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Factors influencing IT-audit support effectiveness: quantifying their impact

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MASTER'S THESIS

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Abstract

Information Technology (IT) has significantly impacted the financial end-of-year audit as it allowed for the increased efficiency and depth of the audit. However, it also introduced a problem as accountants are required to verify the integrity of all IT systems related to a firm's financial statements. Often the accountant is dependent on the IT-auditor. IT-auditors check the relevant IT systems and applications and report their findings (IT-audit support). Regretfully, auditors fail to effectively incorporate IT-audit support into the audit. Due to the breadth of possible factors it is difficult to determine the right approach for improving IT-audit support effectiveness. I address this gap by analyzing factors influencing IT-audit support effectiveness and by using the context of the Auditdienst Rijk (ADR), which leans heavily on IT-audit support, to extract the most influential ones. Effectiveness is measured through the aggregation of indicators which assess both the factual and perceptual components of effectiveness. Based on these measures it is discovered that approachable accountants and IT-auditors, along with feasible IT-audit support deadlines, are key to improving IT-audit support effectiveness. Additionally, experienced IT-auditors have a more critical perception of effectiveness than their lesser experienced colleagues which moderates the overall effectiveness. As a result of this research, auditors are now able to discern how they can best improve the usage and effectiveness of IT-audit support.

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Theo Baart

Table of contents

List of figures

List of tables

List of terms

accountant For the purposes of this thesis a synonym for Chartered Accountant. iii, xiv, 2–11, 14–17, 21, 23–25, 27, 29–33, 35–41, 43, 45, 46, 48, 49, 51, 53, 54, 56, 61–67, 72, 74–78, 81–83, 86–90, 92, 93, 98–105, 107, 117, 119, 120, 122–125, 127, *see* chartered accountant

audit A formal control or analysis of an individual or organization (auditee) with the aim to verify the integrity of the auditee with regard to the subject matter (e.g. financial statements). iii, ix, xi, xiii, xiv, 1–35, 37, 39–42, 44–59, 61–68, 72, 74–79, 82, 83, 85, 86, 101, 103–106, 117–119, 121–126

auditee The entity being audited. xiii, 1, 5, 12–15, 18, 22–27, 29–33, 35–41, 43, 45, 46, 48, 49, 53, 54, 72, 103, 106, 119

auditor The entity performing the audit. Laws and regulations may restrict the entities allowed to audit certain subject matters. iii, xi, 1–6, 8, 9, 11, 13–16, 18, 20, 22–27, 29–33, 35–41, 43, 45, 46, 48, 51, 53–56, 58, 61, 62, 64, 65, 72, 74–79, 81, 83, 85, 88, 90, 99, 100, 103–105, 122, 124, *see* chartered accountant & IT-auditor

chartered accountant Protected title designating those who are legally entitled to (and responsible for) the execution of the control and certification of the financial statements of individuals and organizations. Their exact title and responsibilities varies per country and is often determined by local law. 2

client The entity requesting the audit of the auditee. 1, 2, 11, 13, 22, 23, 51, 53–56, 63, 119

IT-audit support The set of activities executed by IT-auditors with the purpose of supporting the accountant in their analysis of the end-of-year financial statements. iii, ix, xi, xiv, 7–12, 14–21, 24, 27, 33, 35, 38, 45, 46, 54, 57–59, 61–72, 74–83, 85–91, 93, 94, 96–101, 103–107, 117–120, 122–127

IT-auditor IT expert executing IT related audit activities. iii, xiv, 7–11, 14–17, 21, 24, 29–33, 35, 36, 38–41, 43, 45, 48, 49, 51, 54, 62, 64–66, 72, 75–78, 80–83, 86–90, 92, 93, 98–104, 117, 119, 120, 122–125, 127, *see* IT-audit support

lead IT-auditor A title within the ADR denoting the highest authority IT-auditor within an audit. Responsible for all IT-audit support activities within a single audit. 9, 19, 24, 26, 32, 33, 36, 38, 43, 54, 65, 78, 119

signing accountant A title within the ADR denoting the highest authority accountant within an audit. Carries the final responsibility for the entire audit and is held accountable for the findings and conclusions of the audit and the related evidence. 19, 24, 26, 33, 38, 43, 49, 53–55, 75, 119

List of abbreviations

ADR Auditdienst Rijk. iii, v, xiv, 8, 9, 13–26, 29, 30, 32, 45, 49, 51, 53, 54, 56–58, 62, 63, 69, 76, 85, 104–106, 117, 121

BPMN 2.0 Business Process Model and Notation. 22, 27–29, 32, 34, 39, 42, 44, 47, 50, 52, 55, 56

