
Inventory	12	3 (25.0)	2 (16.7)	6 (50.0)	1 (8.3)
Fixed asset register	11	4 (36.4)	2 (18.2)	4 (36.4)	1 (9.1)
Payment-systems/bank account-ledgers	12	2 (16.7)	2 (16.7)	6 (50.0)	2 (16.7)
Salary	11	2 (18.2)	3 (27.3)	2 (18.2)	4 (36.4)
Financial investments	2	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)
Other	11	7 (63.6)	2 (18.2)	2 (18.2)	0 (0.0)
Total	190	59	43	57	31

Panel C: Who Collected the Data for ADA Use?

	n (%)	Type of Engagement			
		ADA	Listed	Large_NL	Small_NL
Member(s) of the regular audit team.	17 (21.0)	2 (11.8)	6 (35.3)	6 (35.3)	3 (17.7)
IT specialists/a special department/specialist group in the audit firm.	26 (32.1)	10 (38.5)	7 (26.9)	7 (26.9)	2 (7.7)
The client did most of the data collection work (based on instructions from the auditor).	35 (43.2)	12 (34.3)	8 (22.9)	10 (28.6)	5 (14.3)
Others (external service providers, etc.).	3 (3.7)	2 (66.7)	0 (0.0)	0 (0.0)	1 (33.3)
Total	81	26	21	23	11

TABLE 6 (continued)

Panel D: Who Cleaned/Structured the Data for ADA Use?

	n (%)	Type of Engagement			
		ADA	Listed	Large_NL	Small_NL
Member(s) of the regular audit team.	30 (37.1)	8 (26.7)	10 (33.3)	6 (20.0)	6 (20.0)
IT specialists/a special department/specialist group in the audit firm.	47 (58.0)	18 (38.3)	8 (17.0)	16 (34.0)	5 (10.6)
The client did most of the ADA analysis (based on instructions from the auditor).	1 (1.2)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)
Others (external service providers).	3 (3.7)	0 (0.0)	3 (100.0)	0 (0.0)	0 (0.0)
Total	81	26	21	23	11

Panel E: Who Conducted the Main Part of the ADA?

	n (%)	Type of Engagement			
		ADA	Listed	Large_NL	Small_NL
Member(s) on the regular audit team.	56 (69.1)	18 (32.1)	14 (25.0)	16 (28.6)	8 (14.3)
IT specialists (a special department/specialist group in the audit firm.	24 (29.7)	8 (33.3)	6 (25.0)	7 (29.2)	3 (12.5)
The client did most of the ADA analysis (based on instructions from the auditor).	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Others (external service providers, etc.).	1 (1.2)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
Total	81	26	21	23	11

[a] ADA = engagement entity where the audit firm expected high ADA usage;
Listed = largest engagement entity (parent company or subsidiary) based on revenues of a listed company (group);
Large_NL = largest engagement entity (parent company or subsidiary) based on revenues of a non-listed (NL) group with group revenues above $100 million; and
Small_NL = engagement entity of a non-listed (NL) group with group revenues below $10 million or a non-listed (NL) entity not part of a group with revenues below $10 million.
[b] The total is greater than the 81 engagements reported ADA use because ADA were used in multiple accounts or records.

Less than a quarter of engagements (25 of 109 engagements) use ADA in client acceptance and continuance decisions. Most common ADA tools in use were firm global template tools and database management systems (i.e., system software for creating and managing databases). Less ADA are used for listed companies than for the other categories. This is consistent with reluctance to use ADA due to higher inspection risk exposure for listed companies. The use of ADA in client acceptance and continuance decisions varies considerably between firms. Firm 4 did not use ADA for such purposes while Firm 3 used ADA on 44.0 percent of their engagements. Only 19 of the 109 engagements use ADA for fraud risk assessments with most frequent use by ADA engagements. Firm global template tools and database management systems are the most commonly used ADA tool for fraud risk assessments. Variation exists between firms in the use of ADA for fraud risk assessments, from 10.5 percent of engagements for Firms 2 and 4 to 36.8 percent for Firm 1. The low overall use is surprising given that ADA have been promoted as particularly valuable in fraud risk assessments and prediction (e.g., AICPA 2017; Perols, Bowen, Zimmermann, Samba 2017; Austin et al. 2020).

The planning phase includes seven audit steps. These are ordered by frequency of ADA use: overall assessment of client's operations and performance (33 engagements), identifying and assessing key risks (27 engagements), mapping of different business processes (26 engagements), determining and allocating materiality (18 engagements), overall assessment of industry risks and understanding the business (17 engagements), assessing going concern issues (11 engagements), and other planning (4 engagements). Although ADA are used to some extent for understanding the client and in risk assessments, the numbers are low as these are areas where the Heads expected ADA to be used. The variation between firms is considerable. Firms 1 and 2 were the most frequent users of ADA in the audit planning phase.

