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A Maturity-level Assessment of Generalised Audit Software: Internal Audit Functions in Australia

Louis Smidt, *Tshwane University of Technology*
Aidi Ahmi, *Universiti Utara Malaysia*
Leandi Steenkamp, *Central University of Technology*
D.P. van der Nest, *Tshwane University of Technology*
Dave Lubbe, *University of the Free State*

The advancement of information technology in today's technologically driven era has had a significant impact on the way corporate organisations are conducting their business, especially in a developed country such as Australia. Consequently, it is now almost impossible to conduct effective and efficient audits without the use of technology-based tools in control environments that are dominated by big data and increasing volumes of electronic audit evidence. Generalised Audit Software (GAS) is one of the most frequently used technology-based tools available for the internal audit function for tests of controls purposes. The objective of this article is to explore the maturity of the use of GAS by internal audit functions in Australia. The literature review reveals that the use of GAS by internal audit functions globally is still at a relatively low level of maturity, despite the increased adoption of information technology and the generation of big data within organisations. Similarly, the empirical results also confirm the low level of maturity in the use of GAS by internal audit functions in Australia. Only 17.4% of the respondents displayed a high level of maturity with regard to the use of GAS.

During the past few decades, the global business environment has seen a dramatic shift towards a so-called 'paperless' business environment (Bierstaker et al. 2001; Carroll 2006; Krahel and Titera 2015; Yu et al. 2000), with today's businesses becoming increasingly reliant on information technology for all processes (Debreceny et al. 2005; Lambrechts et al. 2011). Krahel and Titera (2015) explain that, before this shift, business processes were largely slow and manual. Traditionally, the information technology function was generally situated in a separate business unit in an organisation. However, information systems have evolved to serve many purposes, and now they are fully integrated across organisations, cutting across all business unit functions (Sousa and Oz 2015). Abu-Musa (2008) points out that the use of information technology in business has a number of advantages, such as increasing the accuracy and speed of transaction processing, leading to greater operational efficiency and cost savings, and reducing human error. Conversely, increased use of information technology also brings about an increase in risk, such as data integrity and security risks and possible privacy violations to name but a few (Hall 2013; Schroeder and Singleton 2010).

Issa (2013) explains that the increasing technological advances in businesses have inevitably lead to the creation and storing of massive amounts of data, almost exclusively offered in electronic format – a phenomenon commonly referred to as 'big data'. While there are a number of different definitions of big data, a common thread is that big data is an amplification or expansion of the types, amount and level of detail of data that are collected and stored (Sousa and Oz 2015). In the early 2000s, the challenges surrounding big data management were defined around three dimensions, namely volume, velocity and variety (Laney 2001), and in recent years a fourth dimension was added, namely veracity (IBM 2012). Firstly, the volume of big data suggests its enormity (Vasarhelyi et al. 2015). Secondly, velocity proposes that data are available in real time and added at high speed on a continuous basis (Zhang et al. 2015). Thirdly,

Correspondence: Louis Smidt, Tshwane University of Technology, Tshwane Univeristy of Technology, Staatsartillerie Road, Philip Nel Park, Pretoria, 0183, South Africa. Tel: +27 12 382 0717; email: smidtla@tut.ac.za

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the variety or type of big data implies that big data originates not only from traditional transactional data, but also from numerous other sources such as podcasts, blogs, social media and internet traffic (Sousa and Oz 2015). Finally, as explained by Yoon et al. (2015), veracity refers to having to obtain truthful information from big data (see also Moffitt and Vasarhelyi 2013; Cao et al. 2015). The concept of big data not only poses challenges in terms of data management, but also brings about additional challenges in safeguarding the confidentiality, integrity and availability of big data (The Institute of Internal Auditors 2012; Liu et al. 2015). Cockcroft and Russel (2018) also support this view. In addition, this increase in the number of transactions and the volume of client data has had a significant and direct impact on the internal auditing profession. Internal auditors have had to revisit the manner in which they collect audit evidence in order to achieve predetermined engagement objectives in an efficient manner. Accordingly, the Institute of Internal Auditors (IIA) (the authoritative professional body representing the global internal audit profession), in the latest edition of its International Standards for the Professional Practice of Internal Auditing (Standards), published Standard 1220.A2 *Due Professional Care*, which requires internal auditors to utilise technology-based tools in the execution of their responsibilities (The Institute of Internal Auditors 2016b).

The IIA (2016b: 24) defines technology-based tools as 'Any automated audit tool, such as generalised audit software (GAS), test data generators, computerised audit programs, specialised audit utilities, and computer-assisted audit techniques (CAATs)'. The most popular and frequently used of these technology-based tools is GAS (Braun and Davis 2003; Debreceny et al. 2005; The Institute of Internal Auditors 2016a; Kim et al. 2009; Lin and Wang 2011; Mahzan and Lymer 2014). GAS enables the internal auditor to extract data from multiple sources (i.e., databases and files) from an organisation's integrated systems in order to conduct detailed analyses of this data (Lin and Wang 2011; Ahmi and Kent 2013). Therefore, this article focuses on the use of GAS as a technology-based audit tool.

Internal audit is seen as a cornerstone of good corporate governance in organisations and can play a vital role in financial as well as non-financial management and accountability (The Institute of Internal Auditors Australia 2016). The definition of Internal Auditing states the fundamental purpose, nature and scope of internal auditing. The Institute of Internal Auditors (2016c) defines the internal auditing function as 'an independent, objective assurance and consulting activity designed to add value and improve an organization's operations. It helps an organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes'.

The most recent revision of the Australian Securities Exchange ASX Corporate Governance Principles and Recommendations, issued by the Australian Corporate Governance Council, has adopted the position that if listed organisations do not have internal audit functions, they have to explain why not (The Institute of Internal Auditors Australia 2016). A recent study by KPMG (2016) also found that an internal audit function was present in 2015 for 78% of S&P/ASX 200 entities. Where an internal audit function was not established, the majority of the entities assigned responsibility to the audit committee or the board.

According to The Institute of Internal Auditors Australia (2016), the Australian Prudential Regulation Authority (APRA) has mandated a requirement for internal audit for financial institutions in the Prudential Standard CPS 510 Governance. Further, in the public sector in Australia, many government entities require internal audit functions to be established. However, the Australian Securities and Investments Commission (ASIC) currently has no specific requirements regarding internal audit (The Institute of Internal Auditors Australia 2016).