ERP Enterprise Resource Planning. 3, 4, 6, 35

GITC general IT-control. 5, 6, 15, 35, 36, 48, 54, 66, 67, 74, 77

HARo Handboek Auditing Rijksoverheid. 21, 30, 43

IT Information Technology. iii, xiv, 2–10, 13–16, 18, 24, 27, 29, 31–33, 35, 36, 41, 43, 45, 48, 49, 51, 58, 62–64, 67, 72, 75, 77–79, 81, 82, 90, 101, 103, 123, 127

SAI Supreme Audit Institution. 2, 11–13

Chapter 1

Introduction

1.1 Problem statement

1.1.1 Introduction to auditing

Since the early 1900s the financial audit has been standard practice for large corporations (Teck-Heang & Ali, 2008). The International Auditing and Assurance Standards Board (IAASB) (2009) describes financial auditing as obtaining and reporting on the "reasonable assurance about whether the financial statements as a whole are free from material misstatement [and prepared according to] the applicable financial reporting framework" (p. 74). In essence, those performing an audit (henceforth auditors) make a judgement on the fidelity of the financial statements (Veth, 2009). Audits exist so as to enforce accountability (Teck-Heang & Ali, 2008). Flint, as summarized by Teck-Heang and Ali (2008), clarifies that the audit provides "information or reassurance about the conduct or performance of others in which [the requesting party (henceforth client) has] an acknowledged and legitimate interest" (p. 1). In short, an auditor confirms the trustworthiness of the controlled party (henceforth auditee). Shareholders, for example, would request an audit to receive proof of the credibility of the financial statements of the firm they hold stock in (Teck-Heang & Ali, 2008). From the public sector perspective, audits "provide evidence of public sector accountability for economy, efficiency, and effectiveness" (Cordery & Hay, 2019, p. 134). In other words, the audit verifies the government's integrity in spending tax-payer money. Due to its nature, the financial audit has become critical for corporate trustworthiness

(Teck-Heang & Ali, 2008). Furthermore, it has also adopted an important role within the public sector. For example, in nearly 200 countries so-called Supreme Audit Institutions (SAIs) operate with the sole purpose of verifying the accuracy and correctness of government spending (Cordery & Hay, 2019).

Considering the audit's purpose, it is clear that an auditor's report can have far reaching consequences. For instance, a report falsely indicating trustworthiness can lead to stakeholders making costly mistakes. With the increasing scale at which organizations operate and in the wake of multiple scandals, the importance of an honest and upstanding auditor's ability to confirm an organization's trustworthiness has only increased (Teck-Heang & Ali, 2008). Due to the importance of an auditor's integrity, there are strict guidelines as to who can conduct the financial audit. Legal requirements state that only an independent chartered accountant (henceforth accountant), a protected function, may ratify the findings and conclusions of an audit (Koninklijke Nederlandse Beroepsorganisatie van Accountants (NBA), 2019). This accountant bears the authority and responsibility for the audit and its findings. As it is a protected function, accountants must adhere to strict standards and codes. These dictate, amongst others, the necessity for integrity, objectivity, confidentiality and professional competence and behavior (International Auditing and Assurance Standards Board (IAASB), 2009; International Federation of Accountants (IFAC), 2005). Failure to abide by these norms results in disciplinary measures including a potential removal of the accountant's title (*Wet op het accountantsberoep*, 2012, Article 42). All in all, these measures exist so as to protect and promote the integrity of those conducting audits. As a result, clients know that they can depend on the assurance provided by the audit.

1.1.2 Auditing in a digital world

With the introduction of Information Technology (IT), significant changes have occurred in how organizations operate. Leavitt and Whisler (1958), one of the first to coin the term in the late 1950s, define IT as the processing and systematic manipulation of large amounts of information. This also includes the organization and quantification of information as well as the application of "statistical and mathematical methods to decision-making problems" (Leavitt & Whisler, 1958, p. 1). Through continual technological advancements IT has expanded into collaborative information processing and transitioned into the core of businesses (Press, 2013). Additionally,

it has become the epicenter of the explosion of "the amount of data created, stored, moved and consumed" (Press, 2013). In other words, as predicted by Leavitt and Whisler (1958), IT has transformed businesses and how they deal with information. Part of this transformation involves the incorporation of IT into the (financial) processes of almost all businesses (Marris, 2012). A concrete example of this is the fact that nearly every large company has adopted an Enterprise Resource Planning (ERP) system to manage, execute and log important (financial) processes (Chang, Yen, Chang, & Jan, 2014; Klaus, Rosemann, & Gable, 2000). ERPs can be defined as fully integrated computer systems with centralized data storage which aim to encompass the entirety of a business' processes (Klaus et al., 2000; Saharia, Koch, & Tucker, 2008). In context of Leavitt and Whisler (1958)'s definition of IT, ERPs are systems which store, process and manipulate (nearly) all the information related to a business process (or processes).

