Using generalized audit software to detect material misstatements, control deficiencies and fraud

How financial and IT auditors perceive net audit benefits

Received 3 May 2019
Revised 7 September 2019
Accepted 5 November 2019

Marianne Bradford
Department of Accounting, North Carolina State University, Raleigh, North Carolina, USA

Dave Henderson
Department of Accounting, University of Mary Washington, Fredericksburg, Virginia, USA

Ryan J. Baxter
Department of Accounting, Boise State, Boise, Utah, USA, and

Patricia Navarro
Department of Accounting, University of Central Florida, Orlando, Florida, USA

Abstract

Purpose – As technology integration in auditing continues to grow, it is important to understand how auditors perceive connections between use of generalized audit software (GAS) and audit benefits.

Design/methodology/approach – The DeLone and McLean information systems success model (2003) is adapted with audit-related uses of GAS as antecedents to information quality. Survey data on 188 current users of GAS, who are financial and IT auditors, is analyzed with partial least squares method.

Findings – For financial auditors, detecting material misstatements antecedent is the only significant indicator of information quality for GAS. For IT auditors, detecting control deficiencies and fraud significantly impacts information quality. Information quality influences use for both auditors; however, it only influences satisfaction with GAS for financial auditors. System quality impacts GAS satisfaction for only IT auditors and has no impact on GAS use for either type of auditor. Service quality influences use of GAS for financial, but not IT auditors. For both groups, service quality has no impact on satisfaction with GAS, and GAS use and satisfaction with GAS positively increases their perceptions of audit benefits.

Originality/value – Financial and IT auditors who use GAS are both focused on matching GAS use with their primary audit objectives. Results suggest that as GAS use increases, system quality may be important to satisfaction. Training should first focus on the usefulness of GAS to the audit to increase extent of use. Lastly, the more auditors use GAS and are satisfied with it, the greater their perception GAS contributing directly to benefit the audit.

Keywords Audit analytics, DeLone and McLean information systems success model, Generalized audit software, IT auditor

Paper type Research paper

Managerial Auditing Journal
Vol. 35 No. 4, 2020
pp. 521-547

0268-6902
DOI 10.1108/MAJ-05-2019-2277

Introduction

The demand for technology-fluent auditors has and will continue to grow as business operations become increasingly complex and dependent on IT (Stephan *et al.*, 2017; Lowe *et al.*, 2018). In addition, the Public Company Accounting Oversight Board (PCAOB) reports that technology use in audits will grow through means such as generalized audit software (GAS) (Public Company Accounting Oversight Board, 2017d), and other research notes that auditors need to respond to new legislative and professional requirements (Stoel *et al.*, 2012; Lim *et al.*, 2011). From this vantage, greater understanding of the benefits and integration challenges of IT capabilities, such as GAS, is important to continue examining.

To meet these challenges, financial auditors have increased their reliance upon IT auditors for some time (Brazel and Agoglia, 2007), and the role of the IT auditor has become vital to audit engagements because of complex systems and transactions (Brynjolfsson and McAfee, 2011; EY, 2012; PwC, 2015). Because the financial and IT auditor relationship is a long-standing collaboration, we compare their perceptions to gain an understanding of their use of GAS. This comparison is also important given that research literature comparing IT and financial auditors is relatively sparse (Bauer and Estep, 2017).

GAS is one the most commonly used types of computer assisted audit techniques (CAAT) (Debreceny *et al.*, 2005), but adoption has been lower than expected (Ahmi and Kent, 2013; Debreceny *et al.*, 2005) and GAS capabilities have not been fully exploited in the audit (Janvrin *et al.*, 2008; Kim *et al.*, 2016). Because prior research has primarily emphasized reasons for auditors' adoption of GAS, this leaves the relatively unexplored area of more experienced users' perceptions of GAS, including users' reasons for use as well as whether they believe that such use benefits the audit. This study contributes to GAS research by selecting subjects who identify as GAS users (122 financial and 66 IT auditors).

We adapt DeLone and McLean's (D&M) (DeLone and McLean, 2003) information systems (IS) success model by including measures of specific GAS capabilities as independent variables and audit benefits as the dependent variable. The audit-related uses of GAS focused on were detecting:

- material misstatements;
- control deficiencies; and
- fraud.

Expectations are that these antecedents will potentially capture major reasons for auditors' perceptions of overall usefulness of GAS and extent of use. Further, downstream from their perceptions of usefulness and use, the study explores experienced GAS users to report the connections between using GAS and overall audit effectiveness and efficiency. We also measured other independent constructs, system and service quality from the IS Success model using ease of use and training received. Though secondary to our overall a purpose, a noteworthy contribution in this research is the adaptation of the IS success model to study GAS use in the audit context.

We find that financial auditors' reason for GAS use is narrower in that only detecting material misstatements is a significant contributor to their perceptions of GAS usefulness. In contrast, IT auditors view GAS capabilities of detecting control deficiencies and fraud as significant contributors to their view of GAS usefulness in the audit. While fraud awareness and related demands upon auditors has grown, financial auditors do not consider the opportunity to detect fraud through technology use, whereas IT auditors do.

As expected, usefulness of GAS affects the extent of GAS use for both types of auditors. Yet, we find that only for financial auditors does usefulness impact their satisfaction with

GAS. Again, for only financial auditors does the level of training they receive influence the extent to which they use GAS in the audit. Only for IT auditors does ease of use affect subjects' satisfaction with GAS. We discuss that a plausible explanation as to why IT auditors find that ease of use impacts their satisfaction might be their more extensive use of GAS (i.e. more complex features) coupled with broader technology skill set. Yet, for financial auditors, a narrower use of GAS may lead to a simpler GAS use experience overall and why ease of use is not important as a contributor to their GAS satisfaction. This interpretation has practical implications for training and support as well as cross-training between IT and financial auditors. As financial auditors move from less sophisticated and narrow use-cases of GAS, training will need to first address usefulness from the financial auditor perspective.

As the results show the more that GAS users use the technology then the higher their perceptions of audit efficiency and effectiveness, then future research and practice should continue exploring how to expand GAS use further. Of course, coupled with this claim should be more objective measurements regarding the GAS impact on the audit. Finally, another contribution of this study is to motivate continued and even broader investigation into IT integration into the audit and the various specialist collaborations that are currently emerging in practice.

The remainder of the paper is divided into six sections. The next section presents the pertinent literature on GAS, followed by a brief discussion of the D&M IS Success Model (DeLone and McLean, 2003). Then, an adapted GAS Success Model is presented along with hypotheses. Following the research methodology and results sections, the paper continues with discussion and conclusions.

Literature review

Generalized audit software

GAS are applications used to assist in analyzing data to support audit tasks (Ahmi and Kent, 2013). They enable auditors to import and organize data, perform specific routines on client data, such as analyze, sort, summarize, stratify, calculate and convert to audit a complete population instead of merely a sample (Ahmi and Kent, 2013). These tools assist auditors in checking clients' financial information for quality, completeness, accuracy and consistency (Rezaee *et al.*, 2002).

GAS facilitates compliance with audit standards, such as Auditing Standard (AS) 1105: Audit Evidence[1], which dictates that auditors must obtain appropriate audit evidence sufficient to support the audit opinion (Public Company Accounting Oversight Board, 2018a). PCAOB audit quality inspections have noted deficiencies in the execution of audit engagements that could have been addressed using GAS, such as a failure to test the accuracy and completeness of system reports and spreadsheets used in the operation of controls and to appropriately test automated controls (Public Company Accounting Oversight Board, 2016a; Public Company Accounting Oversight Board, 2017a; Public Company Accounting Oversight Board, 2017b; Public Company Accounting Oversight Board, 2017c).

Prior research has indicated that using GAS improves audit efficiency, effectiveness and quality (Brown-Liburd *et al.*, 2015; Braun and Davis, 2003). However, the AIS literature has shown that GAS acceptance by auditors is lower than expected (Debreceny *et al.*, 2005; Curtis *et al.*, 2009; Kotb *et al.*, 2012). These findings are consistent with Janvrin *et al.* (2008) and Kim *et al.* (2016), who find that advanced IT functionalities have not been fully exploited in the audit. To address these issues, this study chooses to focus on self-identified users of GAS because the issue may not be about acceptance vs. non-acceptance, but rather about the level and type of use.

Most GAS research has focused on the use by either external or internal auditors, mainly examining reasons for its low adoption rate (Widuri *et al.*, 2016). Several studies have found that auditors perceive GAS to be complex and lack the confidence to exploit its capabilities because they feel undertrained (Ahmi and Kent, 2013; Debreceny *et al.*, 2005; Kim *et al.*, 2009). Other studies have found that high implementation costs and a short-term audit budget and evaluation period prevents some auditors from employing GAS (Ahmi and Kent, 2013; Curtis and Payne, 2008). Research has suggested that deterrents to GAS adoption can be alleviated by a longer term budget and evaluation period of staff and approvals of remote superiors (Curtis and Payne, 2008; Curtis and Payne, 2014).