This research article originated from an extensive study conducted by Smidt (2016) on the use of GAS by internal audit functions in the South African banking industry, performed in fulfilment of a PhD degree in Auditing. This study has since been successfully extended to internal audit functions in various industries in the following countries, namely, Canada, Columbia and Portugal. This article highlights the research findings with regard to the maturity of the use of GAS by internal audit functions in Australia.

Research Methodology

The primary method of data collection used in this study was a structured online questionnaire (i.e., lime survey) (quantitative method). The quantitative data, for the purposes of this article, were analysed using descriptive statistics.

Bradburn et al. (2004) suggest that a researcher should identify similar studies that can provide guidance in designing a questionnaire. Ahmi (2012), The Institute of Internal Auditors (2016b), Janvrin et al. (2009), Mahzan and Lymer (2008), Pedrosa et al. (2015), Protiviti (2015) and Shamsuddin et al. (2015), among others, have used questionnaires to successfully explore the use of CAATs and GAS by auditors, and have therefore influenced the design and development of the questionnaire that was used for this study. All these studies produced valid and reliable results. Furthermore, a key characteristic of structured questionnaires is that all participants are asked the same questions and given the same response options (Hofstee 2006). This enhances the

Table 1 **Respondents' industry of employment**

Industry type	Government		Private		Non-profit		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Aviation	1	3.6	0	0.0	0	0.0	1	2.0
Education	5	17.9	0	0.0	1	100.0	6	12.0
Federal government	1	3.6	0	0.0	0	0.0	1	2.0
Finance and banking	2	7.1	7	33.3	0	0.0	9	18.0
Government	3	10.7	0	0.0	0	0.0	3	6.0
Health	1	3.6	0	0.0	0	0.0	1	2.0
Human services	1	3.6	0	0.0	0	0.0	1	2.0
Insurance	1	3.6	2	9.5	0	0.0	3	6.0
Local government	6	21.4	0	0.0	0	0.0	6	12.0
State government	3	10.7	0	0.0	0	0.0	3	6.0
Superannuation	1	3.6	0	0.0	0	0.0	1	2.0
Transportation	2	7.1	0	0.0	0	0.0	2	4.0
Utility	1	3.6	0	0.0	0	0.0	1	2.0
Agriculture	0	0.0	1	4.8	0	0.0	1	2.0
Construction	0	0.0	1	4.8	0	0.0	1	2.0
Entertainment	0	0.0	1	4.8	0	0.0	1	2.0
Information technology	0	0.0	1	4.8	0	0.0	1	2.0
Logistics	0	0.0	1	4.8	0	0.0	1	2.0
Mining	0	0.0	2	9.5	0	0.0	2	4.0
Non-profit	0	0.0	1	4.8	0	0.0	1	2.0
Professional services	0	0.0	4	19.0	0	0.0	4	8.0
TOTAL	**28**	**100.0**	**21**	**100.0**	**1**	**100.0**	**50**	**100.0**

comparability and reliability of the answers provided during data analysis (Hofstee 2006; Saunders et al. 2009).

The success of this (and any) study depends on the respondents' understanding and correct interpretation of the questions posed. The questionnaire was therefore distributed to a pilot group prior to being sent to the full database of potential respondents. The pilot group comprised internal audit practitioners, information systems auditors, academic researchers and certified data analysts on the use of GAS to ensure that the questions posed were clear and would generate usable responses. These test respondents were chosen because of their competence in the way GAS is employed by internal audit functions, as well as for their familiarity with the parameters of academic research. The pilot group consisted of four Certified Internal Auditors (CIAs), two Chartered Accountants (CA (SA)), three Certified Information Systems Auditors (CISA) and two ACL Certified Data Analysts (ACDA), a total membership of 11. One member of the pilot group conducts training for the IIA in North America and has 30 years of experience in the use of GAS and data analytics as employed by internal auditors. The research instrument was then modified on the basis of the feedback received from the pilot group.

A final preparatory step involved consulting a professional statistician (a specialist in the use of questionnaires and their interpretation) regarding the validity, reliability and quality of the questionnaire's probable responses. This was done to ensure that the data to be collected would be usable and would lead to meaningful results that could be analysed through the use of descriptive statistics. The questionnaire was then finalised for distribution.

The online questionnaire was then distributed to the full research population of 322 chief audit executives (CAEs) with support from the IIA – Australia. The executive officer and company secretary of the IIA – Australia distributed the online questionnaire to all 322 CAEs who were registered members (at the time of the research) of the IIA in accordance with their membership database. These CAEs were well represented across a number of different industries (as indicated in Table 1), such as aviation, education, federal government, finance and banking, government, health, human services, insurance, local government, state government, superannuation, transportation, utility, agriculture, construction, entertainment, information technology, logistics, mining, non-profit and professional services.

The total number of online questionnaires returned was 50 (a response rate of 15.53%) from the total research population of 322 internal audit organisations that are registered members of the IIA - Australia. Response bias (a general term for a wide range of cognitive biases that influence the responses of participants away from an accurate or truthful response) was considered from two perspectives. The first considered whether there were any systemic influences from different industry sectors which would cause respondents to refuse to respond to the survey. Table 1 indicates that the 50 respondents who returned completed surveys came from all sectors included in the IIA membership population. The second perspective looked at the possibility of whether individual questions would cause the respondent to have an inherent predisposition to respond in a certain way. Given that the questions were about the state of the business entity (i.e., the maturity of the use of GAS by the respective internal audit function) as opposed to the performance of the individual, it is unlikely that response bias was a factor.

Literature Review

The overarching objectives of the internal audit function are to provide independent assurance over the effectiveness and adequacy of organisational governance, control and risk management processes (Christopher and Sarens 2015; Hay et al. 2017; O'Donnell 2015; The Institute of Internal Auditors 2016a). However, owing to the fact that most organisations are impacted by information technology in various forms, it has become virtually impossible to conduct an effective audit without the use of technology (Lambrechts et al. 2011). The sharp increase in data complexity and volume, together with the availability and progress with data analysis tools and techniques, has a direct impact on how internal audit functions obtain audit evidence, while continuing to deliver in terms of their statement of responsibilities (The Institute of Internal Auditors 2016a). As a result of the availability of big data, data analysis skills for internal auditors are becoming ever more important (Lambrechts et al. 2011).