In line with the significant changes IT has brought about in organizations, the financial audit has also been transformed. The purpose of the audit has not changed, but how this goal is achieved has. For example, the adoption of IT has resulted in the digitization of audit evidence (Marris, 2012). In other words, instead of analyzing stacks of papers, the accountants are looking at a set of entries in an ERP's digital database. This provides accountants with a great opportunity as IT enables them to analyze all financial statements instead of merely a sample (Borthick & Pennington, 2017). On the other hand it is also a challenge. It is much easier to manipulate, hide or obfuscate digital evidence (Marris, 2012). Consider, for example, the evidence of giving approval. In a paper trail this would typically be shown through a prominently placed signature or stamp of approval on the document needing approval. Such approvals are also integrated into digital systems, however, it might not be as obvious. A single screen representing the document needing approval might "not provide visible evidence of the approval" (Marris, 2012, p. 12). The approval might be placed in a sub-menu or a cross-referenced file to which the auditor might not have access. It is possible that the approval is represented in a manner similar to other pieces of information (e.g. a checkbox) and thus potentially misinterpreted by the auditor. Additionally, any (il)licit modifications to the digital evidence can often only be detected through "specifically designed tests" (Marris, 2012, p. 12). In short, the authenticity of digital evidence is not so easily verifiable. This means that the digitization trend complicates an auditor's task.

Expanding upon the digitization trend, regulations around the world have

increased the scope of the financial audit in response to multiple accounting scandals[1] (Teck-Heang & Ali, 2008). *Public Law 107-204: Sarbanes-Oxley Act* (2002) in the United States and *DIRECTIVE 2006/43/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL* (2014) in the European Union, for example, increased the requirements with regard to verifying the internal controls of a (private) organization. While auditors have leaned on internal controls since the early 1930's this new wave of regulations, starting with the *Public Law 107-204: Sarbanes-Oxley Act* (2002), explicitly extended the auditor's duties to include the audit of internal control adequacy with regard to financial reporting (Teck-Heang & Ali, 2008). Where assessing internal control was regarded as 'too expensive' in the 1980s, auditors must now always audit the internal controls related to the financial processes (Teck-Heang & Ali, 2008). Thus, the accountant must explicitly address and provide assurance on the integrity of the financial systems and processes (Hinson, 2007; Teck-Heang & Ali, 2008). By proving the integrity of the financial systems it becomes easier for the auditor to verify the integrity of the digital audit evidence (Marris, 2012). Due to the large role of IT in financial processes this means that they must address the integrity of the related IT systems.

The public sector is not immune to these regulations and trends either. For example, the financial audit of governmental ministries in the Netherlands must include an analysis of the internal controls associated with the IT systems which interact with or generate the financial statements (Auditdienst Rijk, n.d.). In short, the digitization of financial statements and processes has led to the accountant explicitly being held responsible for the integrity of the computer systems and internal controls supporting an organization's financial processes (Nwankpa & Datta, 2012).

Verifying the integrity of the related computer systems is, however, easier said than done. Such requirements necessitate the ability to understand how a computer system operates and the risks associated with the system. For small systems this might be manageable, but at the scope of large-scale organizations it is a different story. The ERPs used in large companies are immensely complicated and require specialized expertise (Klaus et al., 2000; Kuhn & Sutton, 2010). This issue is exasperated as ERPs also have different internal workings and configurations depending on the vendor used: auditing an Oracle system requires different specialized knowledge than auditing a SAP system. Furthermore, through advances in technology, such as big data, the scope and complexity of the systems

[1] For example, those involving Enron, WorldCom, HIH Insurance Ltd or Sunbeam.

and data they must analyse has vastly increased (Borthick & Pennington, 2017). While this increased scope allows for more in-depth analyses, it also places a greater burden of control on the accountant. Borthick and Pennington (2017) note that while auditors have more data to analyze and use as evidence "they are [simultaneously] being pressed to detect deficiencies in internal control over the data on which they rely for evidence" (p. 3). In other words, the advantage of having additional (digital) audit evidence is counteracted by the increased demand to verify the evidence's integrity. Thus, the developments in IT as well as the standards and regulations have placed a greater burden of proof on auditors.