TABLE 7

Use of ADA in the Phases of the Audit

ADA Usage by Audit Phases and Audit Steps			Category of Engagement[a]				Audit Firm				
Audit Phases	**Audit Steps**	**n[b]**	**ADA**	**Listed**	**Large_NL**	**Small_NL**	**1**	**2**	**3**	**4**	**5**
Client Acceptance and Continuance		25	7 (28.0)	3 (12.0)	8 (32.0)	7 (28.0)	6 (24.0)	4 (16.0)	11 (44.0)	0 (0.0)	4 (16.0)
Fraud Risk Assessment		19	7 (36.8)	2 (10.5)	5 (26.3)	5 (26.3)	7 (36.8)	2 (10.5)	4 (21.1)	2 (10.5)	4 (21.1)
Planning	Overall assessment of industry risks, understanding the business.	17	6 (35.3)	2 (11.8)	3 (17.7)	6 (35.3)	7 (41.2)	4 (23.5)	3 (17.7)	2 (11.8)	1 (5.9)
	Overall assessment of client's operations and performance.	33	8 (24.2)	10 (30.3)	7 (21.2)	8 (24.2)	16 (48.5)	6 (18.2)	3 (9.1)	6 (18.2)	2 (6.1)
	Assessing going concern issues (score, rating etc.)	11	2 (18.2)	3 (27.3)	2 (18.2)	4 (36.4)	6 (54.6)	2 (18.2)	1 (9.1)	0 (0.0)	2 (18.2)
	Mapping of different processes.	26	9 (34.6)	4 (15.4)	7 (26.9)	6 (23.1)	13 (50.0)	4 (15.4)	6 (23.1)	2 (7.7)	1 (3.9)
	Identifying, assessing key risks.	27	9 (33.3)	5 (18.5)	7 (25.9)	6 (22.2)	11 (40.7)	4 (14.8)	3 (11.1)	5 (18.5)	4 (14.8)
	Determining and allocating materiality.	18	5 (27.8)	5 (27.8)	2 (11.1)	6 (33.3)	11 (61.1)	2 (11.1)	2 (11.1)	2 (11.1)	1 (5.6)
	Other planning.	4	2 (50.0)	0 (0.0)	2 (50.0)	0 (0.0)	1 (25.0)	0 (0.0)	1 (25.0)	0 (0.0)	2 (50.0)
Internal Control	Test of controls using extracted client data.	37	17 (46.0)	9 (24.3)	7 (18.9)	4 (10.8)	9 (24.3)	7 (18.9)	9 (24.3)	5 (13.5)	7 (18.9)
	Other internal controls.	11	5 (45.5)	3 (27.3)	2 (18.2)	1 (9.1)	2 (18.2)	3 (27.3)	1 (9.1)	4 (36.4)	1 (9.1)
Substantive Testing	Journal entry testing.	74	24 (32.4)	21 (28.4)	17 (23.0)	12 (16.2)	22 (29.7)	12 (16.2)	17 (23.0)	9 (12.2)	14 (18.9)
	Calculating sample-size for testing.	55	14 (25.5)	16 (29.1)	16 (29.1)	9 (16.4)	16 (29.1)	10 (18.2)	6 (10.9)	9 (16.4)	14 (25.5)
	Selecting of random samples from population.	51	17 (33.3)	12 (23.5)	14 (27.5)	8 (15.7)	16 (31.4)	10 (19.6)	1 (2.0)	9 (17.7)	15 (29.4)
	Simple judgmental methods: deviations from average, larger/smaller than/negative.	40	13 (32.5)	10 (25.0)	11 (27.5)	6 (15.0)	16 (40.0)	9 (22.5)	5 (12.5)	3 (7.5)	7 (17.5)
	Visual (non-statistical) identification of deviations, outliers, groups or similar.	37	16 (43.2)	9 (24.3)	8 (21.6)	4 (10.8)	11 (29.7)	9 (24.3)	8 (21.6)	5 (13.5)	4 (10.8)
	Statistical regression.	9	3 (33.3)	2 (22.2)	2 (22.2)	2 (22.2)	3 (33.3)	3 (33.3)	0 (0.0)	3 (33.3)	0 (0.0)
	Statistical grouping, decision trees, clustering techniques by the computer tool.	10	4 (40.0)	3 (30.0)	1 (10.0)	2 (20.0)	4 (40.0)	3 (30.0)	3 (30.0)	0 (0.0)	0 (0.0)
	Making statistical calculations from the data for predictive analysis.	21	10 (47.6)	3 (14.3)	4 (19.1)	4 (19.1)	9 (42.9)	3 (14.3)	4 (19.1)	3 (14.3)	2 (9.5)

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TABLE 7 (continued)