Researchers such as Carroll (2006), Kim et al. (2009), Schroeder and Singleton (2010) and Protiviti (2015) concur that internal audit functions that do not adopt technology-based tools will not only be limited in the audit coverage they can provide to the audit committee and various organisational stakeholders, but will also run the risk of becoming obsolete. Kilgor et al. (2011) also stress the importance of the quality of the audit process and the roles of auditors and auditing. Applying technology-based tools as part of the audit methodology should positively contribute to the quality of the audit and the audit coverage achieved. The adoption of technology-based tools is therefore imperative for the modern day internal audit function if it is to remain relevant in control and business environments that are dominated by technology and electronic information. Moreover, Smidt (2016) emphasises that this often has to be done without the luxury of an increased budget or staff component. In recent years, internal auditors have had to revisit the manner in which they collect audit evidence in order to achieve predetermined engagement objectives in an efficient manner. As summarised by Smidt (2016), the internal auditor can collect audit evidence for the purpose of evaluating the effectiveness of internal controls in one of three ways; firstly, by doing full population testing with the use of technology-based tools such as CAATs; secondly, through selection of specific items for testing based on pre-determined criteria; and thirdly, by way of random sampling for the purpose of generalisation and/or extrapolation and performing statistical tests, to name but a few (see also Suen 2009 and Pedrosa and Costa 2014).

According to existing research, the most widely used of these technology tools is GAS (Braun and Davis 2003; Debreceny et al. 2005; The Institute of Internal Auditors 2016a; Lin and Wang 2011; Mahzan and Lymer 2014). Ahmi (2013) and Smidt (2016) point out that the abbreviation GAS is often used inconsistently throughout the existing CAATs and auditing literature, and that authors sometimes refer to CAATs when in fact they should be referring to GAS. The authors also point out that GAS is a sub-category within the broader definition of CAATs.

The importance of technology-based audit techniques, and especially CAATs, is further emphasised in international audit standard setting. Paragraph A16 of International Standard on Auditing (ISA) 330 (SAICA and IAASB 2016) stresses that the use of CAATs may enable auditors to perform more extensive testing of transactions and files, which may assist the auditor in responding to the risks of material misstatement due to fraud. Some CAATs techniques mentioned in the standard include selecting sample transactions from key electronic files, sorting transactions with specific characteristics and enabling the testing of an entire population instead of only a sample. The literature reveals that with reference to the broad definition of CAATs, there are five popular types of CAATs, namely: test data, parallel simulations, integrated test facilities, embedded audit modules and GAS (Braun and Davis 2003; Coderre 2015; Elefterie and Badea 2016; Jakšić 2009; Kiesow et al. 2014).

Of the various types mentioned above, GAS has been identified through various studies as the most popular and frequently used CAAT by internal auditors (Cangemi 2015; Kim et al. 2009; Mahzan and Lymer 2014). PwC (2013), Jackson (2014) and Coderre (2015) explain that GAS assists the internal auditor in extracting data from multiple sources such as files and databases, further enabling the linkage of traditionally disconnected data sources. GAS includes, amongst others, professional audit software packages such as ACL and Interactive Data Extraction and Analysis (IDEA) (Smidt 2016). However, it should be noted that, while a number of different technology-based tools are available for internal audit functions' use as mentioned above, these are not part of the scope of this article. The purpose of this article is to assess the use of GAS as a technology-based audit tool.

Despite the rising importance of technology-based tools, The Institute of Internal Auditors (2015) indicated in their 2015 Global Internal Audit Common Body of Knowledge (CBOK) report that, globally, the adoption and utilisation of technology-based tools by internal audit functions is still at a relatively low level. This finding is corroborated by The Institute of Internal Auditors Research Foundation (2016). Taking into account the increasing prominence of the use of technology-based tools, a number of maturity assessment frameworks have been developed to measure the extent and effectiveness of the use of data analytics in a number of industries. These include, but are not limited to: PwC's data analytics maturity scale (PwC 2013); KPMG's maturity model for data analytics (2015); Deloitte's maturity model for data analytics (2013); and EY's internal audit analytics maturity model (2014). Most maturity continuums have, on average, five levels, starting at the lowest level where there are some ad hoc functions or nothing in place, to the highest level with continuous auditing.

It is important to note that the effective use of data analytics is not only reliant on the technological aspect (such as specific audit software tools used to perform analytics), but also the aspects of managing people and processes (Coderre 2015; Liddy 2015; PwC 2013; Vasarhelyi et al. 2012). Smidt points out that, for example, an internal audit function could operate on a higher level of maturity with regard to the technology it has at its disposal than the level of maturity of the people aspect, such as the availability of skills for ensuring a successful data analytics initiative. It is thus imperative that all three components (people, process and technology) be assessed in combination so as to offer an overall assessment of the level of maturity displayed in utilising data analytics by an internal audit function. Such a combined approach to measuring the data analytics maturity level could provide stakeholders with useful information relating to specific areas in need of improvement in each of the three 'categories' – people, processes and/or technology. Such a process can enable the entire internal audit function to advance to the next level of maturity (The Institute of Internal Auditors 2016b).

Apart from GAS, other commonly used CAATs for data analysis purposes are Microsoft Excel and Microsoft Access (Ahmi and Kent 2013; Lin and Wang 2011; Mahzan and Lymer 2014). Likewise, The Institute of Internal Auditors Research Foundation (2016) found that 77% of respondents use Microsoft Excel for basic data analysis, 53% of respondents use specialised GAS packages such as ACL and IDEA, and 37% use Microsoft Access for data analysis purposes.

Although Microsoft Excel is also a popular CAAT tool for some internal audit functions, it does have limitations compared to an official GAS package. In addition, internal audit functions that utilise Microsoft Excel for their data analytics strategy are usually associated with lower levels of maturity (The Institute of Internal Auditors 2016b). The following are some of the main limitations associated with the use of Microsoft Excel as a data analysis tool: spreadsheet applications are usually not designed or capable of handling large data sets; spreadsheets are prone to error, especially when the internal auditor needs to clean up large data sets that were acquired from multiple sources; errors in formulas can adversely impact the logic of the analysis that is derived from them; with the use of macros and multiple pivot tables, testing and analysis can be time-consuming and complex; and extensive programming knowledge is often required, for example, to make use of routine or continuous analysis of the data (Caseware Analytics n.d.; Chan and Kogan 2016; Soileau and Soileau 2016).

Based on the above discussion, and as a result of the already elevated and increasing volumes of data and transactions that form part of the day-to-day business activities of an organisation, this study mainly aims to measure existing internal audit function practices in Australia regarding the use of GAS, against a benchmark developed from recognised data analytic maturity models, in order to assess the current maturity levels of internal audit functions in Australia in the use of this software for tests of controls.