The main implication for the financial audit is that, in order to verify the trustworthiness of financial statements, an accountant is also required to verify the correct operation of the complex and large-scale IT systems on which the financial statements are based. In general, there are two types of controls which must be verified in order to achieve this goal. Firstly, there are application controls which "pertain to the scope of individual business processes or application systems" and check application specific factors such as input, output, data processing and integrity or the existence of an audit trail (Bellino, Wells, & Hunt, 2007, p. 2). Secondly, there are general IT-controls (GITCs) which concern all relevant "systems components, processes, and data present in an organization" and check factors such as authorizations, change management, and (cyber) security (Bellino et al., 2007, p. 2). Auditors must confirm the existence of such general and application controls (Schellevis & van Dijk, 2014). This also necessitates checking if the control is configured in accordance with the relevant (technical) standards and norms (Auditdienst Rijk, n.d.). Furthermore, auditors must verify the proper functioning of such controls (Schellevis & van Dijk, 2014). They could, for example, execute a procedure which would trigger the control and verify its proper operation. A last example would be the analysis of the IT system's logs to ensure no changes to the control's configuration occurred during the period covered by the audit.

By verifying the correct operation of the general and application control an accountant can ease the burden of proof. By verifying these controls the accountant can prove that the risks to financial data integrity are addressed by the auditee in their IT systems. (Schellevis & van Dijk, 2014). This minimizes the need for the execution of manual controls (Chang et al., 2014). Furthermore, under certain conditions it is possible to reuse control findings in the next audit (Auditdienst Rijk, n.d.). Note that functioning GITCs are a necessity should the auditor wish to rely on application controls (Schellevis & van Dijk, 2014). Additionally, if the auditor

is not relying on any application controls there is no point in testing the GITCs (Schellevis & van Dijk, 2014). Aside from easing the burden of proof, IT can also be used during an audit to increase the depth of the manual controls executed (Borthick & Pennington, 2017). For example, an ERP's reporting tools could be used to analyze all line entries for a specific financial statement. In other words, the accountant can automatically check all of the entries instead of manually checking a sample of the entries. Obviously, IT controls remain critical as the integrity of the data and the analysis and reporting tools used must be verified (Borthick & Pennington, 2017).

As discussed in the Dutch auditing trade journal Compact, checking IT controls can, in part, be done by the accountants themselves (Meuldijk, Broskij, & Neeteson, 2007). However, as the complexity of the IT systems increases the (technical) expertise and skills needed exceeds their capabilities (Bauer, Estep, & Malsch, 2018; Boritz, Robinson, Wong, & Kochetova-Kozloski, 2017; Meuldijk et al., 2007). This can make it quite challenging for an accountant to meet the legal requirements for the financial audit. Additionally, IT "has not been a core competency of many accounting professionals" despite the importance of IT controls (J.G. Coyne, Coyne, and Walker as cited in E.M. Coyne, Coyne, & Walker, 2018, p. 167). Nevertheless, it is a challenge that must be addressed as organizations are increasingly becoming dependent on their IT systems (Aditya, Hartanto, & Nugroho, 2018). When considering how an accountant can meet the audit requirements there are two possible solutions to address the missing technical expertise. First, by gaining the required knowledge or, second, by enlisting the help of an expert (van Hornsveld-Clement, 2019).

Gaining the necessary knowledge can be quite a challenge, especially since, as noted earlier, many systems greatly differ from one another. While general knowledge may transition between systems, it is necessary that system specific expertise is on hand to be able to properly assess the reliability and accuracy of the system. Meuldijk et al. (2007), for example, go so far as to suggest that an audit of authorisations within an ERP is already a specialism in and of itself. Additionally, IT is a rapidly changing field which makes it a challenge for (IT-)auditors to remain up to date (Hinson, 2007). Thus, it requires a significant investment by the accountant to gain and maintain the necessary expertise and experience to be able to properly discern the reliability of complex IT systems with respect to the financial audit. Knowing this, it is no surprise that the vast majority of financial auditors only "have limited [IT] knowledge and experience" and generally do not have "additional IT qualifications" (Boritz et al., 2017, p. 55). In

other words, the first solution is not realistic. As such, it can be assumed that, in general, an accountant will not have the IT expertise needed to completely verify the correctness of the systems generating the financial statements.