ADA Usage by Audit Phases and Audit Steps

Audit Phases	Audit Steps	n[b]	Category of Engagement[a]				Audit Firm				
			ADA	Listed	Large_NL	Small_NL	1	2	3	4	5
	Text mining (in contracts, reports etc.) to identify patterns, exceptions, etc.	3	1 (33.3)	1 (33.3)	1 (33.3)	0 (0.0)	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	2 (66.7)
	Two- or three-way matching of specific amounts (value, # of items, etc.)	36	16 (44.4)	5 (13.9)	11 (30.6)	4 (11.1)	16 (44.4)	11 (30.6)	7 (19.4)	1 (2.8)	1 (2.8)
	Other substantive analyses.	4	2 (50.0)	1 (25.0)	1 (25.0)	0 (0.0)	2 (50.0)	0 (0.0)	1 (25.0)	1 (25.0)	0 (0.0)
	Summarizing ledgers by computer audit tools.	41	15 (36.6)	9 (22.0)	7 (17.1)	10 (24.4)	16 (39.0)	11 (26.8)	5 (12.2)	1 (2.4)	8 (19.5)
	Recalculating, re-performing, testing formula (e.g. in client Excel spreadsheets) by computer audit tools.	27	10 (37.1)	6 (22.2)	6 (22.2)	5 (18.5)	10 (37.0)	4 (14.8)	2 (7.4)	5 (18.5)	6 (22.2)
	Reconciliations; match total numbers between different ledgers or similar.	33	10 (30.3)	7 (21.2)	8 (24.2)	8 (24.2)	16 (48.5)	10 (30.3)	3 (9.1)	0 (0.0)	4 (12.1)
	Automated reconciliation of external bank confirmations versus client's data.	1	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)
	Other automated reconciliations.	1	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
	Testing of valuation of financial instruments.	6	2 (33.3)	2 (33.3)	1 (16.7)	1 (16.7)	3 (50.0)	0 (0.0)	0 (0.0)	2 (33.3)	1 (16.7)
	Other computer assisted analytical tests of impairment/estimates/values.	5	1 (20.0)	3 (60.0)	0 (0.0)	1 (20.0)	3 (60.0)	0 (0.0)	1 (20.0)	1 (20.0)	0 (0.0)
	Other substantive testing as audit evidence.	4	1 (25.0)	2 (50.0)	1 (25.0)	0 (0.0)	0 (0.0)	3 (75.0)	1 (25.0)	0 (0.0)	0 (0.0)
Final Review and Conclusion	Review of board meetings, audit meetings or similar.	1	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Analytical checks/fairness checks of results, balance values, etc.	25	10 (40.0)	6 (24.0)	4 (16.0)	5 (20.0)	10 (40.0)	4 (16.0)	3 (12.0)	4 (16.0)	4 (16.0)
	Reconciliation/control between final accounts and underlying ledger, etc.	26	9 (34.6)	6 (23.1)	5 (19.2)	6 (23.1)	9 (34.6)	7 (26.9)	2 (7.7)	1 (3.9)	7 (26.9)
	Examining financial statement disclosures and notes.	4	2 (50.0)	1 (25.0)	1 (25.0)	0 (0.0)	1 (25.0)	0 (0.0)	1 (25.0)	0 (0.0)	2 (50.0)
	Control of numbers and text against last year's financial report, internal consistency in current year's financial.	8	2 (25.0)	3 (37.5)	1 (12.5)	2 (25.0)	2 (25.0)	1 (12.5)	0 (0.0)	1 (12.5)	4 (50.0)
	Subsequent/events after the balance sheet date.	6	3 (50.0)	1 (16.7)	0 (0.0)	2 (33.3)	2 (33.3)	1 (16.7)	1 (16.7)	0 (0.0)	2 (33.3)
	Using data analytics when forming the audit opinion.	9	4 (44.4)	0 (0.0)	2 (22.2)	3 (33.3)	4 (44.4)	3 (33.3)	1 (11.1)	0 (0.0)	1 (11.1)
	Other wrap up.	1	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)

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TABLE 7 (continued)

ADA Usage by Audit Phases and Audit Steps

Audit Phases	Audit Steps	n[b]	Category of Engagement[a]				Audit Firm				
			ADA	Listed	Large_NL	Small_NL	1	2	3	4	5
Total		766	269	176	174	147	281	154	117	87	127
Average number of times ADA were used per engagement		7.0	9.6	6.3	6.4	5.7	11.7	7.7	5.1	4.6	5.5

[a] ADA = engagement entity where the audit firm expected high ADA usage;
Listed = largest engagement entity (parent company or subsidiary) based on revenues of a listed company (group);
Large_NL = largest engagement entity (parent company or subsidiary) based on revenues of a non-listed (NL) group with group revenues above $100 million; and
Small_NL = engagement entity of a non-listed (NL) group with group revenues below $10 million or a non-listed (NL) entity not part of a group with revenues below $10 million.
[b] Number of engagements with answer "yes" to the question that ADA were used in the specific sub-category on the selected engagement out of the 109 engagements.

Thirty-seven engagements used ADA to evaluate and test internal controls using extracted client data, with the most frequent use by ADA engagements (17 of the 37 engagements). ADA usage related to internal controls was fairly evenly distributed across firms.

The substantive testing phase was divided into 19 audit steps. The steps with the highest usage of ADA include: journal entry testing (74 engagements); calculating sample-size for testing (55 engagements); selection of random samples from populations (51 engagements); summarizing ledgers by computer audit tools (41 engagements); simple judgmental methods (e.g., deviations from average, larger/smaller, negative) (40 engagements); visual (non-statistical) identification of deviations, outliers, groups or similar (37 engagements); two- or three-way matching of specific amounts (36 engagements); reconciliations (e.g., matching total numbers between different ledgers or similar) (33 engagements); recalculating, re-performing, testing of formula by computer audit tools (27 engagements); and making statistical calculations from the data for predictive analysis (21 engagements). The findings indicate that ADA usage is common for some steps in the substantive testing phase. Some of these analytics have been used in audits for decades while others reflect more recent ADA. Consistent with the firm approaches to implement ADA, Firms 1 and 2 were the most frequent users of ADA in the substantive testing phase.

Eight audit steps were included in the final review and conclusion phase. ADA were used most in reconciliation and control between final accounts and underlying ledger (26 engagements) and for analytical checks and reasonableness checks of results (25 engagements) with again Firms 1 and 2 as the most frequent users.

On average, ADA were used seven times in each engagement with highest average on ADA engagements (9.6 times). The average number of times that ADA was used on engagements for Firm 1 to Firm 5 was 11.7, 7.7, 5.1, 4.6, and 5.5, respectively. This mirrors the firms' strategy for implementing ADA.