Only a small fraction of the GAS research has focused on perceptions between different types of auditor roles (as this study does). In one study, Henderson *et al.* (2016) applied the Dual Factor theory (Cenfetelli, 2004) to compare internal and external auditor perceptions of the enablers and inhibitors of GAS use. Findings in that study were that perceived threat of the technology negatively influenced auditors' use and perceived usefulness of GAS, whereas system problems negatively influenced perceived usefulness and perceived ease of use of GAS. The study also found that the effect of perceived threat of GAS usage was stronger for internal auditors. Stoel *et al.* (2012) compares differences between what financial and IT auditors rank as important to IT audit quality. Interestingly, of their 54 survey questions to these auditors, the question about whether "Computer-assisted auditing tools (CATs, e.g. audit command language [ACL]) are used for testing and analysis" ranked in the bottom ten in terms of perceived impact on IT audit quality, with little difference between IT and financial auditors. The current study teases out the uses of GAS in the financial and IT audits to determine if there are differences in perception when applying a more comprehensive view through the DeLone and McLean IS success model (DeLone and McLean, 2003).

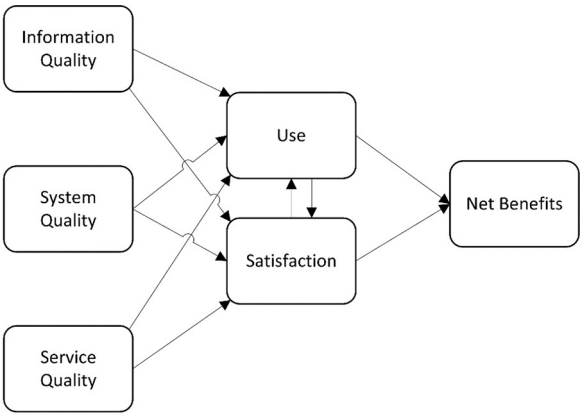
DeLone and McLean's (2003) information systems success model

Throughout the years, IS researchers have proposed various theories to understand factors contributing to systems success. However, the D&M IS success model (DeLone and McLean, 2003) is the most widely cited theory in the literature (Lowry *et al.*, 2007). This model identifies six factors for IS success:

(1) system quality;
(2) information quality;
(3) service quality;
(4) use;
(5) user satisfaction; and
(6) net benefits (Figure 1).

In short, this theory posits that information quality, service quality, and system quality will have a positive effect on net benefits if the end user feels satisfied with the system and uses it (Tam and Oliveira, 2016). D&M's model contributes to our understanding of IS success in two ways:

(1) first, it provides a structure for categorizing the multitude of IS success measures that have been employed in the literature; and
(2) second, it creates a structure of temporal and causal interdependencies between the categories (Wang, 2008).



Source: DeLone and McLean (2003)

Figure 1.
DeLone and McLean IS success model

Studies using the D&M model as the theoretical basis focus on the success of systems ranging from those that affect a large number of users, such as an enterprise resource planning system (Bernroider, 2008; Tsai *et al.*, 2012) to those that affect only a subset of employees, such as a knowledge management system (Velasquez *et al.*, 2009). Furthermore, researchers have used employed various measures for the success measures[2].

Adapting the D&M model for GAS success and hypotheses development

By adapting the D&M Model for GAS success, this study's aim is to identify GAS relevant construct measures, including GAS-specific antecedents that relate to the major constructs of the D&M model. A few other assumptions about employing the D&M model are noteworthy. The adapted version of the D&M Model, as seen in Figure 2, like Figure 1,

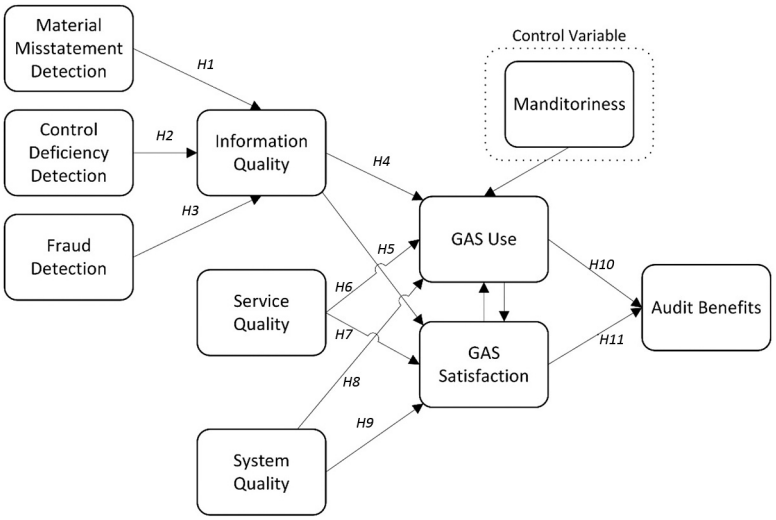


Figure 2.
IS success model adapted for GAS success

continues to be a model with all positive relationships among variables (i.e. all relationships numbered in the proposed models are positive – an increase in X leads to an increase in Y). This study does not anticipate that adapting and using measures related to GAS and audit benefits will change relationships among variables from positive to negative. However, this research investigates differences in strength between financial and IT auditors. In other words, findings may offer evidence to show that financial auditors value a GAS capability whereas IT auditors do not.

Prior research has measured information quality by focusing on perceived usefulness of a system (McKinney *et al.*, 2002) or the usefulness of the output of a system (Petter *et al.*, 2009). This study assumes that the GAS features used to manipulate and analyze information leads to quality outputs used in an audit context. The paper looks at three audit-focused antecedents to information quality. These include GAS's efficacy in detecting:

- material misstatements;
- control deficiencies; and
- fraud[3].

The study compares the influence of these antecedents of information quality between financial and IT auditors.

For auditors, perceiving GAS to be useful for detecting material misstatements should lead to an improvement in the perception of overall GAS information quality (i.e. usefulness). For financial auditors, the concept of assessing the risk of and considering the nature, timing, and extent of testing for material misstatements is more of a direct (first-order effect) involving quantitative and economic judgment to the financial statements. AICPA (2011) and Public Company Accounting Oversight Board (2016b) standards emphasize amounts of what constitutes a material misstateme006Et, considering the precision and degree of certainty in planning as well as in testing. This is not to state that the materiality threshold is fixed, after which no judgment is required in determining the qualitative nature of such misstatements, but rather to emphasize the quantitative and economic dominant perspective. Alternatively, for IT auditors assessing materiality involves considering more qualitative and secondary effects of any control or fraud related issues. The distinction is evident when reviewing the Information Systems Audit and Control Association (ISACA) (2014). In this guideline, materiality between IT and financial auditors is contrasted as follows:

> IS professionals require a different yardstick to measure materiality, as compared to their colleagues working on financial audit engagements. Financial professionals normally measure materiality in monetary terms, because what they audit is also measured and reported in monetary terms. IS professionals normally perform audits of non-financial items, e.g., program development controls, program change controls, physical access controls, logical access controls and computer operation controls on a variety of systems (ISACA).

The standard further addresses that materiality is a matter of professional judgement related to whether an enterprise can meet its business objectives. In working on financial processing systems, the guide asks IT auditors to consider the financial professional's measure of materiality. Accordingly, we posit that IT auditors are less likely approach their GAS use with the objective to find material misstatements as these are secondary judgments based on findings of non-financial items.

IT auditors are generally tasked with examining IT controls for deficiencies, while financial auditors look for control deficiencies in manual controls (not using GAS). Thus, IT auditors should perceive the ability of GAS in detecting control deficiencies (i.e.

configuration, logical access, monitoring) to be positively related to information quality. GAS enables auditors to examine 100 per cent of transactions to validate whether certain transactions comply with a specific configured control rule, or if there is an indication of activities occurring in the information system for which no control has been implemented (Verver, 2008). As an example, using GAS, auditors can download purchase invoice, goods receipt, and vendor invoice transaction tables, join them, and verify that a configured three-way match is working (including tolerance limits for over and under deliveries). Auditors can also check logical access controls by downloading the same tables, joining by primary keys, and checking the user IDs of who created or changed the transactions to determine if there are segregation of duties violations. GAS can also be used for continuous monitoring in which "all transactions within key business processes are automatically tested for compliance using controls on an ongoing basis and anomalies are identified in a timely manner for management response" (Verver, 2008).

With regard to fraud, financial auditors generally are responsible for fraud brainstorming and considering the likelihood of fraud affecting audit risk (including the use of GAS to do so) as mandated by audit standards (AU 316, PCAOB AS2401). These standards also indicate that CAAT be used for identifying fraud. However, recent surveys of external auditors find that their use of GAS related to fraud is not high (Bierstaker *et al.*, 2014; Abou-El-Sood *et al.*, 2015). While financial auditors have an overall fraud assessment mandate, this does not appear to translate into their daily work and use of GAS. AU 316 (*Consideration of Fraud in the Financial Statement Audit*), approved in 2002, assumes that financial auditors will rely upon IT specialists:

> When information technology (IT) is used in the financial reporting process, journal entries and other adjustments might exist only in electronic form. Electronic evidence often requires extraction of the desired data *by an auditor with IT knowledge and skills or the use of an IT specialist* (AU 316.61, p. 1740, emphasis added).