Since gaining the necessary knowledge is not so self-evident, another approach to the expertise problem must be considered. Luckily, standards and regulations allow an accountant to enlist the help of specialists (Boritz et al., 2017). In fact, IT-specialist usage has become an increasingly important part of the financial audit (Bauer & Estep, 2014; Vendrzyk & Bagranoff, 2003; Vîlsănoiu & Şerban, 2010). Concretely, IT specialists often support the accountant by verifying the trustworthiness of the relevant IT systems (Bauer & Estep, 2014). In other words, IT experts execute a set of IT audit activities with the purpose of supporting the accountant in their analysis of the end-of-year financial statements. For succinctness, these activities will be referred to as IT-audit support and those executing these activities will henceforth be referred to as IT-auditors. Note, however, that while IT-audit support activities outsource the IT expertise from the accountant, regulations and standards stipulate that the accountant remains responsible, and hence accountable, for any conclusions made (International Federation of Accountants (IFAC), 2009; Koninklijke Nederlandse Beroepsorganisatie van Accountants (NBA), 2019). This also means that it is vital that the accountant has enough IT expertise to be able to discern the quality of the IT-audit support work delivered and respond appropriately to the findings (Brazel & Agoglia, 2007; van Hornsveld-Clement, 2019).

1.1.3 Accountant and IT-auditor interaction

The increased importance of IT in the financial audit and the corresponding legal requirements provide an interesting context for research into the interaction and collaboration between the accountant and the IT-auditor. As mentioned earlier, it is essential that the signing authority (i.e. the accountant) is able to interpret and understand the IT-audit support work being done. More importantly, the ability to determine the appropriate actions in response to IT-auditor findings greatly impacts both the usefulness of the IT-audit support activities as well as the quality of the financial audit conclusions (Bauer & Estep, 2014; Bhaskar, Schroeder, & Shepardson, 2018; Stoel, Havelka, & Merhout, 2012). Logically, an IT-auditor's ability to discern an accountant's needs and appropriately communicate the IT-audit support conclusions impacts the role that IT-audit support

can play in the audit (Stoel et al., 2012). With respect to those observations and the place IT-audit support has in the audit, Bauer et al. (2018) and van Hornsveld-Clement (2019) believe that the interaction and cooperation between IT-auditors and accountants have great influence. This suggests that the IT-auditor and accountant interaction is important to effective IT-audit support.

Despite its importance, this cooperation is difficult to realize. Financial auditing is strongly focused on providing an independent judgement on the faithfulness of financial statements to third parties whereas IT-related audits place the emphasis on providing (internal) assurance on the quality of IT systems and processes (Veth, 2009). This means that a translation must be introduced from IT-audit support findings to financial risks or weaknesses. IT-auditors struggle with this translation, especially when considering general IT findings (Bauer et al., 2018; Vendrzyk & Bagranoff, 2003). IT-auditors also have the habit of reporting more findings (e.g. irrelevant, superfluous findings) than those related to the financial audit (Meuldijk et al., 2007). This can result in the analysis of systems or processes which have no relation to the financial audit (Schellevis & van Dijk, 2014). In combination with insufficient IT knowledge on the accountant's side this can result in inefficient and ineffective audits. Brazel and Agoglia (2007) argue that an accountant's IT expertise impacts the audit quality and their evaluation of the IT-audit support findings. Additionally, a negative evaluation of IT-audit support findings also means that the accountant cannot use the available IT controls to "reduce the required number of spot-checking procedures" (Chang et al., 2014, p. 200). In summary of the above literature observations, effective usage of IT-audit support requires the ability to translate IT audit findings into concrete consequences for the financial statement findings.

Additionally, the above works observe that auditors struggle with the translation between IT-audit support findings and financial statement findings. Interviews at the Auditdienst Rijk (ADR) highlight that for many findings it is difficult to understand what its implications are for the financial statements. Does, for example, an incorrect setting in a system's authorization automatically imply that all statements depending on this system are invalid? Not necessarily. For instance, employees might not have known they had more rights than they should and as a result never misused the faulty settings. This showcases that a finding is not always directly linked to an issue for a financial flow or statement which complicates the handling of IT-audit support findings and creates room for mistakes. The proper translation of an IT-audit support finding to an im-

plication for the financial audit is a hurdle that must, therefore, be crossed before effective IT-audit support can be realized.

To cross this hurdle the two distinct fields of practice need to come together and work towards a common goal. IT-auditors must be involved early on in the audit process and frequent and clear communication between the two parties is needed (Boritz et al., 2017). Mutual trust and understanding (e.g. good relationships between the parties) greatly aids in improved audit quality (Bauer et al., 2018). Regretfully, this is often not the case. Vendrzyk and Bagranoff (2003) point out that accountants are "reluctant to give up control of the financial audit" (p. 159) and van Hornsveld-Clement (2019) speaks of two distinct worlds. There is also a lack of understanding among accountants as to what added-value IT-auditors will contribute to the audit (Bauer & Estep, 2014). Furthermore, Bauer et al. (2018) note that these factors tend to result in an 'us vs. them' mentality and a potential power struggle between the two disciplines. This means that, instead of aiming to add value to each other's work, the two disciplines fail to understand how their respective results impact each other or the general audit findings (Bauer et al., 2018). This can lead to gaps in the audit evidence generated (Boritz et al., 2017). As Nwankpa and Datta (2012) describe, IT-audit support involvement is nearly inevitable in the modern financial audit, and thus it is critical that the two disciplines learn to understand one another.