Overview of Empirical Results

Respondent background

Regarding the type of industry, as summarised in Table 1, the majority of the respondents, nine out of 50 (18%), are employed in the finance and banking industry, six (12%) are employed in the education sector and another six (12%) are in local government. Further, 28 (56%) are internal auditors employed in the government sector, with 21 (42%) employed in the private sector and only one respondent (2%) is employed in a non-profit organisation.

Years of experience using GAS

As part of the empirical study, the respondents were asked about their experience using GAS. Half of the respondents (50%) had between zero and five years of experience using GAS. A total of 14 of the 50 respondents (28%) had GAS experience between six and 10 years, with the remaining respondents having more than 10 years of experience using GAS. Table 2 details the results.

Table 2 **Summary of respondents' years of experience using GAS**

	Frequency	%
0–5 years	25	50.00
6–10 years	14	28.00
11–15 years	4	8.00
16–20 years	4	8.00
21 years or more	3	6.00
Total	**50**	**100.00**

Prevalence of GAS usage

The results reveal that almost half of the respondents, a total of 23 out of 50 (46%), use GAS for data analytics purposes to obtain audit evidence for conducting tests of controls. The most popular GAS tools currently in use are ACL, Caseware IDEA and Tableau (see Table 3). (The percentages indicated in Table 3 are based on the 23 respondents that use GAS as a data analytics tool, but it should be noted that some of the respondents indicated that more than one GAS tool was in use.)

The remaining 27 respondents (54%) that do not make use of GAS indicated Microsoft Excel was the most popular tool for sample testing and basic data analytical procedures (some departments did not indicate that any tool was currently in use). Some of them have their own applications developed in-house and they also employ Microsoft Access for this purpose (see Table 4). As stated above, The Institute of Internal Auditors Research Foundation (2016) found that 77% of their respondents use Microsoft Excel for basic data analysis, while 53% of their respondents use specialised GAS packages such as ACL and IDEA with 37% using Microsoft Access for data analysis purposes.

Further, the respondents who made use of specialised GAS packages to obtain audit evidence were asked to indicate the percentage of internal audit engagements for which they use GAS (see Table 5). The majority of respondents, nine of the 23 (39.1%), use GAS in less than 20% of their engagements. Five of the 23 (21.7%) estimated that they use GAS for 21–40% of their engagements, four of the 23 respondents (17.4%) indicated that GAS is used for 41–60% of their engagements, while the remaining five (21.7%) indicated that they use GAS for 61–80% of their engagements.

Table 3 Types of GAS used

	Frequency	%
ACL	12	52.2
Caseware IDEA	5	21.7
Tableau	4	17.4
Top CAATs	1	4.3
Alteryx	1	4.3
Archer	1	4.3
CSI	1	4.3
In-house application	1	4.3
TOTAL	**26**	**113.0**

Table 4 Other techniques or tools used to collect audit evidence for tests of controls

	Frequency	%
Microsoft Excel	14	66.7
In-house developed application	3	14.3
Microsoft Access	2	9.5
Other	2	9.5
TOTAL	**21**	**100.0**

Table 5 Internal audit engagements performed with the use of GAS

	Frequency	%
61–80%	5	21.7
41–60%	4	17.4
21–40%	5	21.7
Less than or equal to 20%	9	39.1
Total	**23**	**100.0**

The perceived ability of internal audit team members to embrace data analytics

The respondents who indicated that they use GAS in their internal audit engagements were asked to indicate the skills levels of their internal audit team members. The options provided included limited skills, basic skills and advanced skills in the use of GAS. For the purpose of this study:

- 'limited skills' means that the internal auditors have an awareness of the commands or functions that GAS may offer, but are not proficient enough to independently apply the basic functions and commands that are built into the GAS (e.g., they are not able to run the duplicates, statistics, summarise commands or draw random samples);
- 'basic skills' means that the internal auditors' proficiency in the use of GAS is sufficient to enable them to independently apply the basic functions and commands built into the GAS (e.g., they can run and interpret the results of the duplicates, sampling and summarise commands) but do not have the ability to write scripts;
- 'advanced skills' means that the internal auditors are experienced and can apply all the basic functions and commands built into the GAS and also have the ability to write scripts for the automated performance of tests for internal auditing purposes.

The survey results, as indicated in Table 6, show that nine of the 23 (39.1%) respondents who use GAS estimated that less than or equal to 20% of their staff members have limited skills in the use of data analytics. A total of 17.4% of the respondents indicated that between 21% and 40% of their staff members have limited skills in data analytics, while 21.7% indicated that 41–60% of their staff members have limited skills, and a further 17.4% indicated a limited data analytics skills level for between 81% and 100%. In other words, the majority (56.5%) of the respondents indicated that 40% or fewer of their internal audit staff have limited skills in the use of data analytics.

Table 6 **Ability of internal audit team members to embrace data analytics**

	Limited skills		Basic skills		Advanced skills	
Internal audit function's capabilities	Frequency	%	Frequency	%	Frequency	%
Missing	1	4.3	1	4.3	0	0.0
Less than or equal to 20%	9	39.1	7	30.4	13	56.5
21–40%	4	17.4	8	34.8	5	21.7
41–60%	5	21.7	4	17.4	2	8.7
61–80%	0	0.0	1	4.3	1	4.3
81–100%	4	17.4	2	8.7	2	8.7
Total	**23**	**100.0**	**23**	**100.0**	**23**	**100.0**

Of the 23 respondents that use GAS, seven (30.4%) estimated that less than or equal to 20% of their staff members have basic data analytics skills. A total of 34.8% of the respondents indicated that between 21% and 40% of their staff members have basic skills in data analytics, while 17.4% indicated that 41–60% of their staff members have basic skills. A further 4.3% indicated a basic data analytics skills level for between 61% and 80% of their staff, whereas 8.7% estimated that 81–100% of their staff members have basic skills in data analytics. In other words, the majority (65.2%) of the respondents indicated that 40% or fewer of their internal audit staff have basic skills in the use of data analytics.

In total, 56.5% of the respondents who make use of GAS in their internal audit functions estimated that less than or equal to 20% of their staff members have advanced data analytics skills. Of the respondents, 21.7% indicated an advanced data analytics skills level for 21–40% of their internal audit staff. Also, 8.7% of the respondents indicated an advanced skills level for between 41% and 60% of their staff members, a further 4.3% stated an advanced skills level for 61–80% of their staff members, and the remaining 8.7% stated that they perceived 81–100% of their internal audit staff have advanced data analytics skills.

