

Analytics: good practices for (smaller) IAFs

A field study into experiences and success factors



The Institute of
Internal Auditors
Netherlands

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Title

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Peter W. Bos MSc RO CIA (project coordinator and linking pin for IIA NL PPC)
Dennis Boersen RE (project leader)
Pieter van Ark MSc
Dr Marco van Kleef RA



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Internal Auditors
Netherlands**

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Foreword

The following report, 'Analytics: good practices for (smaller) IAFs', sets out the findings of a field study commissioned by the Professional Practices Committee of IIA Netherlands. The aim of this report is to encourage and support the use of analytics in Internal Audit Functions (IAFs). Analytics has been part of our 'toolset' for many years, but recently rapid advances have been in the available techniques.

"The world hates change, yet it is the only thing that has brought progress." (Charles Franklin Kettering).

The auditing profession first emerged during the industrial revolution, and its original aims were to provide (additional) assurance to clients such as executive and supervisory directors and other stakeholders such as regulators and the general public. Since that time, the profession has steadily progressed and professionalised. However, in recent years many audit and control functions seem to struggle to keep up with the pace of the increasing digitisation and real-time developments in the economy. Traditional auditing in the sense of 'retrospectively checking the figures' is becoming increasingly inadequate. (2012, AICPA White Paper). Solutions to this are sought, including by: involving non-financial perspectives, such as client perspectives and those based on operational management and innovation, increasingly using (upfront) system audits, and increasingly incorporating 'soft controls' (culture and behaviour). These are all useful steps, but they are not sufficient. A promising solution that is already feasible for many audit functions is the use of analytics. It is expected that the use of analytics will enable auditors to substantially improve their effectiveness and efficiency. Furthermore, in the near future the use of analytics will no longer be the exclusive domain of IT auditors, but will increasingly expand to other audit disciplines such as financial and operational auditing, as well as 'second-line' functions such as the internal audit, risk management and compliance functions.

All this calls for research into the use of analytics that looks into the wishes and requirements of IAFs as well the practical experiences they have gained. We hope this field study will inspire and support professionals in the use of analytics and will contribute to the further development and embedding of analytics in the internal audit profession.

We would like to thank the auditors who contributed to this study for sharing their experiences and insights.

Peter Bos, Dennis Boersen, Pieter van Ark, Marco van Kleef

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1 Introduction

Background

In the digital age of the twenty-first century, auditors cannot afford to ignore the opportunities created by digitisation and other technological developments. Management increasingly needs real-time assurance, which cannot be provided with traditional audit techniques due to limitations in terms of labour costs and lead time. This despite the fact that management is effectively the client for which the Internal Audit Function (IAF) performs its work. Hence, there is an urgent need for (some type of 'real time, data-driven assurance' (Chan & Vasarhelyi, 2011). At the same time, the technological options available create ever better conditions for performing data-driven audits, which will transform the audit landscape in the coming years (De Boer, Eimers & Elsas, 2014).

Almost all IAFs in the Netherlands have specified in their mission statement, charter or work plan that analytics is to be used to better equip the audit function, facilitate more fact-based reporting, and generate insights that are of practical use to management.

Reasons for the study

In practice, the use of analytics is often supported by (external) experts and advanced tools. It appears that many (smaller) IAFs as yet do not sufficiently utilise analytics and struggle to achieve their envisaged steps and plans for the use of analytics. Analytics is often regarded as a complex topic and the available knowledge is often limited, as are the options to deploy experts and advanced tools.

That leads to the question how and to what extent the practical experiences and insights gained by more experienced IAFs can be translated into practical applications that can also be used by other IAFs.

Objective

The objective of this study is to provide insight into the potential practical applications of analytics at (smaller) IAFs by looking into the experiences, needs and good practices with respect to analytics.

Target audience

The target audience of this study consists of auditors who want to use analytics as an audit technique or want to improve its utilisation. This includes auditors who are or want to become experts in analytics, but also 'regular' auditors who are able to rely on or hire specialised colleagues, but nonetheless want to understand analytics and want to be able to use it. Both

groups of auditors can use the findings of the study to make informed decisions on the use and improved utilisation of analytics in their own practice.

Research question

The main research question is: What are the potential practical applications of analytics for (smaller) IAFs that have recently started using analytics and what are the relevant good practices?