There are three important facets when considering the interaction between the two disciplines: the available knowledge overlap, their perceptions on the role of IT-audit support and the integration of IT-auditors into the audit team. While it is not necessary, or realistic, to have all auditors be experts in both accounting and IT, it is important that they minimally have a basic understanding of both fields. When IT-auditors understand the basic principles of financial accounting, they are better able to determine which findings are relevant for the financial audit (van Hornsveld-Clement, 2019). As described by a lead IT-auditor at the ADR, it allows them to understand what keeps the accountant up at night and what the IT-auditor can do about it (personal communication). In other words, summarizing the lead IT-auditor's colleagues, how the IT-auditor can ensure that the accountant receives, in a timely manner, the assurances needed on the integrity of the IT systems depended upon. Likewise, a better grip on IT principles allows accountants to more easily determine and communicate what they need to know from IT-auditors to be able to verify the integrity of the financial statements (Brazel & Agoglia, 2007; van Hornsveld-Clement, 2019). In other words, it improves both disciplines'

abilities to provide the translation of IT findings into financial risks or weaknesses. Bhaskar et al. (2018) argue that this improved integration of "control-related information into financial statement audits" can improve audit quality (p. 30). Additionally, it promotes a mutual understanding between the disciplines and stimulates a cooperative attitude (Meuldijk et al., 2007).

Another important facet is the perception that each discipline has on the role that IT-audit support plays in the financial audit. An asynchronous perception introduces conflict and dissatisfaction into the interaction between accountants and IT-auditors. Boritz et al. (2017) denote a general dissatisfaction on both sides with respect to the usage of specialists such as IT-auditors during the audit. They attribute this, in part, to differing perspectives on the need for specialist involvement as well as the timing and scoping of their involvement (Boritz et al., 2017). Additionally, there is disagreement on the importance of IT audit activities. While both agree that IT-audit support is becoming more important, accountants see the financial audit as remaining dominant while IT-auditors envision a shift in dominance (Vendrzyk & Bagranoff, 2003). Logically, this can result in differing opinions on budgets, findings and priorities. Therefore, it is crucial that IT-audit support perceptions are aligned between the two disciplines.

The third facet, IT-auditor integration into the audit team, greatly influences the first two facets. An early IT-auditor involvement in the process can lead to improved scoping and planning as well as a reduction in audit risk (Bauer & Estep, 2014). Logically, earlier involvement in the planning and scoping also means that the perceptions and expectations as to what IT-audit support entails can be aligned more easily. Furthermore, Boritz et al. (2017) observe that a lack of specialist integration plays a role in audit budget overruns and delays. Additionally, integrating IT-auditors and accountants into one team for the audit enables the so-called 'cross-fertilization' of knowledge (Bauer & Estep, 2014; Meuldijk et al., 2007). This 'cross-fertilization' builds the foundation for a common understanding of how IT-audit support can best aid the financial audit and in what manner their findings influence the fidelity of the financial statements. With regard to audit integration, it is important to note that (the perception of) the quality of the relationships between the two disciplines, e.g. how integrated the disciplines actually are, greatly influences the added-value that IT-audit support can bring to the audit (Bauer et al., 2018). This emphasizes, once more, how critical it is that IT-auditors and accountants have the capacity and willingness to understand one another and work to-

gether. However, as subsection 1.1.5 will show, IT-auditor and accountant cooperation can often result in added cost instead of added value. Before discussing this, subsection 1.1.4 frames the context in which the IT-auditor and accountant cooperation will be analyzed.