Only five of the 23 respondents (21.7%) indicated that they have separate data analytics teams who have advanced skills in the use of GAS (i.e., they are sufficiently experienced to be able to apply all the basic functions and commands built into the GAS, and also have the ability to write scripts for the automated performance of tests for the rest of the internal audit function). The number of staff members that form part of the data analytical team is relatively small, between one and four staff members.

In addition, seven of the 23 respondents (30.4%) employ individuals, such as data specialists, who have specific skills (a sufficiently detailed understanding of IT infrastructure and data sources to be able to access the data), and/or ERP systems specialists (who have expert knowledge of ERP systems such as SAP or Oracle) in order to support and enable the internal audit function to conduct data analytics with the use of GAS. The number of specialists employed by these respondents is also relatively small, ranging from between one and four. In conclusion, it is evident that very few of the respondents have an internal audit staff component where the majority of staff members have an advanced GAS skills level.

Motivating factors for improving GAS skills

When asked about the factors that contribute to or motivate internal audit staff to improve their skills in the use of GAS to embrace data analytics, all of the 23 (100%) respondents who made use of GAS indicated that buy-in and support from audit management to use GAS as part of the internal audit methodology was the main

Table 7 **Factors that motivate internal audit staff to improve their skills in the use of GAS to embrace data analytics**

Factors that motivate internal audit staff to improve their skills in the use of GAS to embrace data analytics	Yes		No		Total	
	Frequency	%	Frequency	%	Frequency	%
The use of GAS is one of your internal audit staff's key performance areas	10	43.5	13	56.5	23	100.0
Higher levels of remuneration and/or reward is linked to internal audit staff with specialised data analytical skillsets in the use of GAS (e.g., the successful completion of the ACL Certified Data Analyst or Certified IDEA Data Analyst certifications), in an effort to attract and retain these skills within your internal audit function	3	13.0	20	86.9	23	100.0
There is buy-in and support from audit management for the use of GAS as part of the internal audit methodology	23	100.0	0	0.0	23	100.0

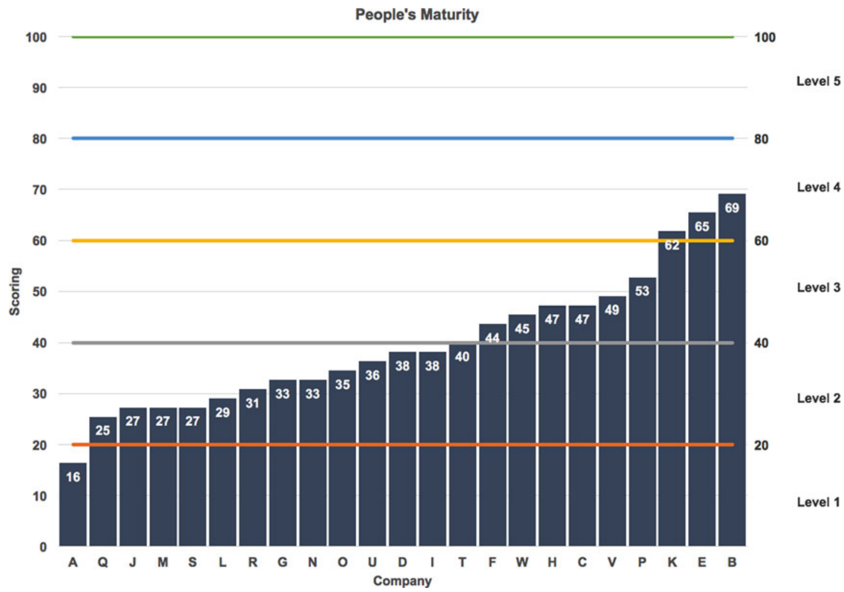

Figure 1 illustrates the distribution of the competency levels in the use of GAS by internal audit staff members from each respondent's internal audit function. The results therefore indicate the level of maturity with regard to the competency of the respective internal auditors in utilising GAS as a tool for conducting an internal audit engagement.

Figure 1 **Maturity assessment: People [Colour figure can be viewed at wileyonlinelibrary.com]**

contributing factor. The majority (13 or 56.5%) of respondents indicated that the use of GAS is not one of the key performance areas (KPAs) for internal auditors' performance evaluations. Furthermore, the majority (20 or 86.9%) of respondents who made use of GAS indicated that internal audit staff members with specialist data analytics skills who can contribute to the use of GAS do not receive higher remuneration in order to attract and retain specialist skills in their functions. Table 7 summarises the findings.

In other words, the respondents do well with regard to buy-in and support from audit management and the CAE to incorporate the use of GAS as part of the internal audit methodology. Nevertheless, the utilisation of GAS as one of the KPAs for internal auditors' performance evaluations, as well as greater remuneration for internal audit staff members with specialist data analytics skills, achieved low response levels, which also adversely impacts on the level of maturity in the use of GAS achieved for the maturity aspect of people.

A maturity assessment for the people aspect

Figure 1 and Table 8 illustrate the distribution of the different levels of maturity achieved for each company with regard to people. The majority of respondents (13 or 56.5%) have a low level of maturity (level 2). Another six (26.1%) respondents have a medium level of maturity (level 3). There were three respondents (13%) that achieved a high level of maturity (level 4) while only one respondent (4.3%) fell in the low level of maturity (level 1).

Table 8 **Summary of maturity assessment: People**

	Frequency	%
Level 1	1	4.3
Level 2	13	56.5
Level 3	6	26.1
Level 4	3	13.0
Level 5	0	0.0
Total	**23**	**100.0**

Processes in place to enable and support the use of GAS

As part of the empirical survey, the respondents were asked to choose the statement that best described their internal audit function's use of GAS. The options given to respondents are detailed in Table 9. A total of 12 out of 23 (52.2%) respondents indicated that the use of GAS is an informal arrangement, and is left to the discretion of the individual internal auditor to decide whether or not to make use of GAS as he/she deems fit. The remaining 11 (47.8%) respondents indicated that the internal audit function has formalised and implemented procedures, standards and documentation, and offers training that provides guidance to the internal audit staff on how GAS

Table 9 Processes in place to enable and support the use of GAS

	Frequency	%
The use of GAS is an informal arrangement: it is up to the individual internal auditor to decide whether or not to make use of GAS as he/she deems fit	12	52.2
The internal audit function has formalised and implemented procedures, standards and documentation, and offers training that provides guidance for internal audit staff on how GAS and data analytics should be applied on an internal audit engagement	11	47.8
Total	**23**	**100.0**

and data analytics should be applied in an internal audit engagement.