This main research question leads to the following sub-questions:

1. What is analytics and what is its importance for IAFs?
2. What are the main (potential) practical applications of analytics for IAFs?
3. What experiences have been gained with the use of analytics?
4. When it comes to successfully using analytics in practice, what are the needs (knowledge-related questions) of (smaller) IAFs that have recently started using analytics?
5. What are good practices (according to the more experienced IAFs) when it comes to this use of analytics?

General research approach and structure of the study

At the start of our research, we conducted a broad review of the professional literature. Based on this literature review, we defined the theoretical framework for our study, which is discussed in section 2. Next, based on our research design and the resulting interview diagrams, we conducted interviews with a selected group of internal auditors to address our research questions. The approach for this stage of our research is detailed in section 3 'Research method'. The remaining sections of this report describe the findings of our field study.

The appendices consist of a list of references, a list of analytics tools and a list of the respondents in our field study.

Scope

This study focuses on the utilisation of analytics as an audit technique by IAFs. It does not involve an assessment of the quality of analytics procedures performed by other organisational functions.

We have looked into the experiences gained at smaller and larger IAFs, and in examining the opportunities for applying analytics, we have focused on whether this is feasible for IAFs with limited options to deploy experts and advanced tools.

2 Theoretical framework: analytics and its importance for IAFs

Analytics

Many different terms and categorisations are used to describe the process of ‘using technology to analyse data’. Increasingly, the overarching term used to describe this process is ‘data analytics’ or simply ‘analytics’ (ISACA, 2017). In this study, we also use this term as it has a sufficiently broad scope. ‘Analytics’ covers the following techniques frequently mentioned in magazines for the internal audit profession: data analysis, data mining, process analysis and process mining. Based on the definitions given by Bos et al. (2017), the techniques are defined as follows:

- *Data analysis*: gathering and analysing datasets, often with the aid of professional analytical tools. This involves gathering large amounts of internal and/or external ‘flat’ (unstructured) data in a systematic manner and converting them into meaningful data (information) by means of analyses.
- *Data mining*: a type of data analysis that focuses on finding (statistical) relationships in order to create profiles. The term ‘data mining’ is analogous to a mining operation where huge amounts of material (data) are sifted through to find something of value.
- *Process analysis*: a type of data analysis where the data subject is a process.
- *Process mining*: a type of data mining where the data subject is a designated area of a process.

The relationship between these four techniques can be visualised as follows:

	Mining	Analysis
Data	Data mining	Data analysis
Proces	Process mining	Process analysis

A related, frequently used term is ‘big data’. This term indicates that the unstructured data referred to is characterised by large volumes, high speeds (of data queries and data changes) and high diversity (in terms of source, availability, format, reliability, etc.)

Importance of analytics for IAFs

Various developments are rapidly making it increasingly important for IAFs to use analytics in their work.

The first of these is the *datafication* of organisations (Lycett, 2013). In the last century, it was already acknowledged that in addition to the classic resources, namely labour, capital and

raw materials, organisations also use information. In recent years, data has been added to this as a separate resource, which is linked to information or treated as a key type of raw material. Lately, the view is gaining ground that organisations produce not only goods and services, but that the primary, support and management processes themselves consist of data (Van Twist et al., 2016). The entire organisation effectively consists of data. This logically implies that to be able to make any statements on the extent to which an organisation is in control, research is required into the data and the operational management and controls put in place based on the data. This is such a wide-ranging task that the use of analytics is a logical option.

Another development is the *breaking down of boundaries* and the accompanying development of open systems. The boundary between internal and external data is fading, as are the boundaries between the classic roles of data owner, processor, user and reviewer, including their associated powers and authorisations. Therefore, examining and assessing the related risks requires an equally 'boundary-breaking' approach, in which analytics techniques play a major or even indispensable role. Not only does the 'internal organisation' use external data, but external parties also have access to external as well as internal data, which these parties use for their own purposes and based on which they are able to form an opinion on the organisation, its service delivery, the extent to which the organisation's operations are sustainable in their view, etc. Due to this breaking down of boundaries, the system of control is beginning to focus less on classic concerns such as 'information supply' and 'information provision', and more on the underlying data themselves and especially the quality of the underlying data.