1.1.4 Auditing in the public sector

The financial audit is an important year-to-year activity for any large organization, whether public or private. Fargher, Mayorga, and Trotman argue that there are many similarities between the private and public sector with respect to audit teams and processes (as cited in Axelsen, Green, & Ridley, 2017). For example, the role of IT-audit support is a relevant issue for the private sector as well as the public sector (Axelsen, Coram, Green, & Ridley, 2011; Bauer & Estep, 2014). Additionally, budget and staffing constraints are not specific to a peculiar sector (Boritz et al., 2017; van Hornsveld-Clement, 2019). Nevertheless, there are differences between the two. Most importantly, a private sector audit is requested because the client wishes to appease (directly involved) shareholders (Teck-Heang & Ali, 2008) whereas the public sector uses the audit to inform the (indirectly involved) public of the efficiency and effectiveness of their government's actions (Cordery & Hay, 2019). This means that the private sector focuses on the accuracy of profit figures and the public sector emphasizes compliance and control (Carslaw, Pippin, & Mason, 2012). Furthermore, private sector audit firms have increasingly placed more importance on consulting while public sector auditors, such as SAIs, generally have no other responsibilities than the audit of government's and their agencies (Cordery & Hay, 2019; Vîlsănoiu & Şerban, 2010).

For the remainder of this thesis the focus will be placed on the public sector. By doing this the scope can be contained while ensuring an interesting and dynamic research context. Financial audits of public sector entities are key tools for protecting the public interest (Institute of Internal Auditors (IIA), 2006). This is especially relevant when considering the multi-billion euro scope at which government entities operate (European Commission, n.d.). Additionally, auditors face the complicated challenge of merging auditing standards with "mandatory government guidelines or legal statutes" (Piper, 2015). The public sector is also notable due to the sensitivity of the (financial) data checked in the audits (Drljača & Latinović, 2017). This can include private citizen data (e.g. taxes due) or confidential government information (e.g. military expenses). Combining all these factors, it is evident that the public sector provides an exciting con-

text within which the relationship of IT-audit support in the financial audit can be explored.

At the foundation of the public sector financial audit is the necessity of promoting and verifying government credibility and accountability (Institute of Internal Auditors (IIA), 2006). With this in mind, the Lima Declaration was adopted in 1977 during the ninth International Congress of Supreme Audit Institutions (International Organisation of Supreme Audit Institutions (INTOSAI), 2019). This declaration, which raised a call for independent government auditing, is seen as the starting point or "Magna Carta of government auditing" (International Organisation of Supreme Audit Institutions (INTOSAI), 2019, p. 5). Since then over 195 nations and supranational organizations have adopted its principals (International Organization of Supreme Audit Institutions (INTOSAI), n.d.). Additionally, the need for independent government auditing has also been adopted into the United Nations via Resolution 69/228 (United Nations General Assembly Official Records (UNGAOR), 2014). Internationally, therefore, the need for the public sector financial audit is clearly recognized.

However, how the various nations address this need is not necessarily uniform. In line with the Lima declaration, SAIs were introduced around the world in order to "audit the legality and regularity of [government] financial management and of accounting" (International Organisation of Supreme Audit Institutions (INTOSAI), 2019, p. 8). By doing this they promote and develop "accountability and transparency in government" (European Court of Auditors, 2019, p. 5). How these SAIs are organized and operate, however, differs per nation. In the European Union, for example, some SAIs's are governed by a single individual and others by a committee (European Court of Auditors, 2019). The European Court of Auditors (2019) also observes that the individuals in some of these governing bodies may have limited terms while others remain in function until the statuary retirement age. In the same trend, the scope of their audits and who is considered an auditee varies per nation (European Court of Auditors, 2019). In other words, each nation has defined for itself how the audit should be led, financed and organized. Nevertheless, each nation underpins the same foundational principles. For example, all SAIs in Europe audit ministries and (central) governmental bodies and have a constitutionally enshrined independence from their auditees (European Court of Auditors, 2019).

Within this context of SAIs, the Netherlands has quite an interesting approach to the governmental audit. In accordance with the Lima Declara-

tion, the SAI is allowed to divide and cooperate on the audit responsibilities with the governmental internal auditors[2]. In contrast to the majority of the other SAIs, the Netherlands has shifted the majority of the financial audit work to their internal auditor, the Auditdienst Rijk (ADR). As enshrined in the Dutch Comptabiliteitswet, the ADR conducts the financial audit, and the Dutch SAI, the Algemene Rekenkamer, conducts a legality and regularity audit[3] of the government finances (*Comptabiliteitswet 2016*, 2017; Budding & van Schaik, 2015, p. 149). While the ADR is responsible for conducting the government financial audit it is important to note that this is an internal audit. Their reports are not officially published but instead sent to the minister, the client, and the Algemene Rekenkamer, who uses it for their external audit of the government finances (personal communication; Budding & van Schaik, 2015, p. 149).