As these standards and the ones that they replaced (i.e. SAS No. 99) indicate, the expectation of IT specialist involvement related to fraud detection is not new, and the recommendations are made specifically considering the use of GAS for fraud detection. Research also indicates and recommends that fraud brainstorming involving IT auditors improves the number of fraud variables generated (Brazel *et al.*, 2010). More recently, research reported that outside of the financial audit team, the IT auditor is the highest attending specialist in fraud brainstorming (Dennis and Johnstone, 2016). Thus, IT auditors should be aware of the importance of fraud detection. Accordingly, this study makes specific predictions for the three proposed antecedents of information quality for financial and IT auditors:

H1. Only financial auditors will identify GAS use for detecting material misstatement as positively related to information quality.

H2. Control deficiency detection will be positively related to information quality for IT auditors, but unsupported for financial auditors.

H3. Only IT auditors will identify GAS use for fraud detection as positively related to information quality.

Continuing downstream, the information quality of GAS should be positively related to satisfaction with GAS and GAS use. The IS success measure user satisfaction constitutes the user's level of contentment when using technology and is considered one of the most important dimensions of IS success (Urbach and Muller, 2011).The IS success measure of use refers to a recipient's utilization of the system's output (DeLone and McLean, 2003). The

following hypotheses capture the relationships among information quality of GAS, GAS use and GAS satisfaction.

H4. Both financial and IT auditors will identify information quality of GAS as positively related to GAS use.

H5. Both financial and IT auditors will identify information quality of GAS as positively related to GAS satisfaction.

Service quality represents the IT department's support of end-users often measured by responsiveness, reliability, empathy (Petter *et al.*, 2009) and training (Chang and King, 2005). Unlike systems that are supported by a dedicated help desk, GAS is auditor software typically learned in the field or in staff training. Thus, similar to Chang and King (2005), this study measures service quality by perceptions of the level of training received. We expect that because of the presumed IT auditors' technical expertise training will not be as important to their level of GAS use as it will be for financial auditors. However, as training and resources are generally viewed as positive for users' satisfaction of IT we offer the following hypotheses:

H6. Only financial auditors will identify service quality as positively related to GAS use.

H7. Both financial and IT auditors will identify service quality as positively related to GAS satisfaction.

System quality refers to the performance of the system in terms of data accuracy and system accuracy, features, and efficiency (Gable *et al.*, 2008). However, in Urbach and Muller's (2011) meta-analysis of D&M studies, they note that a very common measure for system quality is also perceived ease of use from the technology acceptance model (Davis, 1989). Noting that ease of use could likely affect both satisfaction and use of GAS we expect no differences in how system quality will impact the use of GAS or satisfaction with GAS by financial and IT auditors.

H8. Both financial and IT auditors will identify system quality as positively related to GAS satisfaction.

H9. Both financial and IT auditors will identify system quality as positively related to GAS satisfaction.

The reciprocal relationship between IS use and IS satisfaction has been examined in-depth in prior studies and has widespread support (Urbach and Muller, 2011). Therefore, we do not propose hypotheses for these relationships.

The net benefits dimension of the D&M Model comprises the extent to which an IS contributes to the success of an individual or an organization (Urbach and Muller, 2011)[4]. The addition of "net" in "net benefits" is important as no outcome will be completely positive without any negative consequences (DeLone and McLean, 2003). Surveys of auditors as measured by mean averages on questions about whether users agree that GAS leads to audit benefits (e.g. audit effectiveness and efficiency) have been positive (Braun and Davis, 2003; Rosli *et al.*, 2013). We contend that for both types of auditors, if they employ GAS as part of their audit procedures this should in turn, provide for more relevant, reliable, and timely information and improve the efficiency (cost/time) and effectiveness (quality) of the audit. It is expected that for both financial and IT auditors, satisfaction with GAS will also positively impact audit benefits. Thus, the following hypotheses are proposed:

H10. Both financial and IT auditors will identify GAS satisfaction as positively related to audit benefits.

H11. Both financial and IT auditors will identify GAS use as positively related to audit benefits.

Control variable

Users of a system in a mandatory environment might base their decision about use on a complex set of beliefs, which in turn might have differing influences on relevant variables (Hwang *et al.*, 2017). Even when an organization mandates the use of a system, individuals retain considerable discretion regarding their use of the system's features (Hartwick and Barki, 1994). As "mandatoriness" has been used as a control variable when examining GAS adoption in prior literature (Henderson *et al.*, 2016), we control for it in our study.

Research methodology

Participants

This study was conducted in the USA and targeted at financial and IT auditors who currently use GAS in the audit. A three-phased approach was employed to design the survey instrument. The first phase, construct definition, involved developing valid definitions for each construct by conducting a literature review. In phase two, the initial item development phase, a baseline pool of items for each construct was created (Nunnally, 1978). Initial items were developed by relying on prior research, where possible. New items were developed when the literature review indicated that usable items did not exist for a given construct. The preliminary survey instrument was pretested in a research workshop and later with nine participants, including AIS professors, auditing practitioners, and graduate auditing students. Feedback from the pretest groups was used to refine the instrument and clarify the instructions.

A Web-based survey helped to obtain a much larger sample of respondents than in person and to reduce manual data entry errors (Griffis *et al.*, 2003). A link to the survey was made available to potential users of GAS, and the email described the importance of the survey and offered the chance for a $250 cash prize. Respondents were recruited from several sources:

- the ISACA website;
- a GAS user group LinkedIn page;
- a large GAS vendor; and
- personal contacts in the auditing profession.

A total of 243 participants began the online survey and 232 finished it, resulting in a completion rate of 93 per cent[5]. Data was removed for 26 respondents who had not yet adopted GAS and for 12 respondents who did not complete all questions required for model testing, resulting in 188 responses for measurement and structural model testing.

Measurement of variables

All constructs were measured on a seven-point Likert scale where 1 = "strongly disagree," 4 = "neutral" and 7 = "strongly agree." Additional questions collected data on respondents' demographics and audit-related characteristics. See Appendix for survey questions, constructs, and sources. All questions were identical for both financial and IT auditors

except for the question asking whether GAS improves the overall effectiveness of the IT (for IT auditors) or financial (for financial auditors) audit. Single items were used for most measures in the research model. This is acceptable in situations when the instrument is long (Straub *et al.*, 2004) and when constructs are unambiguous, focused (Sackett and Larson, 1990), and concrete (Bergkvist and Rossiter, 2007), which applies to the single-item constructs in our research model.

Demographics

Table I presents respondents' demographics (Panel A) and characteristics (Panel B). The majority of the sample is males (62 per cent), 40 years old or younger (63 per cent) and working in the USA (92 per cent). Respondents primarily hold the CPA certification (53 per cent), followed by the CISA (30 per cent) and CIA (18 per cent). Respondents work in a wide range of industries, with the largest proportion in accounting (40 per cent). Panel B reveals that most of the respondents have six years of GAS experience or less (62 per cent) and have a fairly even distribution of time in the audit profession. The majority of our sample work is external auditors (57 per cent) and financial auditors (65 per cent). Most of the sample use IDEA (80 per cent), followed by ACL (24 per cent).

Measurement model results

Table II lists descriptive statistics for the constructs in the research model. The control variable, mandatoriness, is slightly below neutral suggesting that GAS use is generally not mandated, though with more variability than the other measures. Nearly all other measures are in the five (somewhat agree) to above-six (agree) range.

Partial least squares using SmartPLS was used to test the measurement and structural models. The measurement properties of the reflective constructs – system quality and audit benefits – were evaluated, and convergent and discriminant validity was assessed separately for each auditor role[6].

To ensure adequate convergent validity, all item loadings (outer loadings) should be greater than 0.70, indicating that more than half of the variance is captured by the constructs. As shown in Tables III and IV, all item loadings for system quality and audit benefits constructs are greater than 0.70 (shaded cells). As suggested by Gefen *et al.* (2000), the *t*-statistic for each item loading is greater than 1.96. A further test of convergent validity is to ensure that constructs have an average variance extracted (AVE) greater than or equal to 0.50, implying that 50 per cent or more of the indicator variable is accounted for by the latent variable (Chin, 1998). The AVE for system quality and audit benefits for the financial auditor sample is 0.90 and 0.81 respectively and for the IT auditor sample, 0.95 and 0.88, respectively. As such, the AVE for both constructs meet the AVE 0.50 requirement.