A third development is the so-called *data explosion* (Beath et al., 2012). The amount of data is rapidly and exponentially increasing, as a result of which manual explorations and analyses are increasingly inadequate. Combined with the above-mentioned datafication and breaking down of boundaries, this data explosion means that it's only effective but also very urgent for auditors to understand and be able to apply analytics techniques.

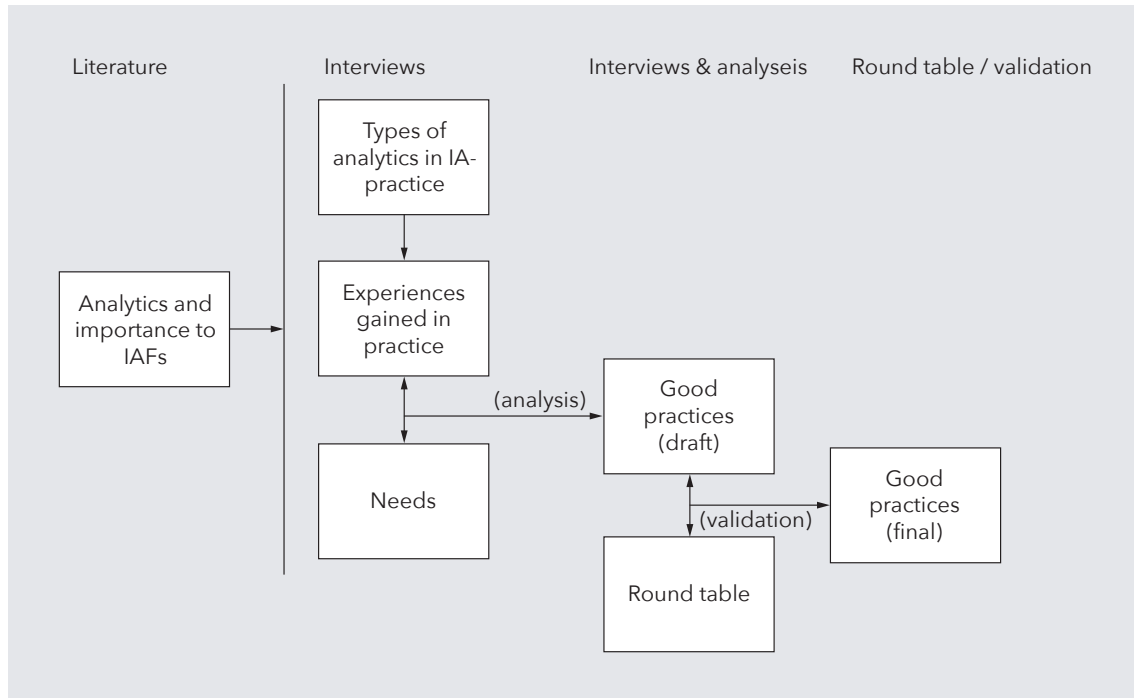
The importance of analytics is also heightened by laws and regulations, which both limit and foster the use of data. This includes, for example:

- The General Data Protection Regulation, which restricts the disclosure and use of data. This EU Regulation, which will replace the Dutch Personal Data Protection Act, will be in force throughout the European Union and requires notifying competent supervisory authority of any data breaches.
- Government bodies are increasingly expected to proactively make relevant data available to the general public. The quality of these data must be safeguarded from the outset.
- Regulators such as the Dutch National Bank (DNB), Netherlands Authority for the Financial Markets (AFM), Dutch Healthcare Authority (NZA), Netherlands Authority for Consumers and Markets (ACM) and the Dutch Data Protection Authority (PA) increasingly want more insight into how organisations handle their own and third-party data.

Lastly, there are *increasing technological options*. Various tools have been developed recently that IAFs can use. Experiences have been gained with these tools that can be shared, and there are courses and training modules that can be followed. In this sense, for IAFs with any opportunities in this area there are few arguments against using analytics techniques to start a transition towards data-driven auditing. In other words: if IAFs do not make this transition in the near future, they may 'have some explaining to do'.

3 Research method

Our field study was conducted based on the following research model.



In the previous section, we defined analytics and explained its importance for IAFs based on a review of the relevant professional literature.