Table 8 shows which type of ADA tool and the number of times they were used by engagement category and firm. Excel with basic functionality is used 424 times as an ADA tool (representing 34.4 percent of the total 1,232). More advanced Excel (including Power-BI, Solver, Miner, and Macros) is used 319 times (25.9 percent of the total). More sophisticated software with capacity to handle Big Data is used less. Statistical packages (e.g., R, Stata, SPSS); programming languages (e.g., Python and Pearl), and visualization programs (e.g., Tableau and Spotfire) are used 2.7 percent, 2.2 percent, and 10.6 percent of the total times, respectively. "Other" ADA tools (8.1 percent of the total) include firm specific tools—PACE (EY), Halo (PwC), KAAP (KPMG), and Spotlight (Deloitte). According to the firm Heads these tools include some of the tools described above. Business Intelligence (BI) Analytics Management Software (e.g., IBM, Oracle, SAP, SAS) and database management systems (e.g., Access, MySQL, SQLServer, Oracle) were used 6.9 percent and 9.2 percent of the total times, respectively. ADA tools were used most on ADA engagements (441 times of 1,232; 35.8 percent) and these engagements have the highest frequency of use of advanced Excel, database management systems, visualization programs, and "Other"' tools. As expected, Firm 1 uses ADA tools most frequently (39.7 percent of the total number of times), followed by Firm 2 (19.9 percent), Firm 3 (15.3 percent), Firm 5 (14.0 percent), and Firm 4 (11.0 percent).

Untabulated results indicate that statistical packages are mostly used for statistical sampling or journal entry testing and that visualization tools are, in many cases, used for journal entry testing, non-statistical visualization, or simple visualization of deviations.

During the semi-structured discussions that followed the completion of the questionnaire, participants drew our attention to ADA use and the tender process. One participant made the following comment: "When we have written about data analytics all over the place in the audit tender and promised to use it in the presentations—well, then you just have to use it when you have won the audit." Based on the comments about the tender process, we contacted each firm and asked how many of the 109 engagements were a new client in the years 2016 or 2017. Ninety-five were continuing engagements and 14 were new tendered engagements in 2016 and 2017. Table 9 shows engagement perceptions of the usefulness of ADA (cf. Table 5, Panel C) and the number of times ADA were used in the auditing process (cf. Table 7, last row) for continuing and new engagements.

ADA usefulness is systematically perceived higher for all statements for new compared to continuing engagements. On average, ADA were used 14 times for new engagements and six times for continuing engagements. Based on the discussions in the firm sessions, the reasons for the higher use of ADA on new engagements seem to be a combination of expectations from the clients, commitments in the tender process to the use ADA and the cost of changing the audit approach and procedures on continuing engagements.

Viewing ADA Use through an Institutional Theory Perspective

To better understand the low use of ADA on audit engagements and develop insight into the underlying causes of the problems facing the auditor in the decision to apply ADA and how these can be mitigated, we relate our findings and analysis to

TABLE 8
Type of ADA Tools Used

Which ADA Tool was Used[b]	Total[c]	Category of Engagement[a]				Audit Firm				
		ADA	Listed	Large_NL	Small_NL	1	2	3	4	5
Excel—basic functionality	424	101	98	111	114	159	75	40	53	97
	(34.4)	(23.8)	(23.1)	(26.2)	(26.9)	(37.5)	(17.7)	(9.4)	(12.5)	(22.9)
Excel—advanced	319	141	47	58	73	144	66	61	18	30
	(25.9)	(44.2)	(14.7)	(18.2)	(22.9)	(45.1)	(20.7)	(19.1)	(5.6)	(9.4)
Analytical tools BI	85	21	22	37	5	19	20	36	10	0
	(6.9)	(23.6)	(25.9)	(43.5)	(6.9)	(22.4)	(23.5)	(42.4)	(11.8)	(0.0)
Statistical packages	34	5	10	16	3	15	9	5	5	0
	(2.7)	(14.7)	(29.4)	(47.1)	(8.8)	(44.1)	(26.5)	(14.7)	(14.7)	(0.0)
Database management systems	113	53	26	23	11	69	23	6	1	14
	(9.2)	(46.9)	(23.0)	(20.4)	(9.7)	(61.0)	(20.4)	(5.3)	(0.9)	(12.5)
Programming languages	27	3	4	1	19	23	1	2	0	1
	(2.2)	(11.1)	(14.8)	(3.7)	(70.4)	(85.2)	(3.7)	(7.4)	(0.0)	(3.7)
Visualizations programs	130	68	33	29	0	51	10	11	32	26
	(10.6)	(52.3)	(25.4)	(22.3)	(0.0)	(39.2)	(7.7)	(8.5)	(24.6)	(20.0)
Other	100	49	23	24	4	9	41	28	17	5
	(8.1)	(49.0)	(23.0)	(24.0)	(4.0)	(9.0)	(41.0)	(28.0)	(17.0)	(5.0)
No. of times ADA tools were used	1232	441	263	299	229	489	245	189	136	173
	(100)	(35.8)	(21.3)	(24.3)	(18.9)	(39.7)	(19.9)	(15.3)	(11.0)	(14.0)

[a] ADA = engagement entity where the audit firm expected high ADA usage;

Listed = largest engagement entity (parent company or subsidiary) based on revenues of a listed company (group);

Large_NL = largest engagement entity (parent company or subsidiary) based on revenues of a non-listed (NL) group with group revenues above $100 million; and

Small_NL = engagement entity of a non-listed (NL) group with group revenues below $10 million or a non-listed (NL) entity not part of a group with revenues below $10 million.

[b] Excel—basic functionality, Excel—advanced (e.g., Power-BI, VBA, Solver, Miner, Macros), Analytics tools BI (e.g., IBM, Oracle, SAP, SAS), Statistical packages (e.g., "R," Stata, SPSS, MATLAB, SAS, JPM, Crystal Ball), Database management systems (e.g., Access, MySQL, SQLServer, Oracle), Programming languages (e.g., Python, Pearl, visual Basics, C++), Visualizations programs (e.g., Tableau, SAS Visual, Qlikview, Spotfire), Other (audit firm tools like PACE [EY], Halo [PwC], KAAP [KPMG], Spotlight [Deloitte] or "firm tool," and external tools like IDEA and AIDA, or not specified).