Discriminant validity was assessed in two ways. First, the analysis corroborates that each item loaded more strongly on its target construct than on any other construct in the model (Fornell and Larcker, 1981). As shown in Tables III and IV, all items meet this requirement. Second, the square root of the AVE for system quality and audit benefits was larger than its correlation with any other construct (Fornell and Larcker, 1981). As shown in Tables V and VI, system quality and audit benefits meet this requirement. Scale reliability was assessed for system quality and audit benefits via Cronbach's alpha and composite reliability (Fornell and Larcker, 1981). The composite reliability score for system quality and audit net benefits 0.97 and 0.94 for the IT auditor sample and 0.95 and 0.89 for the financial auditor sample. The Cronbach's alpha score for system quality and audit benefits are 0.95 and 0.87 for the IT auditor sample and 0.89 and 0.76 respectively for the financial auditor

	n	(%)
Panel A: Demographics		
Gender		
Male	116	62
Female	70	37
Did not answer	2	1
Age		
Less than 30 years	51	27
30-40 years	67	36
41-50 years	29	15
51-60 years	29	15
Over 60 years	10	6
Did not answer	2	1
CPA	99	53
CISA	57	30
CIA	33	18
CFE	19	10
Other	45	24
None	14	7
Country		
USA	174	92
Other	10	6
Did not answer	4	2
Industry		
Accounting	75	40
Banking and finance	22	12
Government	21	11
Professional services	14	7
Higher education	9	5
Manufacturing	9	5
Professional services	11	6
Oil and gas	2	1
Non-profit	3	1
Tourism and gaming	3	1
Other	12	7
Did not answer	7	4
Panel B: Characteristics		
Length of time using GAS		
Greater than 10 years	29	15
Greater than 6 years and up to 10 years	40	21
Greater than 2 years and up to 6 years	74	40
2 years or less	42	22
Did not answer	3	2
Length of time in audit profession		
More than 15 years	45	24
10-14 years	38	20
5-9 years	71	38
0-4 years	33	17
Did not answer	1	1

(*continued*)

Table I.
Demographics and characteristics

	n	(%)
Type of auditor		
Internal	80	43
External	108	57
Role on audit team		
Financial auditor	122	65
IT auditor	66	35
Type of GAS used*		
IDEA	150	80
ACL	45	24
Other	14	7

Table I.

Note: *Totals and percentages do not add to 188 (100%), as some respondents had multiple certifications and used multiple types of GAS

Type of auditor	Construct	Mean	SD
IT Auditors	System Quality (SYSQUAL)	5.35	1.60
	Service Quality (SERVQUAL)	5.67	1.59
	Information Quality (INFOQUAL)	6.15	1.13
	Control Deficiencies (CONTROLDEF)	5.63	1.35
	Detect Fraud (DETFRAUD)	5.58	1.42
	Material Misstatement (MATMISS)	5.47	1.47
	Use Gas (USEGAS)	6.48	1.09
	User Satisfaction (USERSAT)	6.52	0.73
	Audit Benefits (AUDBEN)	5.85	1.28
	Manditoriness (MAND)	3.89	1.91
Financial Auditors	System Quality (SYSQUAL)	5.11	1.39
	Service Quality (SERVQUAL)	5.08	1.74
	Information Quality (INFOQUAL)	6.18	0.80
	Control Deficiencies (CONTROLDEF)	4.77	1.25
	Detect Fraud (DETFRAUD)	5.29	1.25
	Material Misstatement (MATMISS)	5.08	1.16
	Use Gas (USEGAS)	6.51	0.75
	User Satisfaction (USERSAT)	6.39	0.81
	Audit Benefits (AUDBEN)	5.89	1.01
	Manditoriness (MAND)	3.30	1.92

Table II.
Measurement properties, means and standard deviations

sample. Therefore, all reliability scores exceed the recommended 0.70 cutoff (Nunnally, 1978).

Structural model results

Table VII summarizes the structural model for financial auditors. As shown in Table VII, material misstatement has a significant positive effect on information quality, while control deficiencies and fraud detection do not significantly affect information quality. Information quality has a significant positive impact on GAS use and GAS satisfaction. Service quality (i.e. training) has a significant impact on GAS use, but not on GAS satisfaction. System quality (i.e. ease of use) does not have a significant effect on GAS use or GAS satisfaction. Finally, both GAS use and GAS satisfaction significantly impact audit benefits.

Table III. Cross loadings – financial auditors

Construct	CONTROLDEF	DETFRD	INFOQUAL	MAND	MATMISS	AUDBEN	SERVQUAL	SYSQUAL	USEGAS	USERSAT
CONTROLDEF	*1.00*	0.28	0.30	0.03	0.69	0.37	0.01	0.18	0.14	0.16
DETFRAUD	0.28	*1.00*	0.29	0.15	0.46	0.47	0.15	0.24	0.17	0.34
INFOQUAL	0.30	0.29	*1.00*	0.15	0.40	0.74	0.22	0.43	0.44	0.65
MAND	0.03	0.15	0.15	*1.00*	0.14	0.24	0.24	0.26	0.14	0.22
MATMISS	0.69	0.46	0.40	0.14	*1.00*	0.54	0.13	0.26	0.11	0.26
EFFICIENTAUDIT	0.36	0.53	0.67	0.29	0.59	*0.89*	0.21	0.34	0.32	0.52
EFFECTIVEAUDIT	0.32	0.32	0.66	0.15	0.40	*0.91*	0.19	0.31	0.46	0.52
TRAINING	0.01	0.15	0.22	0.24	0.13	0.22	*1.00*	0.54	0.31	0.14
NOTDIFFICULT	0.18	0.22	0.43	0.27	0.29	0.33	0.56	*0.96*	0.32	0.28
EASYTOUSE	0.16	0.23	0.39	0.23	0.21	0.36	0.47	0.94	0.33	0.17
USEGAS	0.14	0.17	0.44	0.14	0.11	0.44	0.31	0.34	*1.00*	0.32
USERSAT	0.16	0.34	0.65	0.22	0.26	0.58	0.14	0.24	0.32	*1.00*

Note: The significance is $p < 0.05$

Table IV.
Cross loadings – IT auditors

Construct	CONTROLDEF	DETFRD	INFOQUAL	MAND	MATMISS	AUDBEN	SERVQUAL	SYSQUAL	USEGAS	USERSAT
CONTROLDEF	*1.00*	0.68	0.77	0.42	0.68	0.82	0.09	0.59	0.56	0.45
DETFRAUD	0.68	*1.00*	0.69	0.32	0.79	0.65	0.22	0.50	0.65	0.34
INFOQUAL	0.77	0.69	*1.00*	0.38	0.60	0.82	0.18	0.66	0.78	0.51
MAND	0.42	0.32	0.38	*1.00*	0.32	0.42	0.03	0.22	0.43	0.42
MATMISS	0.68	0.79	0.60	0.32	*1.00*	0.63	0.33	0.54	0.49	0.35
EFFICIENTAUDIT	0.80	0.60	0.79	0.36	0.60	*0.93*	0.23	0.65	0.54	0.42
EFFECTIVEAUDIT	0.74	0.63	0.75	0.42	0.58	*0.95*	0.16	0.56	0.61	0.55
TRAINING	0.09	0.22	0.18	0.03	0.33	0.21	*1.00*	0.30	0.09	0.14
NOTDIFFICULT	0.58	0.52	0.65	0.14	0.52	0.62	0.32	*0.97*	0.36	0.41
EASYTOUSE	0.57	0.46	0.63	0.28	0.53	0.63	0.26	*0.98*	0.36	0.58
USEGAS	0.56	0.65	0.78	0.43	0.49	0.62	0.09	0.37	*1.00*	0.33
USERSAT	0.45	0.34	0.51	0.42	0.35	0.53	0.14	0.52	0.33	*1.00*

Note: The significance is $p < 0.05$

Table V. Latent variable correlations, financial auditors

Construct	CONTROLDEF	DETFRD	INFOQUAL	MAND	MATMISS	AUDBEN	SERVQUAL	SYSQUAL	USEGAS	USERSAT
CONTROLDEF	*1.00*									
DETFRAUD	0.28	*1.00*								
INFOQUAL	0.30	0.29	*1.00*							
MAND	0.03	0.15	0.15	*1.00*						
MATMISS	0.69	0.46	0.40	0.14	*1.00*					
AUDBEN	0.37	0.47	0.74	0.24	0.54	*0.90*				
SERVQUAL	0.01	0.15	0.22	0.24	0.13	0.22	*1.00*			
SYSQUAL	0.18	0.24	0.43	0.26	0.26	0.36	0.54	*0.95*		
USEGAS	0.14	0.17	0.44	0.14	0.11	0.44	0.31	0.34	*1.00*	
USERSAT	0.16	0.34	0.65	0.22	0.26	0.58	0.14	0.24	0.32	*1.00*

Note: The italicized data represents the average variance extracted (AVE). There is no significance associated with AVE.