For the field study described in the following sections, we drew up interview diagrams, which we based on our research design and theoretical framework. We then conducted two rounds of semi-structured in-depth interviews. The first round was conducted with respondents from IAFs that recently started using analytics, and who were able to clearly describe their experiences with analytics and their knowledge requirements based on these experiences. The second round was conducted with respondents from IAFs with an above-average level of experience with using analytics, who were able to share their experiences in greater depth and to translate these into good practices for fellow auditors, partly on the basis of the previously identified knowledge requirements. We made reports on all interviews, which we presented to the respondents for approval. We processed and analysed the gathered data in accordance with our research question. Lastly, we finalised the research findings in a round table session with the interviewed respondents.



4 Types of analytics applied by IAFs

In practice, mining techniques are usually applied by IAFs in exploratory procedures, whereas analysis techniques are mainly used in review procedures. This section describes the applications of analytics mentioned by the IAFs, which we have categorised into exploratory procedures and review procedures (analysis and assessment).

Exploration

In the case of exploratory procedures, analytics techniques are used to explore and describe the area of attention in order to gain a comprehensive overview and identify (potentially) relevant aspects. Frequently mentioned applications related to auditing are:

- Risk-focused identification of potential audit subjects as input for the IAF-wide audit planning.
- Exploring the audit context, as a preliminary procedure for a specific audit. The identified points for attention together comprise the input for the design of the planned audit.
- At the end of the implementation phase, performing an (in-depth) analysis of the context of specific key audit findings. This analysis serves as input for the audit reporting and/or the additional context based on which follow-up steps can be formulated, such as a targeted improvement initiative by the responsible management or follow-up audit by the auditor.

Other applications related to this are:

- Analytics applications such as 'consulting activities', which focus primarily on providing insight and less on reviewing or assessing in order to provide additional assurance.
- Risk-focused identification of indicators of potential fraud (red flags), which serve as input for a detailed forensic audit. However, as the procedures in this category share characteristics with review procedures (analysis and assessment), they can also be placed into the latter category.

Analysis and assessment

In the case of review procedures, analytics procedures are used to examine, analyse and assess audit subjects in order to provide additional assurance. Below, we list the most frequently mentioned applications for IAFs (categorised based on the 'classic' audit disciplines, which overlap in practice):

Financial auditing

- Performing reconciliation procedures and substantive analytical procedures in respect of the (financial) information to be reported, in order to support an external (financial) audit, or as part of an internal audit of (financial) reporting.
- Transaction (system-focused) analyses: for example, mapping financial statements items in terms of processes and reviewing the relevant control. See also under 'operational auditing' below.

IT auditing

- Testing general IT controls, such as testing authorisations: operating effectiveness versus design, undesirable combinations of roles and authorisations and breaches of segregations of duties.
- Testing application controls, such as through three-way matching, or the effectiveness of mandatory fields and syntax of application controls.

Operational auditing

- Auditing processes by mapping the actual operation of processes and comparing this to the expected operation of processes or to other assumptions (if available). Aspects that may be assessed include compliance, outcome reliability, lead times, flexibility and effectiveness.
- Testing key controls.

Other frequently mentioned applications in the 'analysis and assessment' category are:

- Examining indications of fraud (red flags), which involves exploring and describing as set out above under the heading 'Exploration'.
- Using source data to identify items such as receivables and payables and comparing the items to the financial accounts (if available), for example in connection with an insolvency.

Many of these types of analytics applications are 'exception analyses'. This means that the sample encompasses the largest possible portion of the population, whereas the subsequent analysis focuses on the identified exceptions.

5 Experiences with the use of analytics

This section describes the experiences gained by IAFs with the applications of analytics described in section 4. These experiences are categorised based on the benefits and the costs and limitations of using analytics as experienced by the IAFs. We conclude this section by describing the knowledge-related questions faced by smaller IAFs that have recently started using analytics.

5.1 Benefits

Fuller, more integrated overview of reality

The use of analytics makes it possible to gain a fuller, more integrated overview of the reality of the matters that are audited. This transcends system boundaries, for example when mapping entire process chains, and brings together the sometimes 'separate' worlds of performance (objectives, budgets, progress, etc.) and control (risks, controls, monitoring, etc.). In addition, this broader insight enables IAFs to better contextualise matters, including in terms of gaining insight into patterns, exceptions and relationships. Lastly, another benefit of this broader insight is that it enables better prioritisation by the IAF in terms of its work plan, targeted designing of individual audits and reporting of audit findings.