[c] Number of times ADA tools were used in the specific sub-category on the selected engagement in the 109 engagements. Number of tools are higher than number of ADA use in Table 7 since several tools may be used for each phase.

perspectives from institutional theory.[25] The term "institutional theory" covers a broad body of literature. Wooten and Hoffman (2017, 55) state: "What these literatures have in common, however, is an underlying skepticism towards atomistic accounts of social processes, relying instead on a conviction that institutional arrangements and social processes matter in the formulation of organizational action (DiMaggio and Powell 1991)." At its core, the institutional theory literature looks at the source of action as existing exogenous to the actors (Wooten and Hoffman 2017).

Legitimacy is a fundamental concept of organizational institutionalism and refers to how organizations seek legitimacy by their audience (constituencies) of their activities.[26] Institutional theory-based auditing research has focused on the

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[25] The accounting information system literature has tested several theories about the acceptance and adoption of emerging technologies (e.g., Goodhue and Thompson 1995; Dowling 2009; Zhou, Lu, and Wang 2010; Bierstaker, Janvrin, and Lowe 2014; Payne and Curtis 2017; Li, Dai, Gershberg, and Vasarhelyi 2018). Our study is of an exploratory nature and these theories typically require a large and structured data set to test. In a recent study examining how data analytics influence interactions among user groups (i.e., managers, auditors, and regulators), Austin et al. (2020) interpret their interview findings through socio-technical systems of innovation theory (S-T theory), drawing on sociology and institutional theory as advanced by Geels (2004).

[26] The literature contains several definitions of the concept of legitimacy. Based on a review of the literature Deephouse, Bundy, Tost, and Suchman (2017, 32) offer the following definition of legitimacy: "Organizational legitimacy is the perceived appropriateness of an organization to a social system in terms of rules, values, norms, and definitions." Suchman (1995) identifies three primary forms of legitimacy that an organization may use to gain legitimacy with its audience (constituencies) of its activities. Pragmatic legitimacy relates to whether organizational activity benefits the audience; moral legitimacy relates to whether organizational activity is normatively approved by the audience; and cognitive legitimacy relates to comprehensibility (predictability and plausibility) of organizational activity and whether organizational activity is taken for granted (necessary or inevitable) by the audience. Our focus is primarily on pragmatic legitimacy.

TABLE 9

Continuing Engagements and New Engagements in 2016 or 2017
Perceptions of Usefulness of ADA

	Average Score[a]	
	Continuing Engagements[b]	**New Engagements[c]**
Number of engagements	95	14
In my opinion. ADA are currently useful for risk identification on this engagement.	4.6	4.8
In my opinion. ADA are currently useful for substantive testing to obtain audit evidence on this engagement.	4.6	5.2
I am personally hesitant to use ADA in this engagement with the ADA tools and procedures currently available in our firm.	2.9	2.5
Our firm has adequate ADA tools for this engagement.	4.7	4.8
Compared to traditional audit tools and procedures, the ADA tools and procedures currently available in our firm are improving the quality on this engagement.	4.8	5.1
Compared to traditional audit tools and procedures, the ADA tools and procedures currently available in our firm are efficient (time, effort, or cost in generating the result) to use on this engagement.	4.3	4.8
We lack technical competence on the audit teams to use ADA tools on this engagement.	3.1	2.7
We have sufficient specialist support (outside the core teams) for data-gathering, handling and/ or ADA when needed on this engagement.	5.0	5.6
On this engagement, the client has a positive attitude to our collection of client data for ADA purposes.	5.0	5.2
It is easy to collect sufficient data for ADA purposes from the client on this engagement.	3.9	4.1
Number of times ADA was used in the specific sub-category on the selected engagement		
Total	570	196
Average number of times per engagement	6.0	14.0

[a] Average score of the auditors on the engagements by rating scale: 1—Strongly Disagree, 4—Neutral, 7—Strongly Agree.
[b] Engagements that were taken on by the audit firm in 2015 or earlier.
[c] Engagements that were new for the audit firm in 2016 or 2017.

conception of legitimacy and legitimation processes of audit practices (Power 1997, 2003). This legitimacy-oriented perspective views the interrelationship between audit practices and attempts to secure its legitimacy as central to development and widespread acceptance of emerging practices (O'Dwyer, Owen, and Unerman 2011). Several studies have empirically investigated how audit practices seek to gain legitimacy with key constituencies (e.g., auditees, regulators, and supervisory inspection authorities) necessary for them to prosper (e.g., Curtis and Turley 2007; Robson, Humphrey, Khalifa, and Jones 2007; O'Dwyer et al. 2011; Griffith, Hammersley, and Kadous 2015; Salijeni et al. 2019). Operating in a highly regulated and supervised industry and acting in the public interest, audit practices need legitimacy. Salijeni et al. (2019) argue that the rise of ADA should be understood as auditors' attempts to promote technological solutions for the problem of maintaining (or restoring) the legitimacy of the audit function. Walker and Brown-Liburd (2019) propose a conceptual framework that comprehensively describes the emergence of the use of ADA by audit professionals through the lens of institutional theory.[27] They argue that in the process of incorporating ADA into the audit, firms respond to pressure from the external environment and attempt to gain legitimacy of ADA usage within their environment.[28] Given environmental pressure and firms' legitimation process, the individual auditor acts and decides whether it makes sense to use ADA in the audit. Walker and Brown-Liburd (2019) refer to sense-making theory to investigate how practitioners decide and act (or do not act) to use of ADA. In the following discussion of our results we draw on the view above that institutional

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[27] Walker and Brown-Liburd (2019) relate their conceptual framework to interview responses from 27 experienced internal and external auditors.