In order to shed some light on the above answers, the respondents were also asked to indicate additional characteristics of the processes they have in place in their respective organisations to support and enable the use of GAS. Table 10 shows that 17 of the 23 respondents (73.9%) indicated that their departments previously developed data analytics scripts that have been through a quality assurance review and are readily available for use by the respective internal auditors. For seven of the respondents (30.4%) the use of GAS is standard practice throughout their internal audit function. A further eight respondents (34.8%) indicated that comprehensive suites of tests have been developed and tested, and are available in a central, controlled environment for use by internal audit staff, while five other respondents (21.7%)

Table 11 Summary of maturity assessment: process

	Frequency	%
Level 1	3	13.0
Level 2	10	43.5
Level 3	9	39.1
Level 4	1	4.3
Level 5	0	0.0
Total	**23**	**100.0**

have custom-built automated scripting and testing in place that runs according to a predefined schedule (i.e., continuous auditing). Only two (8.7%) of the 23 respondents pointed out that there is real-time data monitoring with system workflow processes in place through which the control owners in the respective business units are notified of exceptions, and are able to respond to them (i.e., continuous monitoring). It should be noted that continuous monitoring refers to the feedback mechanism for ongoing management review in order to verify whether implemented controls are functioning as intended and whether transactions are being processed according to predefined criteria. It is the responsibility of management and therefore forms an integral part of an organisation's internal control environment (KPMG 2013; The Institute of Internal Auditors South Africa 2015; The Institute of Internal Auditors 2016c, 2015). Although continuous monitoring does not fall within the scope of the internal audit function, some internal audit functions may at times utilise the results that are derived from the continuous monitoring system workflow processes to notify management of control breakdowns so that corrective action can be taken as deemed appropriate.

Table 10 Characteristics of processes in place to support and enable the use of GAS

	Yes		No		Total	
	Frequency	%	Frequency	%	Frequency	%
The use of GAS is standard practice throughout your internal audit function (i.e., it is integrated in all audit programs) for tests of controls	7	30.4	16	69.6	23	100.0
Previously developed data analytics scripts (i.e., custom-built scripts) that have been through a quality assurance review are defined and are readily available for use by the respective internal auditors	17	73.9	6	26.1	23	100.0
Comprehensive suites of tests have been developed and tested, and are available in a central, controlled environment for use by internal audit staff	8	34.8	15	65.2	23	100.0
Custom-built automated scripting and testing is in place and is running according to a predefined schedule (i.e., continuous auditing)	5	21.7	18	78.3	23	100.0
There is real-time data monitoring with system workflow processes in place through which the control owners in the respective business units are notified of exceptions and are able to respond to them (i.e., continuous monitoring)	2	8.7	21	91.3	23	100.0

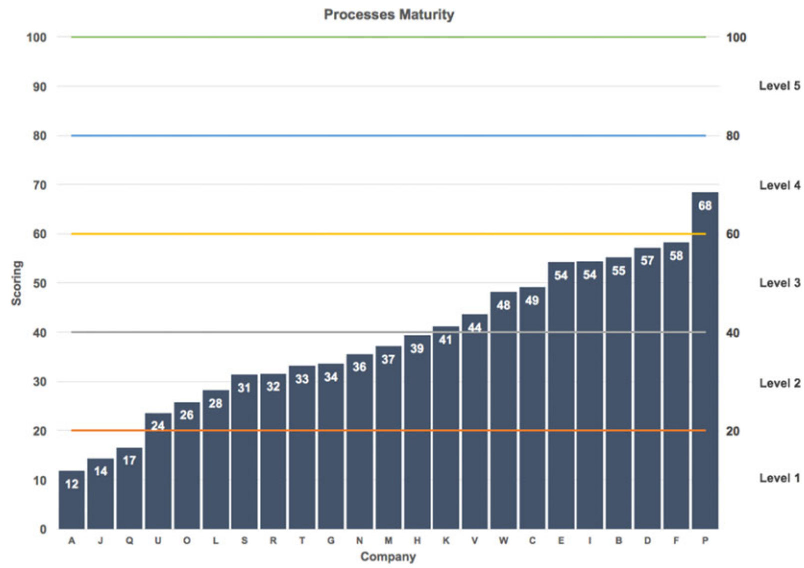

Figure 2 illustrates the distribution of the maturity levels achieved in the various processes that are implemented or that are in place to support and enable the use of GAS.

Figure 2 **Maturity assessment: Process [Colour figure can be viewed at wileyonlinelibrary.com]**

Table 12 **Technology aspects of internal audit functions regarding the use of GAS**

	Yes		No	
	Frequency	%	Frequency	%
It is difficult for the internal audit function to obtain access to the organisational data without support from IT	19	82.6	4	17.4
The internal audit function has an established data access protocol with the IT department that enables it to obtain data for audit and analytical purposes (i.e., the organisational data are easily accessible through the IT department)	16	69.6	7	30.4
The internal audit function has a well-structured and centrally managed server environment that stores and maintains large data sets and the contents of the audit analytics processes (e.g., tests, results, audit procedure documentation and related materials)	9	39.1	14	60.9
The internal audit function has access to a central enterprise data store that allows for easy access to data for audit and data analytical purposes	12	52.2	11	47.8
The internal audit function has an automated data extraction, transfer and load capability	7	30.4	16	69.6
Data analytics are performed with the use of Microsoft Excel (or similar) rather than with commercial GAS packages such as ACL and IDEA. (Please take note of the definition of GAS provided on page 1 when answering this question)	8	34.8	15	65.2
Complex processing of large data volumes is performed on high-powered servers	8	34.8	15	65.2
Advanced analytics that have been developed by data analysis specialists with expert knowledge of ERP systems (e.g., SAP or Oracle) are in place and are available for use within the internal audit function	6	26.1	17	73.9

In addition to the above, an overwhelming majority (22 of the 23 respondents that do use GAS, or 95.7%, believed that GAS could be utilised more frequently within their internal audit functions.

Maturity assessment for the process aspect

Table 11 and Figure 2 illustrate the distribution of the different levels of maturity achieved for each department with regard to process. Reviewing the results from Figure 2, the processes in place that support and enable the use of GAS are also far from optimal in most of the companies' internal audit functions. To summarise, the majority of respondents (10 out of 23 or 43.5%) fell in a level 2, and 9 of the 23 respondents or 39.1% were a level 3. Only one respondent (4.3%) achieved a maturity level of 4 and no respondents achieved a maturity level of 5.