Table VI. Latent variable correlations, IT auditors

	CONTROLDEF	DETFRD	INFOQUAL	MAND	MATMISS	AUDBEN	SERVQUAL	SYSQUAL	USEGAS	USERSAT
CONTROLDEF	*1.00*									
DETFRD	0.68	*1.00*								
INFOQUAL	0.77	0.69	*1.00*							
MAND	0.42	0.32	0.38	*1.00*						
MATMISS	0.68	0.79	0.60	0.32	*1.00*					
AUDBEN	0.82	0.65	0.82	0.42	0.63	*0.94*				
SERVQUAL	0.09	0.22	0.18	0.03	0.33	0.21	*1.00*			
SYSQUAL	0.59	0.50	0.66	0.22	0.54	0.64	0.30	*0.97*		
USEGAS	0.56	0.65	0.78	0.43	0.49	0.62	0.09	0.37	*1.00*	
USERSAT	0.45	0.34	0.51	0.42	0.35	0.53	0.14	0.52	0.33	*1.00*

As indicated in Table VIII, for IT auditors, material misstatement does not have a significant effect on information quality, while control deficiencies and fraud detection do have significant positive effects on information quality. Information quality has a significant positive effect on GAS use, but not GAS satisfaction. Service quality does not have a significant positive effect on GAS use or GAS satisfaction. Finally, system quality has a significant positive effect on GAS satisfaction, but not GAS use.

As shown in Figures 3 and 4, the R^2 for information quality is 17.9 per cent for financial auditors and 64.4 per cent for IT auditors. The R^2 for user satisfaction is 42.1 per cent for financial auditors and 31.7 per cent for IT auditors. The R^2 for GAS use is 24.5 per cent for financial auditors and 67 per cent for IT auditors. Finally, the R^2 for audit benefits is 40.5 per cent for financial auditors and 49.9 per cent for IT auditors.

Discussion

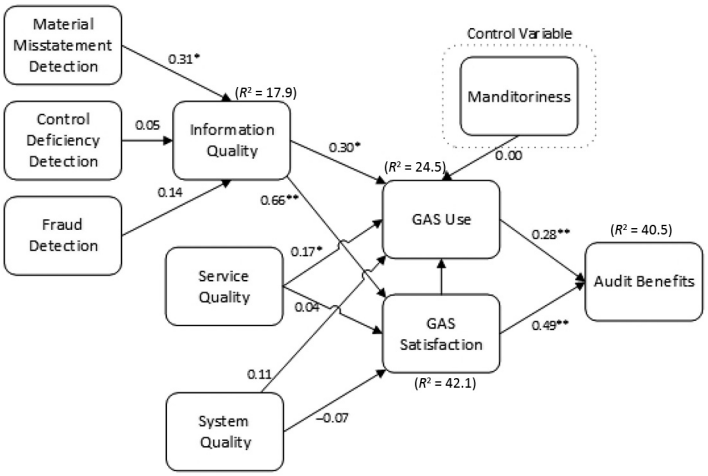
Motivated by the emphasis to employ more IT in the audit owing to clients' increased operational complexity and use of technology (Lowe *et al.*, 2018), this study focuses on a well-known but underused audit technology, GAS, and how IT and financial auditors compare in their perceptions of use. As further motivation for the study, accounting professional and educational associations have called for increased usage of IT and data analytics in accounting practice (AACSB, 2014; PwC, 2015), and the Public Company Accounting Oversight Board (2017d) is closely following how IT is being incorporated into audits in a way that exercises due care and alignment with audit objectives.

Hypothesis	Path	Path coefficient	*T*-statistic	*P*-value
H1	MATERIALMISS → INFOQUAL	0.31	2.30	$p < 0.05$
H2	CONTROLDEF → INFOQUAL	0.05	0.42	NA
H3	DETFRAUD → INFOQUAL	0.14	1.45	NA
H4	INFOQUAL → USEGAS	0.30	2.18	$p < 0.05$
H5	INFOQUAL → USERSAT	0.66	8.00	$p < 0.01$
H6	SERVQUAL → USEGAS	0.17	1.70	$p < 0.05$
H7	SERVQUAL → USERSAT	0.04	0.35	NA
H8	SYSQUAL → USEGAS	0.11	0.86	NA
H9	SYSQUAL → USERSAT	−0.07	0.91	NA
H10	USEGAS → AUDBEN	0.28	3.01	$p < 0.01$
H11	USERSAT → AUDBEN	0.49	6.67	$p < 0.01$

Table VII. Structural model results, financial auditors

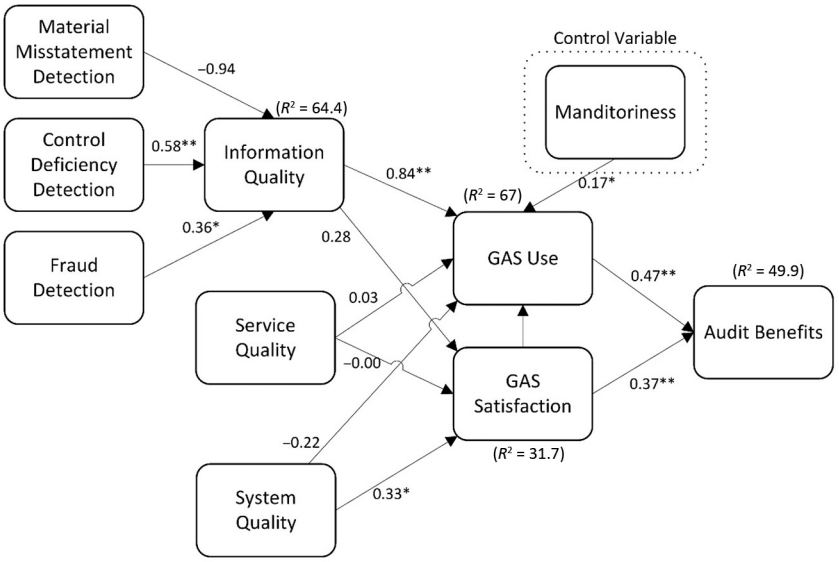
Hypothesis	Path	Path coefficient	*T*-statistic	*P*-value
H1	MATERIALMISS → INFOQUAL	−0.94	0.41	NA
H2	CONTROLDEF → INFOQUAL	0.58	4.15	$p < 0.01$
H3	DETFRAUD → INFOQUAL	0.36	2.10	$p < 0.05$
H4	INFOQUAL → USEGAS	0.84	5.02	$p < 0.01$
H5	INFOQUAL → USERSAT	0.28	1.33	NA
H6	SERVQUAL → USEGAS	0.03	0.05	NA
H7	SERVQUAL → USERSAT	−0.00	0.13	NA
H8	SYSQUAL → USEGAS	−0.22	1.43	NA
H9	SYSQUAL → USERSAT	0.33	1.85	$p < 0.05$
H10	USEGAS → AUDBEN	0.47	3.24	$p < 0.01$
H11	USERSAT → AUDBEN	0.37	3.12	$p < 0.01$

Table VIII. Structural model results, IT auditors



Notes: *$p < 0.05$; **$p < 0.01$

Figure 3.
Results for the financial auditor sample



Notes: *$p < 0.05$; **$p < 0.01$

Figure 4.
Results for the IT auditor sample

This study contributes to GAS research by comparing perceptions of two auditor roles, financial and IT. Much of GAS research has studied homogenous groups of auditors without comparison between roles (Debreceny *et al.*, 2005) – bank auditors; Curtis and Payne (2014) – external auditors; Kim *et al.* (2016) – internal auditors.

This study adapts the DeLone and McLean IS success model (DeLone and McLean, 2003) by emphasizing audit uses of GAS and how these influence perceived information quality (usefulness). The results show that financial auditors view GAS as useful for detecting material misstatements only, while IT auditors believe GAS is useful for both detecting control deficiencies and fraud. These findings support *H1*, *H2* and *H3* and show that financial auditors are focused on use of GAS within the financial and reporting elements (i.e. material misstatements) of auditing. As companies increase reliance on automated controls and less on manual processes and controls, this does call into question whether financial auditors will move in the direction of expanding their use of GAS use or grow in their reliance upon specialists, such as IT auditors. While financial auditors do not see GAS as useful for detecting fraud, the literature does support that considering fraud (i.e. brainstorming) is higher quality with more diverse specialists involved (i.e. IT, tax and fraud specialists) (Brazel *et al.*, 2010). Perhaps as financial auditors increase their use of GAS in what they are comfortable performing they will better understand and be able to expand their use of GAS into other areas as well, such as in fraud detection. Yet, the driver is likely that financial auditors and IT auditors are simply focused on financial reporting and controls testing, respectively.

The information quality R^2 for financial auditors is much lower than for IT auditors. This suggests that the three audit-related antecedents included in the model far better explain GAS's usefulness for IT auditors than for financial auditors. IT auditors view GAS's usefulness as much higher than do financial auditors. A possible implication is that IT auditors more fully understand how and why GAS is useful for supporting audit objectives. Possibly more education or collaborative training with IT auditors could be useful for financial auditors if they are concerned about their level of involvement in the analytical detection of controls, fraud, and material misstatements. On the other hand, it may be that financial auditors value GAS, but do not possess skills and/or the work assignments are not aligned with using GAS for these purposes.