More assurance

A key added value of analytics is that it enables taking larger samples or even an exhaustive sample of the population. This ensures that conclusions are better supported by factual evidence, are quantifiable and can be illustrated with concrete practical examples. This makes the findings more reliable and transparent. Lastly, another considerable benefit is that when the findings are reported, discussions with users quickly move on from a debate about the audit itself to a (constructive) focus on the findings of the audit and how they can be optimally applied.

More 'creative tension'

The fuller, more integrated overview of reality provided by the use of analytics usually presents a more accurate view of the entire system and how it actually operates in practice. It specifically visualises blind spots and other counter-intuitive outcomes: there are realities that are unexpected and perplexing to those involved. All this fosters a debate not only about exceptions to the system ('Are we doing it right?'), but also about whether the system itself can be improved and how that relates to the bigger picture (Are we doing the right things?). As such, analytics-supported audits foster creative debates about governance issues at higher (organisational) levels and of greater strategic significance.

Repeatable analyses: efficiency and comparability

Lastly, there are a few specific benefits with respect to analyses that are planned to be performed multiple times or even regularly rather than as a one-off. When the design of such repeatable analyses is sufficiently structured and robust, this improves the efficiency of the analyses (less time and expertise required) and the quality and comparability of the outcomes.

5.2 Costs and limitations

Commitment and budget

The application of analytics requires commitment and the allocation of a sufficient budget. In practice, the commitment of the organisation (the client) and the management of the IAF is not always a given or easily obtainable. Often, obtaining sufficient budget for investments in knowledge, skills, tooling and content turns out to be difficult as well. As a result, whether analytics is actually applied often depends on (the knowledge and preferences of) influential instigators of change, and on whether tooling is in place or obtainable with relative ease.

Identifying and obtaining data

In practice, it takes a great deal of time, expertise and convincing to identify and obtain the required data. The following limitations play a part in this:

- In many systems, the data required for the analysis is retained only to a limited extent (labels, audit trail).
- Systems use different data structures.
- Data is often (reputed to be) the responsibility of data managers, who may be reluctant to provide it.
- Data may be privacy sensitive, which places restrictions on its disclosure and use.
- Often, data that is received has already been processed (it's not pure raw data).

In practice, whether data can be adequately identified and obtained is also affected by the maturity of the available Business Intelligence (BI) functions.

These limitations may also apply to repeatable, standardised analyses when the reality (such as the actual operation of a process) is subject to change or other risks and/or controls have become key priorities, meaning that standardised analyses may have to be readjusted to such changes.

Validation and interpretation of outcomes

The interpretation of the outcomes of analyses of data may be subject to significant limitations. Analyses readily generate a lot of 'hits' and other 'remarkable' outcomes, but their meaning and importance is not always clear. In practice, there is relatively high risk of incorrect conclusions, so a lot of attention will have to be paid to validating the outcomes of analyses and their exact meaning.

Responsibilities around analytics

The analyses performed by the IAF are often felt to be (partly) the responsibility of the line organisation or of a different staff function. In terms of the 'three lines of defence', this generally holds true to:

- repeatable analyses to monitor risk and controls that ought to be in the second line of defence;
- analyses that constitute a control that ought to be part of the first line of defence.

In practice, organisations do not readily perform these analyses themselves, and the IAF will therefore be confronted with the question whether it is not taking on board too much work and too many of the related investments that ought to be done by the first and second line.

Mandates and authorisations

A practical limitation is that the powers and authorisations of the IAF with respect to obtaining data are usually restricted. As a result, the auditor is unaware of important information. When auditors are aware of this (when they know what is unknown), they can often estimate and interpret the limitations this creates with respect to the outcomes of the audit. However, when this not the case (when they don't know what is unknown), this creates an even greater risk of invalid or irrelevant outcomes, for example because auditors unknowingly disregard key risks.

These limitations apply to all systems, but particularly to outsourced systems, as in practice it is often difficult to obtain data for these systems.