[28] This reasoning is in line with Griffith et al. (2015, 836) who apply institutional theory to examine audit of accounting estimates and state: "Institutional theory posits that organizations respond to the pressures and constraints of their environments by developing and changing existing practices that establish or enhance the organizations' legitimacy within the environment."

(environmental pressure), organizational (audit firms' legitimacy process), and auditor-specific factors (sense-making) influence the actual ADA usage on audit engagements.

Accounting firms perceive pressures from their institutional environment that will likely influence their decision around the adoption of ADA.[29] It is clear from the firms' public announcements and their investments in ADA that technological advancements, the richer sources of data available, and expectations of providing effective audits more efficiently in a data analytic intensive business environment, represent significant technological pressures on the firms to adopt ADA. All the Heads of professional practice of the five international public accounting firms confirm that there is a global firm push for ADA to be used on audit engagements. At the individual level, the audit team leaders (partners and managers) perceive that the firms give incentives or exert pressure to use ADA instead of traditional audit tools. Audit client pressure may also influence their decision around the adoption of ADA although all Heads of professional practice did not agree on such pressure. We observe that more ADA are used for clients where the accounting system is fully integrated with other ERP/IT systems (e.g., payroll/HR, inventory, production, fixed assets). Client integrated ERP/IT systems both force and give the auditor an opportunity for cost-efficient use of ADA. Further, a higher frequency of ADA use is observed for new audit engagements that have recently been tendered. This may reflect that management and the audit committee exert pressure for use of ADA in the tendered audits but also firm peer pressure to commit to use of ADA in the tendered audit. Overall, the audit team leaders perceive the usefulness of ADA to be higher on new engagements. In addition to client pressure for ADA usage and commitment to use ADA in tendered audits, cost-efficiencies of ADA use on new versus continuing engagements may explain this attitude. We do not observe that it is perceived that standard-setters or supervisory inspection authorities exert pressure to apply ADA in the audits. Rather uncertainty of supervisory authorities' position on ADA usage in the audit evidence gathering process is perceived as preventing or limiting its use because of potential detrimental consequences of inspections concluding non-compliance with regulations and standards.

The firms' Heads express significant uncertainty about how the supervisory authorities will evaluate and accept ADA generated audit evidence. They indicated that the supervisory authorities are passive and silent on the use of ADA in the audit. The supervisory authorities in Norway, the FSA, have informed several of the audit firms that their strategy is to inspect completed audit engagements and then form their own opinion on the appropriateness of the ADA usage. For audit engagements subject to PCAOB supervisory authority, supervisory risk has led all the firms to inform the audit teams not to use ADA as the only form of audit evidence. The partners did not express strong views on whether the supervisory authorities and the current auditing standards accept the use of audit evidence derived from ADA. We did not identify that the firms had developed a legitimation strategy of ADA usage toward the supervisory authorities. Thus, the primary arena for the accounting firms' search of legitimacy of ADA usage seems currently toward audit clients and particularly new clients. It is not clear from our data, however, whether the client or the tendering audit firm is the most proactive in pressing for ADA usage during the tender process. Further, no firm has introduced mandatory use of advanced ADA tools in their audits and the firms differ in their strategies on how they implement the use of ADA in their practices; from a "wait and see" position to more active firm involvement to facilitate ADA use. The firms appear to act cautiously toward implementation of more advanced ADA. We therefore conclude that legitimization of ADA usage is not yet a high priority for the surveyed firms, except for promoting externally in press statements, speeches, publications, and on their webpages that they are engaged in the process of transforming to ADA usage in the audit,[30] and at least to some extent in search of legitimacy of ADA usage toward audit clients, particularly new clients.[31]

Given environmental pressure, the firm's legitimization strategy, and other considerations such as the audit team's ADA skills, specialist resources available, adequate available firm ADA tools, audit client characteristics (e.g., integrated ERP/IT systems or not), money, and time available within the engagement budget; the partner and managers decide whether to use ADA on a specific engagement. The firms encourage, but do not require, the use of ADA tools and the decision of ADA usage is left to the leaders of the audit team. We are not able to substantiate that the partners and managers find firm available ADA tools inadequate, available firm specialist support (outside the core team) insufficient, or their ADA competence a hindrance to

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[29] DiMaggio and Powell (1983) suggest three forms of institutional pressures for isomorphism; coercive (stemming from political influence), mimetic (resulting from standard responses to uncertainty), and normative (associated with professionalization). The perspective has also been used to explain how and why organizations change established practices (e.g., Greenwood, Suddaby, and Hinings 2002). Our main focus is on coercive pressures exerted by key constituencies to change (or not change) to ADA usage.

[30] This concurs with Salijeni et al.'s (2019) conclusion the firms promote technological solutions for the problem of maintaining (or restoring) the legitimacy of the audit function.