Support was found for *H4*, in that both auditor types identify information quality (usefulness) as positively related to GAS use. However, support was not found for *H5*, which posited that both auditor types would identify information quality (usefulness) as positively related to GAS satisfaction; only results from financial auditors indicated a positive relationship between the usefulness of GAS and satisfaction with GAS. In this regard, an area of future research could be further study of mandatoriness and its influence on the relationship between usefulness and satisfaction. The model accounted for perceptions of whether GAS use was mandatory and results indicate that mandatoriness positively impacts usage for IT auditors, but not for financial auditors. Prior research has explored how the use of mandated systems can be inherently dissatisfying (Bhattacherjee *et al.*, 2018) and this may be why for IT auditors there was no relationship between usefulness and satisfaction. The logic stated from the perspective of an IT auditor might be, "Since I have to use it, whether or not I am satisfied with using it depends upon how easy it is to use in my work." System quality (ease of use) was the only factor to influence GAS satisfaction for IT auditors.

Service quality (i.e. training) is significantly related to GAS use for financial auditors, but not for IT auditors, supporting *H6*. This implies that for financial auditors, more and better kinds of training could affect their use of GAS in the audit. Many companies are moving towards different types of operational and regulatory training to address the millennial demographic such as concise messages that emphasize visuals and infographics vs longer training exercises once a year. However, training does not significantly impact either auditor's satisfaction with GAS, so *H7* is unsupported.

Related to service quality future research could consider more refined analysis and extent of alignment of training for both auditor types. While training may be perceived as sufficient to use GAS, it may not be enough to improve users' efficient usage of the software,

leading to a lack of related GAS satisfaction for both IT and financial auditors[7]. Next, it is plausible that the effect of training is mediated by other variables, such as system quality or information quality. For example, perhaps training impacts perceptions of the benefits of using GAS (information quality), which then impacts use and satisfaction. While positing these relationships were outside the scope of our DeLone and McLean-based model, future research could explore these additional relationships.

System quality (ease of use) is not significantly related to GAS use for either financial or IT auditors, so *H8* is unsupported. This is somewhat surprising as ease of use has strong support in prior literature. System quality is significantly related to GAS satisfaction for only IT auditors, so *H9* is unsupported. Perhaps financial auditors' use of GAS is narrower, as the results suggest, and that their use of the software is not as technical enough to make the question of ease of use less of an issue. Other reasons may be a high level of maturity of software design[8], and in combination with this maturity users have a higher overall fluency of technology use (Stephan *et al.*, 2017). More interestingly, however, is that IT auditors do find that ease of use is impactful to their GAS use satisfaction. An explanation for this may be that as they are using GAS more extensively, that ease of use in the advanced features is more important to them.

The R^2 for GAS use is much lower for financial auditors. Manditoriness, information quality (usefulness) system quality (ease of use) and service quality (training) explains more variance for IT auditors than they do for financial auditors. The implication here for financial auditors is to emphasize the information quality (usefulness) of GAS through certain means such as education. Additionally, IT auditors view GAS use as influenced by mandatoriness whereas financial auditors do not. Averages for this item for IT and financial auditors, 3.89 and 3.30 respectively, are fairly low so many are not seeing GAS as a tool that their firms and/or superiors are requiring them to use. While higher expectations or mandates may increase use, this would likely need to be motivated through both technical and use-case training (service quality) examples.

The R^2 for GAS satisfaction is higher for financial auditors with only one antecedent significant – information quality (usefulness). This implies that for financial auditors only information quality as is important for whether they are satisfied with GAS use. As noted above, for IT auditors, only system quality (ease of use) impacts their satisfaction with GAS. Implications for these findings suggest that training with use-case examples to focus on GAS usefulness would be helpful for financial auditors. Yet, venturing into new use-cases or wider use as the IT auditors are doing, reinforces that ease of use takes on a more important role. In this case, expanding financial auditor's use of GAS may lead to them caring more about ease of use. With the myriad of audit analytics tools on the market, these results suggest that GAS vendors should continue to work on ease of use and that especially for sophisticated use-cases improving ease of use is likely important.

The R^2 for audit benefits is somewhat lower for financial auditors. This implies that for IT auditors, they perceive the use of GAS and their satisfaction with GAS to impact audit efficiency and effectiveness more. *H10* and *H11* are supported.

Limitations

A limitation in this study (and opportunity for future research) entails adding additional dependent variables that measure more objectively and directly audit effectiveness and efficiency. In assessing the overall impact, this study uses GAS adopters' individual perceptions of the overall audit effectiveness, and for efficiency we focus on their perception of personal efficiency. As the audit effectiveness question is worded without reference to their own personal audit effectiveness we assume, but cannot guarantee, that they responded to the perspective of the overall audit team's performance. It seems plausible that

an individual would possess an awareness of the overall audit effectiveness because even junior-level auditors are quite conscious of the budgeted engagement hours. With regard to efficiency, it also seems appropriate to direct the issues more pointedly at their personal efficiency based on their experience of working with GAS. However, this too would benefit from future research to incorporate the combination of individual perception along with objective and direct measures of audit engagement efficiency and effectiveness. It seems plausible as well that these overall audit improvements would take time to become visible as new GAS capabilities deployed across clients and users become more fluent in their use.

Conclusions

GAS is in a state of maturity to where it is possible to identify users from different auditor groups (55 per cent have used GAS for more than two years). Even with a well-established software audit tool among auditors that have more commonalities than typical users across an organization and a common overall objective, this study finds differences regarding technology use related to audit benefits. Thus, there is benefit to studying auditors across their different auditor role types rather than as a single group of GAS users. Our results show that there are differences based on auditor type. The well-established D&M IS success model (DeLone and McLean, 2003) posits generally positive relationships from system capabilities (i.e. information quality) to use and satisfaction leading to net benefits. Interestingly, on the surface, it may be considered obvious that for experienced users, quality of data and capabilities that facilitate objectives, and ease of system use should lead to use and satisfaction. Yet, this is a domain where baseline comparisons need to be considered given that prior research does indicate some potential variability support across contexts (Urbach and Muller, 2011). From practical experience in auditing, these results confirm the nuanced relationship that overlaps with some similarities and differences when it comes to technology use. These results also provide awareness to firms investing in and deploying GAS in terms of how to motivate different user types to consider and effectively employ GAS. For example, software trainers and developers should know their audience to customize training with specific use-cases and highlighting how the tool accomplishes the intended goal and how it will directly impact audit effectiveness and efficiency – both personal and engagement level.

Other practical trends motivated this work and should foster continued research regarding use of GAS and other audit technologies. First, calls for increased technology use to support the audit, including GAS, are unlikely to go away (Braun and Davis, 2003). Research indicates that IT use in audits continues to grow and demand is expected to continue (Lowe *et al.*, 2018). Second, as technology gains sophistication, not all skills sets may be practically attainable through upgrading the skills of only IT and financial auditors. Thus, firms are and will likely continue diversifying audit teams by relying on and closely coordinating work with specialists to capture potential audit benefits. Audit firms are increasingly hiring professionals with diverse skill sets outside of accounting to meet their various specialty needs[9].

As auditors and specialists work tightly together with a narrow scope of work objectives (Bauer and Estep, 2017) more attention to the nuances of how professionals perceive differences in software as well as their actual use should continue to be explored. There may be opportunities to better cross-train between specialists and financial auditors so that over time the auditor technology fluency improves more markedly. Another reason might be that technology fluency coupled with the appropriate audit background may lead to novel applications of technology that would otherwise go unnoticed. We might even make an argument that the profession's slower adoption of GAS, and the currently limited in scope

use presented in this research, is an illustration of what happens when opportunities are off-loaded to the specialists.

Research that explores across groups' differing perceptions and backgrounds in technology use would add to a limited body of accounting and auditing research. For example, research could directly explore the underling basis of role differences through measures related to education, experience, and cognitive drivers relevant to using IT. Theory related to this approach might leverage the concept of technology frames (Orlikowski and Gash, 1994), which describe different types of users' cognitive structures as technological frames, which are "the core set of assumptions, expectations, and knowledge of technology collectively held by a group or community" (p. 199). Exploring these would facilitate a more nuanced understanding of the perceptual differences between IT and financial auditors with respect to the decision to adopt and the extent to which they use GAS. Deeper exploration involving technology frames would also benefit from qualitative data, in the form of open-ended survey questions and interviews to better understand how financial and IT auditors use GAS in the audit. A deeper dive may also explore, through quantitative or qualitative methods, to better understand how individual's perceive audit benefits relative to differing uses of GAS with which they are less familiar. To sum up, we hope that continued research will further explore opportunities and challenges from innovative technology use and diversity of professional expertise increases in auditing.