Use and performance of tooling

Tooling is an important prerequisite for the successful use of analytics. IAFs are confronted with the following limitations in this area:

- They are unsure what tools are best suited to specific applications.
- They do not have the tools they would like to have.
- They are unable to optimally utilise the options offered by the tools.
- They are faced with a technological environment with a limited capability, meaning that more extensive analyses cannot be properly performed.

5.3 Knowledge required to successfully use analytics

Based on the described experiences, the IAFs in our study have the following knowledge-related questions with respect to successfully using analytics in their own practice:

1. How can decision-makers be convinced of the importance of analytics?
2. How can the collaboration required for analytics be fostered within the organisation?
3. How can analytics be optimally utilised?
4. What is the (required) impact of analytics on the IAF?
5. How should the allocation of tasks between the IAF and the other 'lines of defence' be handled?

The answers to these questions are provided in the next chapter, in the form of good practices identified by IAFs with considerable experience with using analytics.



6 Good practices when using analytics

To meet the needs of the (smaller) IAFs that have recently started using analytics, as specified in section 5.3, the more experienced IAFs have translated their experiences and insights into good practices. Below, we discuss the most frequently mentioned good practices.

6.1 Convincing decision-makers

- Cater to the stakeholder interests of the decision-makers who are relevant to analytics. Put yourself in their shoes and explain the added value of analytics in terms of their interests. The following broad distinction applies in terms of roles and typical interests:
 - Executive Board and senior management: effective and efficient operational management, which may also include internal controls (first line) and monitoring activities (second line).
 - Audit committee and IAF leadership: fuller overview of reality and any related potential risks and higher level of assurance with respect to audit outcomes.
- Start by demonstrating the added value through 'low-hanging fruit': a simple application or pilot that can be expected to quickly produce results (instead of addressing the 'key' matters first).
- Present concrete, successful examples (instead of 'visionary' improvement opportunities).
- Customise the presentation of results to the target audience. Use an illustrative writing style and appealing graphics (instead of reports, tables and lists that only 'GRC people' understand).
- Create ambassadors in the organisation and let enthusiastic auditees explain the importance to decision-makers (instead of the auditor 'pitching' his pet project and wanting a budget for it).

6.2 Fostering optimal collaboration

- Establish an understanding of how and by whom the BI functions are performed and what the shared interests are in applying analytics. Set up collaborations with the BI functions based on this understanding.
- Foster the creation of 'data lakes' in the organisation. Encourage initiatives to achieve this, for example by including it in the scope of audits or bringing it to the attention of decision-makers in some other way.
- Encourage that only the performance aspects, but also the necessary control aspects are incorporated in the specifications applied for the procurement or (further) development of software applications. This will help ensure that the analytics provide better options, and will also facilitate meaningful communications about these options with users and data managers.

- Ensure there are adequate mandates and authorisations to permit and enable data extraction. Also establish this for outsourced systems and shared service centres: ensure that this is safeguarded in the SLAs, including in terms of obtaining data extractions, data ownership and the right to audit. In addition, any potential privacy aspects that could limit the attainment and use of data should be taken into account from the outset.
- Don't refer to analytics as an 'audit' if there is no need for it. Using a different description tailored to the target group may defuse potential resistance and thus increase the chance of being allocated a budget (see section 6.1).
- Bear in mind that auditors may not always be experienced as the most 'welcome guests'. If the collaboration doesn't run smoothly, don't immediately interpret it as resistance to analytics.

6.3 Optimal use of tooling

- Arrange a workspace that is suitable for analytics applications, including in terms of: sufficient capability and performance, the required authorisations and adequate security. Many organisations have standardised workspaces, so sometimes additional efforts will be required to obtain and utilise a 'non-standard' workspace.
- Use all BI resources already available in the organisation, such as larger (ERP) systems and data lakes. This way, the IAF supports the relevance of the BI functions and encourages their further development.
- To get off to a quick start, use MS Excel and Access. For these programs, only limited training is required to be able to perform relatively simple explorations and analyses. For the next step, consider using MS Power BI. This is a relatively cheap solution with many (additional) options¹.
- Further safeguarding, deepening and repetition of analytics procedures can be achieved by scaling up to specialised tools. The appendices include a list of the tools most frequently mentioned by the respondents.