Table 13 **Levels of GAS satisfaction**

	Frequency	%
Very satisfied: no improvement required	0	0.0
Reasonably satisfied: however, some improvement may be required	10	43.5
Neither satisfied nor dissatisfied: functional but not yet optimal	5	21.7
Dissatisfied: requires improvement	6	26.1
Significantly dissatisfied: requires major improvement	2	8.7
Total	**23**	**100.0**

Table 14 **Summary of maturity assessment: Technology**

	Frequency	Percent
Level 1	1	4.3
Level 2	9	39.1
Level 3	7	30.4
Level 4	3	13.0
Level 5	3	13.0
Total	**23**	**100.0**

Technology platforms enabling the performance of data analytics

As part of the survey, the respondents were also requested to give responses regarding the technology platforms that are currently available to their internal audit functions. A number of possible options were available to choose from, as can be seen in Table 12, and the respondents were allowed to select more than one answer. The majority of the respondents (19 out of 23, 82.6%) agreed with the statement that it is difficult for the internal audit function to obtain access to organisational data without IT support. A further 16 of the 23 respondents (69.6%) indicated that the internal audit function did, however, have an established data access protocol with the IT department that enables it to obtain data for audit and analytical purposes (i.e., the organisational data are easily accessible through the IT department). In addition, 12 of the 23 respondents (52.2%) stated that their internal audit function has access to a central enterprise data store which allows for easy access to data for audit and data analytical purposes. Further details of the results are presented in Table 12.

In addition to the characteristics of the technology platform described, it is important to note that the use of data visualisation tools for reporting purposes (i.e., to present complex data in an understandable format through visual depictions such as statistical graphics, plots, information graphics, tables and charts) also contributes to enhancing the assessed level of maturity that can be achieved from a technology perspective. The results further reveal that eight of the 23 respondents (34.8%) sometimes make use of data visualisation tools for reporting purposes, with six of the 23 respondents (26.1%) indicating that they never or rarely make use of data visualisation tools. Only two of the 23 respondents

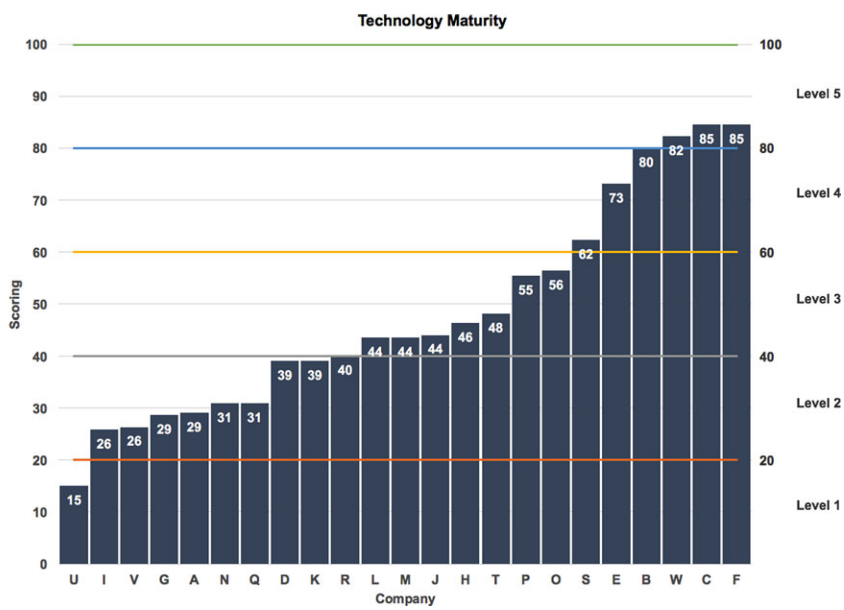

Figure 3 illustrates the distribution of the maturity levels achieved regarding the data analytical software that is implemented and the technology platform that is in place in each of the internal audit functions that support and enable the use of GAS.

Figure 3 **Maturity assessment: Technology [Colour figure can be viewed at wileyonlinelibrary.com]**

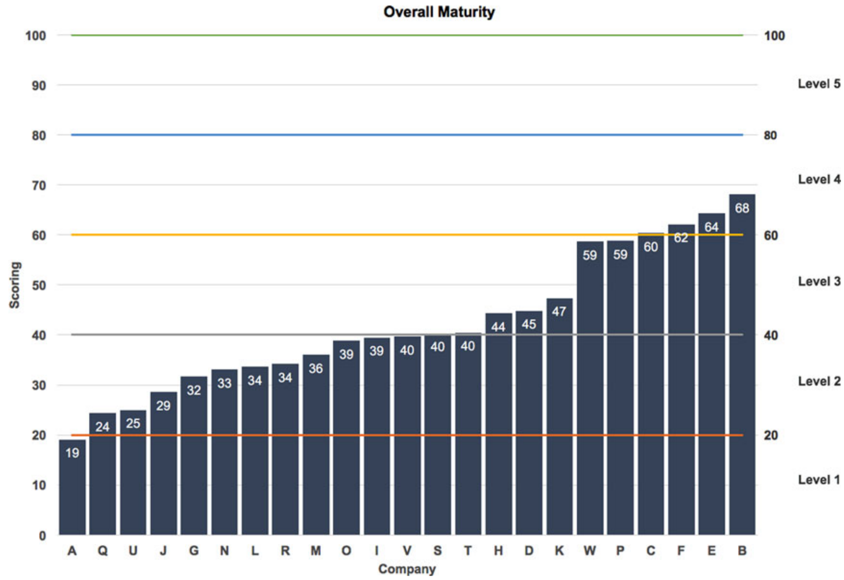

Figure 4 illustrates the distribution of the overall maturity levels achieved (i.e., the combined maturity level for all three aspects: people, process and technology) in the use of GAS by each of the internal audit functions.

Figure 4 Overall maturity scoring [Colour figure can be viewed at wileyonlinelibrary.com]

(8.7%) indicated that they always make use of data visualisation tools for reporting purposes, and only one respondent (4.3%) indicated that they often make use of these tools.

Levels of satisfaction with the current degree to which GAS has been implemented

The respondents who make use of GAS in their internal audit functions were asked to indicate their level of satisfaction with the current degree to which GAS has been implemented in their internal audit function. Nearly half of the respondents (43.5%) were reasonably satisfied with GAS implementation in their internal audit function and none of the respondents indicated that they were very satisfied. The detailed results are presented in Table 13. These results also provide a strong indication of the level of maturity of the use of GAS by these respective internal audit functions.

Maturity assessment for the technology aspect

Figure 3 and Table 14 illustrate the distribution of the different levels of maturity achieved for each department with regard to technology. In summary, 10 of the 23 respondents (43.4%) have a low level of maturity (level 1 and 2) with regard to technology. A further seven (30.4%) have a medium level of maturity (level 3). Only six (26.0%) display a high level of maturity (levels 4 and 5).