[31] The firms' "passive" legitimization strategy toward regulators and supervisory authorities may reflect that this is considered an issue to be primarily handled at the international rather than the national level. For example, the IAASB is currently exploring issues arising from technology in conjunction with audit evidence gathering (IAASB 2019). PCAOB has established a Standing Advisory Group (SAG) to discuss the use of data and technology in audits and the potential implications for PCAOB auditing standards. Committee of European Audit Oversight Bodies (CEAOB) has on its agenda: "Analysis of the impact of new audit tools and technologies on audit quality and auditor oversight as well as cyber security risks" (CEAOB 2018, 9).

the use of ADA tools. The ability of the ADA tools to efficiently and effectively provide sufficient and appropriate evidence is fundamental in the auditor decision to apply ADA in the audit (i.e., ADA usage must make sense for the practitioner given regulations, firm requirements, and the above mentioned considerations such as budget and client characteristics).[32] The need to make sense by those in the organization who will use the new technology intensifies in circumstances where individuals face unexpected situations in their organizations, experience a high degree of ambiguity, and there is no predetermined way to act (Weick, Sutcliffe, and Obstfeld 2005). Uncertainty and ambiguity are both important attributes in the decision to adopt ADA (Walker and Brown-Liburd 2019). The audit team leaders with intimate knowledge of regulations, inspection risk, and firm policies, are likely to be aware of and consider the limitations of the usage of ADA tools in the evidence gathering process and therefore act cautiously in adopting extensive use of ADA.[33] A partner made the following statement: "You know, we all know we should use data analytics in the audit. But when you are not quite sure how to do it, you know it is costly to implement, and you are not quite sure what the supervisory authorities will say. Well, then you wait a bit."

Based on the arguments in the preceding and illustrated by the quote above, we suggest that the limited use of ADA will persist until it is incorporated internally in the firms' methodology and reward systems; explicitly supported and accepted by standard-setters and supervisory bodies; and practitioners find that ADA use proves efficient and effective on the engagement. Thus, it is likely that institutional changes directed to reduce perceived inspection risk related to ADA usage and incorporation of ADA into the firm methodologies, as well as convincing insight into the gains of ADA use in evidence gathering, are necessary to advance to an extensive use of ADA in the audit process.

V. CONCLUDING COMMENTS

In this study we report on auditors' perceptions on ADA use and the actual use of ADA on 109 different audits. The evidence was gathered from (1) semi-structured interviews with the Heads of professional practice of five international public accounting firms in Norway and (2) responses to a detailed questionnaire from 216 engagement partners and/or managers on their attitudes and perceptions toward the acceptance and application of ADA, and the implementation of ADA on 109 audits of 2017 financial statements.

The results show that despite the firms' global strategy to extend the ADA usage and the auditors' general positive attitude toward its use, the actual use of ADA is limited, and the use of more "advanced" ADA is rare. Some of the variation between firms in ADA use is explained by differences in firm strategies of implementation of ADA. ADA output is mostly used as supplementary evidence. As expected, more ADA are used for clients with integrated ERP/IT systems. A higher frequency of ADA use is observed for new and tendered audit engagements. The firms' Heads of professional practice express significant uncertainty about how the supervisory inspection authorities will evaluate and accept ADA generated audit evidence. None of the firms have introduced mandatory use of advanced ADA tools.

The study draws on institutional theory in the discussion of the findings. We conclude that environmental pressures for firms to apply ADA primarily stem from technological advancements and to some extent from audit clients, particularly new clients. Except for promoting to external parties that they are engaged in the process of transforming to ADA usage and to some extent toward audit clients, particularly new clients, legitimization of ADA usage to other constituencies seems not to be a high priority for the surveyed firms. In deciding the use of ADA at the engagement level, the auditor must be confident in the ability of the ADA tools to efficiently and effectively provide sufficient and appropriate evidence. Institutionalized conventions suggest that the limited use of ADA will likely persist until its use is incorporated internally in the firms' methodology and reward systems; explicitly supported and accepted by standard-setters and supervisory bodies; and practitioners must find that ADA use proves efficient and effective in the evidence gathering process.

The results from the study point to several potential fruitful avenues for future research. It would be interesting to perform follow-up studies to learn (1) how the use of ADA in practice develops over time and (2) whether ADA usage is more accelerated for audits of very large companies than for audits in Norway, a relatively small country with a limited number of large companies. A key challenge for more ADA use seems to be how to cost-efficiently transform the output from ADA to sufficient and appropriate audit evidence. Research can contribute to better understand which factors inhibit this transformation to assist auditors to better apply ADA, for example along the lines suggested by No et al. (2019). Uncertainty about supervisory bodies' inspection behavior inhibits auditors' use of ADA. A better understanding on how inspection risk affects auditors'

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[32] This argument is line with Curtis and Turley (2007, 440) who point out that from the practitioner perspective he or she "may be concerned that the process not only meets firm determined standards on methodology, but also actually provides a body of evidence that the practitioner believes to be valid as a basis for signing the audit opinion and as a defensible record of the audit process."

[33] Although not new (e.g., Arnold and Sutton 1998), there is a growing awareness within the academic literature about limitations of the usage of ADA tools (e.g., Brown-Liburd, Issa, and Lombardi 2015; Appelbaum 2016; Sutton, Arnold, and Holt 2018; No, Lee, Huang, and Li 2019).

ADA use (or non-use) is of importance. Finally, insight into how clients may drive the demand for auditors' ADA use, including the role of ADA in the tender engagement process, seems a promising area for future research.

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APPENDIX A

Interview Script—Heads of Professional Practice

Estimated time: 60–90 min.

Introduction

Background data:
Personal data/firm.

Give an overview of the current type of data tools and data analytics (CAAT/ADA).
Type of tools in the firm, how much is in use or implemented in Norway.

Now, please give specific comments to the status on CAAT and ADA on the different phases of the audit:

1. Client Acceptance or Renewal Phase

Does your firm have standardized data tools with interactive yes/no answers, scoring systems or is your firm using internal/external data bases that provides guidance or answers on whether an audit client can be accepted or renewed? Please describe.
Developed globally or locally/nationally? Is the system mandatory or voluntary?

2. Fraud/Fraud (ISA 240)

Does your firm have standardized data tools for assessing fraud? What is the name of the system and explain in short how it works, and what sources (external/internal) it uses and how the results are generated?