6.4 Impact on IAFs

The impact of analytics on IAFs can be categorised based on the following IAF activities: planning, implementation and staffing².

Planning

- Ensure that analytics is taken into consideration as a serious option when the IAF planning is developed. Therefore, the opportunities presented by analytics and what the IAF has to offer in this respect should be sufficiently understood by all parties involved. This includes management, the Executive Board, the Audit Committee, the IAF leadership and any relevant third parties, such as the external auditor and regulators.³

1 MS Power BI is still being enhanced, as are the options it offers to IAF.

2 For the impact on the tooling, see section 6.3.

3 See also section 6.1 Convincing decision-makers.

Implementation

- Make analytics techniques and integral part of the audit methodology. Safeguard that potential applications are considered as logical choices when designing the audit. Prevent a situation where analytics is experienced as coming 'on top off' everything else.
- First invest sufficient time in the preparations and design for the audit and then perform it according to a plan and systematically. This applies to all audits, but particularly to analytics procedures, which have relatively high costs of error and repair.
- Designate part of the required budget as research budget; don't overburden the individual audit (manager) with 'start-up costs'.

Staffing

- Ensure that all auditors are aware of the opportunities and added value of analytics.
- Allocate the following 'specialised' roles (within the organisation and to specific functions):
 - Contact persons for analytics: within and outside of audit;
 - Data analysts (functional requirements): at least within audit;
 - Technical analysts (technical requirements): ideally also allocated to audit, but smaller IAFs usually have to seek collaboration with analysts outside of audit.
- Ensure there is a training budget that is linked up to realistic expectations. Training costs time and money and requires proactive support.

6.5 Allocation of tasks between IAF and other 'lines of defence'

- Identify the analytics applications that (also) relate to matters that are the responsibility of the first or second line. These are usually repeatable analyses to monitor risks, controls and improvement opportunities (second line) and analyses that constitute a control (first line). Explain the added value of these applications, based on an understanding of the role and interests of the parties involved. This increases the chance that they will indeed consider it relevant and feasible to implement these applications.
- Encourage governance-based thinking among the parties involved in the first and second line. This fosters an effective collaboration (see section 6.2) However, don't raise excessive expectations among decision-makers about a fast transfer.



7 Discussion and recommendations

The research questions have been answered in the previous sections. This section discusses the application of the findings of our study, in the context of what happens in practice according to the respondents and potential developments in the near future.

Task of IAF includes all steps up to and including definition of functional requirements

It is crucial that the IAF defines what it wants and why this is necessary. The IAF must be able to explain the added value of using analytics, for the organisation as well as individual audits. The IAF must be able to define what exactly is to be audited: what the subject is and what knowledge has to be gathered. In other words: the task of the IAF includes implementing all steps up to and including the definition of the functional requirements.

Data governance is increasingly a critical hygiene factor

Data governance has become a critical data hygiene factor. Organisations have to know what data they have, where data is located, who the data owners are, how data can be accessed, etc. Furthermore, they have to know what the quality of the data is and also, for example, what privacy aspects are involved. All this is necessary not only to facilitate the management and control of the organisation; it's also a prerequisite for taking the next step towards a mature use of analytics. At present, a lot of work goes into examining in more detail all kinds of potential exceptions ('hits') that upon closer examination turn out to be invalid or insufficiently relevant or material to be reported. In addition, most applications still focus on existing patterns. With predictive analyses, there is still a very high risk of incorrect conclusions.

Knowledge: sharing, integration and safeguards required

Many requirements and data models that have been developed by organisations are basically also suitable for other organisations from the same sector or with similar processes. However, often the utilisation of analytics depends on the efforts of a few individuals and is driven by the technology that 'happens to be' available. As a result, development costs are high (everyone reinvents the wheel), analytics remains the domain of an 'inner circle' of experts, the experiences of others are utilised only to a limited extent, and the necessary further professionalisation doesn't get off the ground. The IAFs in our study have made the following recommendations to address these issues:

Fellow organisations:

- Share lessons learned and practical examples, and develop applications together where applicable. First of all within sectors, but perhaps also together with other organisations with similar processes.