Notes

1. Previously AS No. 15. Reference to standards was updated based on the reorganization of PCAOB auditing standards, which was effective as of December 31, 2016.
2. According to DeLone and McLean (2003), selection of the success dimensions and measures should be contingent on the objectives and context of the research study.
3. While it is true that material misstatements include fraudulent financial reporting (Public Company Accounting Oversight Board, 2018b) we are interested in fraud in a general sense and thus include it as a separate information quality antecedent in the model adaptation.
4. According to Urbach and Muller (2011), the decision on which impact should be measured depends on the system being evaluated, the purpose of the study and the level of analysis.
5. There is no way of knowing how many people viewed the survey posted on the various websites. Those receiving the invitation letter containing the hyperlink to the survey could have passed it along to other auditors. Therefore, following Davis and Tuttle (2013) and Henderson *et al.*'s (2012), this study reports the completion rate instead of the response rate.
6. A reflective construct is where the indicators of a construct are considered to be caused by that construct – system quality and audit benefits are the reflective constructs in the model.
7. In this study we operationalized audit benefits as comprising both efficiency and effectiveness. Further research could attempt to distinguish the impact of training related to both efficient and effective use of GAS.
8. Include for endnote/footnote. ACL was established in 1987 and Idea in 1988. See: https://idea.caseware.com/about/about-us/ and https://www.ithistory.org/db/companies/acl-services-ltd
9. Currently, anecdotal and observation of Big 4 accounting firm hiring trends suggest that they are not waiting to develop financial auditors into technology or other subject-matter specialists. Thus, firms are adding a variety of other professional capabilities, including data scientists and software engineers.

References

AACSB (2014), "AACSB international accounting accreditation standard A7: information technology skills and knowledge for accounting graduates: an interpretation", available at: www.aacsb.edu/~/media/AACSB/Publications/white-papers/accounting-accreditation-standard-7.ashx (accessed 10 April 2019).

Abou-El-Sood, H., Kotb, A. and Allam, A. (2015), "Exploring auditors' perceptions of the usage and importance of audit information technology", *International Journal of Auditing*, Vol. 19 No. 3, pp. 252-266.

Ahmi, A. and Kent, S. (2013), "The utilisation of generalized audit software (GAS) by external auditors", *Managerial Auditing Journal*, Vol. 28 No. 2, pp. 88-113.

American Institute of Certified Public Accountants (AICPA) (2011), *Materiality in Planning and Performing an Audit*, AU-C Section 320, American Institute of Certified Public Accountants (AICPA), Durham.

Bauer, T. and Estep, C. (2017), "One team or two? Investigating relationship quality between auditors and IT specialists: implications for audit team identity and the audit process", available at SSRN: https://ssrn.com/abstract=2579198 (accessed 10 April 2019).

Bergkvist, L. and Rossiter, J.R. (2007), "The predictive validity of multiple-item versus single-item measures of the same constructs", *Journal of Marketing Research*, Vol. 44 No. 2, pp. 175-184.

Bernroider, E. (2008), "IT governance for enterprise resource planning supported by the DeLone-McLean model of information systems", *Information and Management*, Vol. 45 No. 5, pp. 257-269.

Bhattacherjee, A., Davis, C.J., Connolly, A.J. and Hikmet, N. (2018), "User response to mandatory IT use: a coping theory perspective", *European Journal of Information Systems*, Vol. 27 No. 4, pp. 395-414.

Bierstaker, J., Janvrin, D. and Lowe, D.J. (2014), "What factors influence auditors' use of computer-assisted audit techniques?", *Advances in Accounting*, Vol. 30 No. 1, pp. 67-74.

Brazel, J. and Agoglia, C. (2007), "An examination of auditor planning judgements in a complex accounting information system environment", *Contemporary Accounting Research*, Vol. 24 No. 4, pp. 1059-1083.

Brazel, J., Carpenter, T. and Jenkins, G. (2010), "Auditors' use of brainstorming in the consideration of fraud: reports from the field", *The Accounting Review*, Vol. 85 No. 4, pp. 1273-1301.

Braun, R. and Davis, H. (2003), "Computer-assisted audit tools and techniques: analysis and perspectives", *Managerial Auditing Journal*, Vol. 18 No. 9, pp. 725-731.

Brown-Liburd, H., Issa, H. and Lombardi, D. (2015), "Behavioral implications of big data's impact on audit judgment and decision making and future research directions", *Accounting Horizons*, Vol. 29 No. 2, pp. 451-468.

Brynjolfsson, E. and McAfee, A. (2011), "Race against the machine: how the digital revolution is accelerating innovation", *Driving Productivity, and Irreversibly Transforming Employment and the Economy*, Digital Frontier Press, Lexington, Massachusetts.

Cenfetelli, R. (2004), "Inhibitors and enablers as dual factor concepts in technology usage", *Journal of the Association for Information Systems*, Vol. 5 No. 11, pp. 472-492.

Chang, J.C.J. and King, W.R. (2005), "Measuring the performance of information systems: a functional scorecard", *Journal of Management Information Systems*, Vol. 22 No. 1, pp. 85-115.

Chin, W.W. (1998), "The partial least squares approach for structural equation modeling", in Marcoulides G.A. (Ed.), *Modern Methods for Business Research*, Lawrence Erlbaum Associates, Hillsdale, NJ, pp. 295-336.

Curtis, M. and Payne, E. (2008), "An examination of contextual factors and individual characteristics affecting technology implementation decisions in auditing", *International Journal of Accounting Information Systems*, Vol. 9 No. 2, pp. 104-121.

Curtis, M. and Payne, E. (2014), "Modeling voluntary CAAT utilization in auditing", *Managerial Auditing Journal*, Vol. 29 No. 4, pp. 304-325.

Davis, F. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, Vol. 13 No. 3, pp. 319-340.

Curtis, M., Jenkins, J.G., Bedard, J. and Deis, D. (2009), "Auditors' training and proficiency in information systems: a research synthesis", *Journal of Information Systems*, Vol. 23 No. 1, pp. 79-96.

Davis, J. and Tuttle, B. (2013), "A heuristic-systematic model of end-user information processing when encountering is exceptions", *Information and Management*, Vol. 50 Nos 2/3, pp. 125-133.

Debreceny, R., Lee, S., Neo, W. and Toh, J. (2005), "Employing generalized audit software in the financial services sector: challenges and opportunities", *Managerial Auditing Journal*, Vol. 20 No. 6, pp. 605-618.

DeLone, W. and McLean, E. (2003), "The DeLone and McLean model of information systems success: a ten-year update", *Journal of Management Information Systems*, Vol. 19 No. 4, pp. 9-30.

Dennis, S.A. and Johnstone, K.M. (2016), "A field survey of contemporary brainstorming practices", *Accounting Horizons*, Vol. 30 No. 4, pp. 449-472.

Fornell, C. and Larcker, D. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, pp. 39-50.

Gable, G., Sedera, G. and Chan, T. (2008), "Re-conceptualizing information system success: the is-impact measurement model", *Journal of the Association for Information Systems*, Vol. 9 No. 7, pp. 77-408.

Gefen, D., Straub, D. and Boudreau, M. (2000), "Structural equation modeling and regression: guidelines for research practice", *Communications of the Association for Information Systems*, Vol. 4 No. 7, pp. 1-57.

Griffis, S.E., Goldsby, T.J. and Cooper, M. (2003), "Web-based and mail surveys: a comparison of response, data, and cost", *Journal of Business Logistics*, Vol. 24 No. 2, pp. 237-258.

Hartwick, J. and Barki, H. (1994), "Explaining the role of user participation in information system use", *Management Science*, Vol. 40 No. 4, pp. 440-465.

Henderson, D., Bradford, M. and Kotb, A. (2016), "Inhibitors and enablers of GAS usage: testing the dual factor theory", *Journal of Information Systems*, Vol. 30 No. 3, pp. 135-155.

Henderson, D., Sheetz, S. and Belanger, F. (2012), "Explaining developer attitude toward using formalized commercial methodologies: decomposing perceived usefulness", *Information Resources Management Journal*, Vol. 25 No. 1, pp. 1-20.

Hwang, Y., Chung, J., Shin, D. and Lee, Y. (2017), "An empirical study on the integrative pre-implementation model of technology acceptance in a mandatory environment", *Behaviour and Information Technology*, Vol. 36 No. 8, pp. 861-874.

Information Systems Audit and Control Association (ISACA) (2014), "Is audit and assurance guideline. 2204 materiality", available at: www.isaca.org/Knowledge-Center/ITAF-IS-Assurance-Audit-/IS-Audit-and-Assurance/Pages/Guideline-2204-Materiality.aspx

Janvrin, D., Bierstaker, J. and Lowe, D.J. (2008), "An examination of audit information technology use and perceived importance", *Accounting Horizons*, Vol. 22 No. 1, pp. 1-21.

Kim, H., Kotb, A. and Eldaly, M. (2016), "The use of generalized audit software by Egyptian external auditors: the effect of audit software features", *Journal of Applied Accounting Research*, Vol. 17 No. 4, pp. 456-478.