Overall maturity assessment

In order to calculate the overall maturity level of each department, with respect to their use of GAS to conduct data analytics for tests of controls purposes, the three aspects (people, processes and technology) should collectively contribute to generating the overall maturity assessment. In order to achieve this, each of the three aspects was equally weighted. This means that, because there were differences in the numbers of questions addressing each of these aspects (e.g., as the process aspect had more questions than the others, it could have had a much higher influence on the assessment than either the technology or people aspects), a simple arithmetic average was calculated for each department, using the following formula:

$$(P + PR + T)/3 \quad (1)$$

where P = the total score for people for a specific department; PR = the total score for process for a specific department; and T = the total score for technology for a specific department.

Figure 4 illustrates the distribution of the overall maturity levels that were achieved after having applied the above formula to the data for each department with regard to the three aspects, namely people, processes and technology. In addition, Table 15 summarises the maturity level achieved for each aspect of people, process and technology. The results as displayed in Table 15 therefore

Table 15 **Maturity level per aspect**

	Low maturity		Medium maturity	High maturity	
Aspect	Level 1	Level 2	Level 3	Level 4	Level 5
People	A	Q	F	K	
		J	W	E	
		M	H	B	
		S	C		
		L	V		
		R	P		
		G			
		N			
		O			
		U			
		D			
		I			
		T			
Process	A	U	K	P	
	J	O	V		
	Q	L	W		
		S	C		
		R	E		
		T	I		
		G	B		
		N	D		
		M	F		
		H			
Technology	U	I	L	S	W
		V	M	E	C
		G	J	B	F
		A	H		
		N	T		
		Q	P		
		D	O		
		K			
		R			

Table 16 **Overall maturity assessment per company**

	Low maturity		Medium maturity	High maturity	
Overall per aspect	Level 1	Level 2	Level 3	Level 4	Level 5
People	A	Q	V	C	
Process		U	S	F	
Technology		J	T	E	
		G	H	B	
		N	D		
		L	K		
		R	W		
		M	P		
		O			
		I			

contribute to the overall maturity assessment that was achieved and is summarised in Table 16.

In summary, as indicated in Table 17, the majority of the respondents (11 or 47.8%) have a low level of maturity (level 1 and 2) with regard to overall GAS maturity. A further eight (34.8%) respondents who use GAS have a medium level of maturity (level 3) for this aspect. Only four respondents (17.4%) displayed a high level of maturity (level 4) with regard to overall maturity.

Table 17 **Summary of maturity assessment: Overall**

	Frequency	%
Level 1	1	4.3
Level 2	10	43.5
Level 3	8	34.8
Level 4	4	17.4
Level 5	0	0.0
Total	**23**	**100.0**

Conclusion

The objective of this article was to measure the existing practices of internal audit functions in Australia regarding the use of GAS, against a benchmark developed from recognised data analytic maturity models, in order to assess the current maturity levels of internal audit functions in Australia in the use of this software for tests of controls. The literature review revealed that the use of GAS by internal audit functions globally is still at a relatively low level given today's big data-dominated control environments. This is despite the fact that The Institute of Internal Auditors (2016a) in Standard 1220.A2 *Due Professional Care*, requires internal auditors to utilise technology-based tools in the execution of their responsibilities.

The empirical results of this article also confirm the low maturity of GAS use by internal audit functions in Australia. The results revealed that 23 of the 50 respondents (46%) currently use GAS for data analytics purposes to obtain audit evidence for conducting tests of controls. The most popular GAS tools currently in use are ACL, Caseware IDEA and Tableau. Although 46% of the respondents are currently using GAS (ACL, Caseware IDEA and Tableau), the frequency of their use in conducting internal audit engagements is still at a low level with 22 of these 23 respondents (95.7%) believing GAS can be utilised more frequently than it is at present. Those respondents that are not making use of specialised GAS packages (27 of the 50 respondents, 54%) indicated the use of Microsoft Excel as the most popular tool for sample testing and basic data analytical procedures.

The overall assessment of the maturity of the use of GAS (i.e., the sum of the assessments of maturity of the people, process and technology aspects) revealed that 47.8% of the respondents that do use GAS achieved a low level of maturity (levels 1 and 2), while 34.8% demonstrated a medium level of maturity (level 3). Altogether, no respondents achieved an overall maturity rating of level 0, which is an indication that internal audit functions in Australia have at least started on the maturity continuum in their use of GAS for tests of controls purposes. At the other end of the spectrum, no respondents received an overall maturity rating of level 5, which is an indication that the maturity of the use of GAS by internal audit functions in Australia has not yet been optimised. To reiterate, Protiviti (2015) and Schroeder and Singleton (2010) are of the opinion that internal audit functions that are not adopting technology-based tools will not only be limited in the audit coverage they can provide to the audit committee and various organisational stakeholders, but will also run the risk of becoming obsolete.

This overall low level of maturity in the use of GAS is further substantiated through the degree of satisfaction indicated by the respondents in the use of GAS whereby all respondents felt that there is still room for improvement in the use of GAS. The highest overall level of maturity achieved was level 4, and only four respondents (17.4%) achieved this level. This indicates that the use of GAS by these departments' internal audit functions is at a higher level of maturity than it is in the other departments surveyed. It should however be noted (as was revealed by the empirical results recorded) that not a single respondent reached a level in any of the three aspects, where there is no longer any room for improvement (even if an overall maturity rating of 5 was achieved).

In addition, as revealed by the empirical results of this article and the results of various other authoritative internal audit studies, it is clear that the overall use of technology-based tools, and in particular the use of GAS, is still lower than expected, given the current dominance of technologically driven business practices that are now dominated by big data. Coderre (2015: 40) states, 'Study after study has shown that the data analytics capabilities of internal audit functions consistently fall below what is desired and even what is required'.

With the rapid growth in technology over the past decade it is inevitable that current internal audit functions will experience increased pressures from their various stakeholders to provide meaningful audit results in an efficient manner. In this fast-paced era, business managers and those charged with governance need reliable audit results that will enable them to make decisions in almost real time. Those internal audit functions that optimally use and implement GAS as part of their internal audit methodologies should be able to respond to the pressures imposed on them. It is hoped that the modern internal audit function realises that GAS is a tool that will enable a more robust and efficient audit approach and that they will continue in their pursuit of adopting and incorporating the use of GAS as part of their internal audit methodologies.

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