Developed globally or locally/nationally? Is the system mandatory? For all clients/some type of clients (listed/SEC/all major)?

3. Planning/Risk Assessment

Does you firm have standardized data tools or standardized data analysis according to the audit firm's audit methodology in the planning phase for risk identification, assessment of internal control, audit plan, etc.?

Examples in different phases of the audit if the Head does not answer without support:

- For use in business understanding; analysis of past accounts, market understanding, trends, etc.
- Assessment of control environment, internal control, IT environment
- Other types of "audit planning software" or "risk assessment software"
- The questions do not apply to project management, hourly usage, fees or etc. We will return to material calculations.

For each of these systems:

What are the name of the tools and explain in short, how they work and what sources (external/internal) they use and how results are generated.

Developed globally or locally/nationally? Is the system mandatory? For all clients/some type of clients (listed/SEC/all)?

Other types of data analysis (voluntary or mandatory) included in the audit company's standard methodology during the planning phase and risk assessment?

4. Materiality

Does your firm have standardized data tools or standardized data analysis according to the audit firm's audit methodology in the planning phase for calculating and distributing/detailing materiality into single areas and single entities?

What is the name of the system and explain in short, how it works and what sources (external/internal) it uses and how the results are generated.

Developed globally or locally/nationally? Is the system mandatory? For all clients/some type of clients (listed/SEC/all)?

5. Mapping of IT Environments and Internal Control Tests

Does your firm have standardized data tools or standardized data analysis according to the audit firm's audit methodology for mapping IT environments, internal control, and internal control testing?

Examples in different phases of the audit if the Head does not answer without support:

- Mapping of transaction processes and/or controls
- Mapping of IT environments and systems
- Testing of IT controls, databases
- Testing of transactions, monitoring of transactions
- Other

For each of these tools or analysis:

What are the systems named and explain in short, how it works and what sources (external/internal) it uses and how results are generated?

Developed globally or locally/nationally? Is the system mandatory? For all clients/some type of clients (listed/SEC/all)?

Other types of data analysis (voluntary or mandatory) included in the audit company's standardized method of testing internal control?

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6. Substantive Testing/Detail Testing

Does your firm have standardized data tools or standardized data analysis according to the audit firm's audit methodology for substantive testing?

Examples in different phases of the audit if the Head does not answer without support:

- Sampling/random selection tools
- Tools for summation control/completeness/accuracy etc.
- For example, Journal Entry testing
- Summary tools for testing accuracy in different files
- Calculation controls
- XL spreadsheet formula checks, summaries and similar

Data mining tools

- Text Analysis
- Search for special numbers, transactions with special characteristics (negative numbers, all over X in value and similar)
- Test of entire populations instead of variety testing/sampling

Analytical tests

- Analytical tools; for example, for use of revenue testing
- Analytical tools; for example, for stock inventory testing
- Analytical tools; for example, for the use of claims testing
- Analytical tools; for example, for use on taxes, fees, holiday pay, VAT testing
- Analytical tools; for example, for testing of other costs and provisions

Tools or data analysis methods for auditing estimates or value estimates

- Valuation of derivatives
- Valuation for testing of impairment
- Other analysis or tests of estimates
- Visualization tool with standardized presentations
- Tools for use for external confirmations
- Tools for confirmation of existence e.g., of inventories; camera, drones and similar

Other types of data analysis (voluntary or mandatory) included in the audit company's standard methodology in substantive tests/detail testing?

For each of these tools and analysis:

What are the systems named and explain in short, how it works and what sources (external/internal) it uses and how results are generated. Is it Excel based or based on other software?

To what extent are "simple" analysis (deviations from average, abnormal sizes) or more statistical analysis, clustering or sorting/structuring large amounts of unstructured data?

Are analysis or tools used for risk identification or audit evidence?

Developed globally or locally/nationally?

Is the system mandatory? For all clients/some type of clients (listed/SEC/all)?

7. Wrap Up/Summary/Conclusion

Does your firm have standardized data tools or standardized data analysis according to the audit firm's audit methodology for use in summary and conclusion?

For example:

- Reconciliation/control between final accounts and underlying ledgers etc.
- Text control, control of numbers and text compared to last year's, internal consistency and similar.
- Analytical checks/fairness checks of results, balance values, etc.
- Subsequent/events post balance sheet date

About actual use of data tools in Norway.

Actual implementation of audit assignments carried out in Norway by the various tools:

- Has the firm or the Norwegian firm taken any formal position of the use of data analytics and related tools in general or in special areas? Any impediments in your opinion on use versus GAAS or supervisory authorities?
- In your opinion, to what extent has the various tools been implemented in audit assignments in Norway for the 2017 audit?
- Differences between SEC, listed, major/minor audit assignments, industries?
- Differences depending on customer characteristics (IT systems, degree of integrated systems, own data analysis, expectations/attitudes)?
- Selected pilots for general use? Specific tools pilot tested on some type of audit assignments? What types and explain why.
- Degree of mandatory use/voluntary/incentives (bonus/'allowed' to spend several hours)/measurement/expectation and central pressure on use?
- Type and amount of training, support etc.
- Your assessment of user complexity/user threshold, implementation costs, efficiency and/or improvement of audit quality for the various tools. You may be able to provide some tools that you think have low user threshold, low implementation costs, high efficiency gains, or quality improvement, and vice versa.
- Or other factors (but not personal characteristics of the team/responsible partner) that affect the extent of the use of data tools and data analysis? In your opinion, what may prevent more extensive use?
- What do you think about the use of tools and data analysis, for example comparing two to three years ahead from today?

Other comments?
Thank you!

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