Kim, H.J., Mannino, M. and Nieschwietz, R. (2009), "Information technology acceptance in the internal audit profession: impact of technology features and complexity", *International Journal of Accounting Information Systems*, Vol. 10 No. 4, pp. 214-228.

Kotb, A., Roberts, C. and Sian, S. (2012), "E-business audit: advisory jurisdiction or occupational invasion?", *Critical Perspectives on Accounting*, Vol. 23 No. 6, pp. 468-482.

Lim, J.H., Dehning, B., Richardson, V.J. and Smith, R.E. (2011), "A meta-analysis of the effects of IT investment on firm financial performance", *Journal of Information Systems*, Vol. 25 No. 2, pp. 145-169.

Lowe, D.J., Bierstaker, J., Janvrin, D.J. and Jenkins, J.G. (2018), "Information technology in an audit context: have the big 4 lost their advantage?", *Journal of Information Systems*, Vol. 32 No. 1, pp. 87-107.

Lowry, P.B., Karuga, G.G. and Richardson, V.J. (2007), "Assessing leading institutions, faculty, and articles in premier information systems research journals", *Communications of the Association for Information Systems*, Vol. 20 No. 16, pp. 142.

McKinney, V., Kanghyun, Y. and Zahedi, F. (2002), "The measurement of web-customer satisfaction: an expectation and disconfirmation approach", *Information Systems Research*, Vol. 13 No. 3, pp. 296-315.

Nunnally, J.C. (1978), *Psychometric Theory*, 2nd ed., McGraw-Hill, New York, NY.

Orlikowski, W.J. and Gash, D.C. (1994), "Technological frames: making sense of information technology in organizations", *ACM Transactions on Information Systems*, Vol. 12 No. 2, pp. 174-207.

Petter, S., DeLone, W. and McLean, E. (2009), "Information systems success: the quest for the independent variables", *Journal of Management Information Systems*, Vol. 29 No. 4, pp. 7-62.

Public Company Accounting Oversight Board (2016a), "Report on 2015 inspection of KPMG LLP", available at: https://pcaobus.org/Inspections/Reports/Documents/104-2016-175-KPMG.pdf (accessed 10 April 2019).

Public Company Accounting Oversight Board (2016b), "Substantive analytical procedures: auditing standard (as) no. 2305", PCAOB, Washington, DC, available at: https://pcaobus.org/Standards/Auditing/Pages/AS2305.aspx

Public Company Accounting Oversight Board (2017a), "Report on 2016 inspection of Deloitte and Touche LLP", available at: https://pcaobus.org/Inspections/Reports/Documents/104-2017-198-Deloitte.pdf (accessed 10 April 2019).

Public Company Accounting Oversight Board (2017b), "Report on 2016 inspection of Ernst and Young LLP", available at: https://pcaobus.org/Inspections/Reports/Documents/104-2018-018-Ernst-Young.pdf (accessed 10 April 2019).

Public Company Accounting Oversight Board (2017c), "Report on 2016 inspection of PricewaterhouseCoopers LLP", available at: https://pcaobus.org/Inspections/Reports/Documents/104-2018-001-PricewaterhouseCoopers.pdf (accessed 10 April 2019).

Public Company Accounting Oversight Board (2017d), "Staff inspection brief: information about 2017 inspections", available at: https://pcaobus.org/Inspections/Documents/inspection-brief-2017-3-issuer-scope.pdf (accessed 10 April 2019).

Public Company Accounting Oversight Board (2018a), "Auditing standard no. 1105: audit evidence", available at: https://pcaobus.org/Standards/Auditing/Pages/AS1105.aspx (accessed 10 April 2019).

Public Company Accounting Oversight Board (2018b), "Auditing standard no. 2401: consideration of fraud in a financial statement audit", available at: https://pcaobus.org/Standards/Auditing/Pages/AS2401.aspx (accessed 10 April 2019).

PwC (2015), "Data driven: what students need to succeed in a rapidly changing business world", available at: www.pwc.com/us/en/faculty-resource/assets/PwC-Data-driven-paper-Feb2015.pdf (accessed 10 April 2019).

Rezaee, Z., Sharbatoghlie, A., Elam, R. and McMickle, P. (2002), "Continuous auditing: building automated auditing capability", *Auditing: A Journal of Practice and Theory*, Vol. 21 No. 1, pp. 147-163.

Rosli, K., Yeow, P. and Eu-Gene, S. (2013), "Adoption of audit technology in audit firms", *24th Australasian Conference on Information Systems (ACIS)*, RMIT University, pp. 1-12.

Sackett, P.R. and Larson, J. (1990), "Research strategies and tactics in industrial and organizational psychology", *Handbook of Industrial and Organizational Psychology*, Consulting Psychologists Press, Palo Alto, CA, pp. 419-489.

Stephan, A. Kamen, M. and Bannister, C. (2017), "Tech fluency: a foundation of future careers", available at: www2.deloitte.com/insights/us/en/deloitte-review/issue-21/tech-fluency-mastering-the-language-of-technology.html (accessed 12 April 2019).

Stoel, D., Havelka, D. and Merhout, J.W. (2012), "An analysis of attributes that impact information technology audit quality: a study of IT and financial audit practitioners", *International Journal of Accounting Information Systems*, Vol. 13 No. 1, pp. 60-79.

Straub, D., Boudreau, M.C. and Gefen, D. (2004), "Validation guidelines for is positivist research", *Communications of the Association for Information Systems*, Vol. 13 No. 24, pp. 380-427.

Tam, C. and Oliveira, T. (2016), "Performance impact of mobile banking using the task-technology fit (TTF) approach", *International Journal of Bank Marketing*, Vol. 34 No. 4, pp. 434-457.

Tsai, W.H., Lee, P.L., Shen, Y.S. and Lin, H.L. (2012), "A comprehensive study of the relationship between enterprise resource planning selection criteria and enterprise resource planning system success", *Information and Management*, Vol. 49 No. 1, pp. 36-46.

Urbach, N. and Muller, B. (2011), "The updated DeLone and McLean model of information systems success", *Information Systems Theory*, Springer, London, pp. 1-18.

Velasquez, N., Durcikova, A. and Sabherwal, R. (2009), "Studying knowledge management system success in system administration", paper presented at HI International Conference on System Sciences (HICSS '09), Big Island, HI.

Venkatesh, V., Morris, M., Davis, G. and Davis, F. (2003), "User acceptance of information technology: toward a unified view", *MIS Quarterly*, Vol. 27 No. 3, pp. 425-478.

Verver, J. (2008), "Best practices for the use of data analysis in audit", available at: www.dataconsulting.co.uk/Files/wp_best_practices.pdf (accessed 3 September 2019).

Wang, Y. (2008), "Assessing E-commerce systems success: a respecification and validation of the DeLone and McLean model of is success", *Information Systems Journal*, Vol. 18 No. 5, pp. 529-557.

Widuri, R., O'Connell, B. and Yapa, P. (2016), "Adopting generalized audit software: an Indonesian perspective", *Managerial Auditing Journal*, Vol. 31 Nos 8/9, pp. 821-847.

Further reading

Protivit (2019), "Millennial communication 101", available at: www.protiviti.com/US-en/insights/millennial-communication-101 (accessed 27 April 2019).

Shin, D.H., Lee, S. and Hwang, Y. (2017), "How do credibility and utility play in the user experience of health informatics services?", *Computers in Human Behavior*, Vol. 67 No. C, pp. 292-302.

Appendix

Survey item	Construct	Source
I did not receive enough training to use generalized audit software. (reverse coded)	SERVQUAL	New item developed for this study, based on Braun and Davis, 2003
Using generalized audit software is not difficult to use	SYSQUAL	Adapted from Davis (1989)
Overall, I believe that generalized audit software is easy to use	SYSQUAL	Adapted from Davis (1989)
Overall, generalized audit software is useful in my job	INFOQUAL	Adapted from Davis (1989)
Using generalized audit software increased the likelihood that I will find control deficiencies	CONTROLDEF	New item developed for this study, based on Braun and Davis (2003) and Janvrin *et al.* (2008)
Generalized audit software is useful for helping me to detect fraud during an audit	DETFRAUD	New item developed for this study, based on Braun and Davis (2003) and Janvrin *et al.* (2008)
Using generalized audit software increased the likelihood that I will find material misstatements	MATMISS	New item developed for this study, based on Braun and Davis (2003) and Janvrin *et al.* (2008)
I use generalized audit software	USEGAS	Adapted from Davis (1989)
Using generalized audit software improves the overall effectiveness of the IT audit/ financial statement audits	NETBEN	New item developed for this study, based on Braun and Davis (2003)
I am able to complete audit procedures more efficiently using generalized audit software than I could without it	NETBEN	New item developed for this study, based on Braun and Davis (2003)
Using generalized audit software is a good idea	USERSAT	Venkatesh *et al.* (2003)

Table AI.
Survey items

Corresponding author
Marianne Bradford can be contacted at: mbradfo@ncsu.edu