Suppliers of tools:

- Provide more illustrative content along with the tools, in the form of general processes and examples of risks and audit questions for each process.
- Aim for realistic expectations. Because application landscapes differ technologically, there is always a need for tailored detailing at the technological level, and often also at the functional level before that.
- Give more training (also in view of the factors mentioned above). This encourages a better and more prolonged utilisation of the options provided by tools.

The profession as a whole (profession organisations, study programmes and researchers):

- Develop a 'library' with functional processes, translated into data models (illustrative data extracts) for well-known software applications such as SAP, Oracle and Exact.
- Develop minimum standards and further regulations regarding applying judgment (including regarding the level of assurance) and compiling files when performing analytics-supported audits.
- Integrate analytics and the 'library' into core academic subjects, such as Accounting Information Systems (Administrative Organisation).

Analytics: developments in the near future

The efficiency of repeatable analyses can be improved by applying analytics. In addition, some take the view that certain applications are actually (also) the responsibility of the first and second line (see sections 5.2 and 6.5), and should therefore in time be allocated more within the organisation. That way, the rise of analytics could provide a stimulus to IAFs to focus more on governance at a higher (organisational) level and to develop an approach more based on management and behavioural science. Consequently, the IAFs in our study feel that it's very conceivable that this will make it possible to scale back the larger IAFs.

Specifically regarding the application of analytics by the IAF, it's expected that this will become more system-focused and future-oriented. In addition, the expectation is that in future the IAF will be required to audit the quality the analytics applications of the first and second line. At present, little has been done with respect to both these matters and the knowledge of these matters at IAFs is limited. Therefore, further research into these areas would be welcome.

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Analytics tools

Below is a list of the tools that were referred to in our field study. These tools are referred to as follows, based on the type of analytics involved: data mining (DM), data analysis (DA), process mining (PM) and process analysis (PA). The list is indicative. It is not intended as a basis for a tool selection.

Tool	DM	DA	PM	PA	Application
MS Excel	V	V			Can be used to perform relatively simple explorations and analyses with only limited training.
MS Access	V	V			Use mainly to link tables; a database application. Requires more knowledge and training than Excel.
MS Power BI	V	V			Analysis Suite in MS. Used mainly to create better visualisations in order to understand and present outcomes.
Tableau	V	V			Similar to Power BI. Can operate as a full standalone.
ACL	V	V			Specific audit tool with a simple script language for repeatable work programs. With the look and feel of Excel, but from an audit perspective. Logging for audit file.
Arbutus	V	V			Similar to ACL. Slightly less well-known. Can be used as a full standalone.
IDEA	V	V			Similar to ACL. Uses VB code for programming, so requires more knowledge and training.
SPSS	V	V			Mainly focused on statistical analyses and predictions. For more experienced users. Extensive options for visualising outcomes.
Disco	V	V	V	V	In addition to its data analysis options, this tool is mainly used for process mining.
Perceptive	V	V	V	V	Similar to Disco. Mainly used for process mining.
PROM	V	V	V	V	Open source, less user-friendly. Scientific, more or less the 'basis' for Disco and Perceptive.
FTK/Encase	V	V			Advanced forensic audit tool. Focused on exploration of large raw data files, particularly mailboxes, share drives, etc.

Respondents

Simon Heijnen MSc and Piet Goeyenbier MSc RE RA RO
ADR [Central Dutch Government Audit Service]

Bas Molenaar, Ewoud Benschop CIA and Kjell van Milaan MSc RE CIA
ANWB [Royal Dutch Touring Club]

Jan Rodenburg MSc RO RE CIA CISA
Binck Bank

Sjabbe Bouman RE
Brondata

Joko Tenthof van Noorden MSc LLM CIA CISA
Exact

Marieta Vermulm MSc RO RE
LM Wind Power

Matty Pleumeekers MSc RE CFE
MP Analytics

Reynold ten Hoor MSc RE
Rabobank

Joost Beljaars MSc RE and Vincent Vonk RA
SNS / De volksbank

Jeroen Ouwerkerk MSc RO
Trans Link Systems (TLS)

Evert van Gooswilligen
UWV [Employee Insurance Implementing Body]



**The Institute of
Internal Auditors
Netherlands**

Burgmeester Stramanweg 102a
1101 AA Amsterdam
www.iaa.nl
iaa@iaa.nl
Phone: + 31 88 00 37 100