The reason for this construction, as explained by the Vaktechniek department at the ADR in a personal conversation, is mostly historical and out of scope of this thesis. Nevertheless, it serves to say that all parties involved see significant advantages in this system (personal communication). As the ADR is an internal auditor, the ministers have direct access to (interim) feedback on the integrity of their department and the opportunity to have the ADR conduct other additional audits (e.g. operational or IT) to improve the performance of their department (personal communication). At the same time, as it uses the ADR's audit as input, the Algemene Rekenkamer can still fulfill their external auditor responsibilities while having created the capacity for conducting legality and regularity audits (personal communication). By having this construction all parties can therefore have insight into the integrity of the governmental finances while efficiently using the resources available to the government.

The Dutch system does, however, lean strongly on the integrity of the auditors at the ADR and it is, therefore, critical that this integrity is protected. The Comptabiliteitswet, in combination with the Besluit Auditdienst Rijk (Ministerie van Financien (2018)), formalizes the ADR mandate and asserts their constitutionally enshrined independence. The latter means that, while auditors at the ADR are officially employees of the Ministry of Finance, the governmental ministers, and their subordinates, can-

[2]Internal auditor refers to an auditor who is in the employ of the auditee with the aim to improve the auditee's operations. In contrast, external auditors are not a part of or related to the auditee and focus on certifying the auditee's adherence to certain set of laws or regulations.

[3]See https://www.ccrek.be/EN/Presentation/Competences.html for a concise description of these audit types.

not direct the ADR with regard to the financial audit as to what and how they should audit (Ministerie van Financien, 2018). So as to further ensure the independence of the ADR and its auditors an independence arrangement has been established. This arrangement, as described in Auditdienst Rijk (n.d.), emphasizes the ADR's conformance to rules and regulations regarding auditor independence as enshrined by the Institute of Internal Auditors Netherlands (IIA NL) as well as the relevant auditor trade organizations (NBA and NOREA). Additionally, the ADR has instituted an independence officer who is responsible for ensuring that the relevant regulations and codes of conduct are adhered to within the ADR (Auditdienst Rijk, n.d.). Lastly, the Algemene Rekenkamer, who depends on the ADR's reports, also continually and critically looks at the quality of the ADR's work (personal communication; Algemene Rekenkamer, n.d.).

The ADR is the audit institution in the Netherlands which is responsible for performing the financial audit of all of the governmental ministries and agencies (Institute of Internal Auditors (IIA), 2017). At the time of writing this means that 12 ministries, where the vast majority have multi-billion euro budgets, are audited (Ministerie van Financien, 2020; Rijksoverheid, n.d.). When considering their scope it is clear that these are no simple audits. Additionally, many of these ministries also employ complex IT infrastructures. As a result, IT-audit support can play a critical role in maintaining high quality audit results in a complex and changing environment. Since the auditees are the same every year and law dictates the financial scope of the audit[4] the ADR provides a relatively consistent environment within which to analyze the interaction between accountants and IT-auditor. As each ministry approaches its finances, IT and auditee role in a different manner it is possible to see how different approaches can result in different perspectives on the need for and usability of IT-audit support. Lastly, the ADR has been transitioning into increased knowledge specialization through expertise groups and increased audit integration as well. Therefore, analysis can show how these shifts have impacted IT-audit support. In other words, within the public sector context, the ADR is a perfect testbed for discovering what factors play a role within the utilization and effectiveness of IT-audit support.

1.1.5 The issue at hand

The test bed that the ADR provides is key. It provides a setting in which it is possible to discover potential solutions to the issue at hand. As argued

[4]See *Comptabiliteitswet 2016* (2017) and Ministerie van Financien (2018).

in subsection 1.1.2, the verification and control of financial statements (i.e. the audit) is increasingly dependent on IT expertise. Expertise which, for complex systems, many accountants do not have. They are, therefore, dependent on IT-auditors. The successful cooperation between the two disciplines is, as shown in subsection 1.1.3, influenced by the available knowledge overlap as well as the synchronization of their perceptions on the role of IT-audit support. The degree of integration of IT-auditors into the audit team also plays a role. However, difficulties still arise in effectively putting IT-audit support to use. Effective IT-audit support means that the accountant is able to depend on and utilize the analysis and findings provided by the IT-auditor.

In theory an increased assurance of IT dependability means that accountants can decrease the amount of manual, sample-based, controls needed (Bellino et al., 2007). An added advantage is that, provided the in-scope IT environment has not been compromised or changed, IT application specific controls can be re-used (Bellino et al., 2007; Schellevis & van Dijk, 2014). For year-on-year audits, such as those conducted by the ADR, this allows for either a less resource intensive or a more in-depth audit in the long run. In short, it saves work. Regretfully, this added-advantage is often not realized. As one IT-auditor notes, depending on the IT-auditor or the accountant the (responses to the) findings can differ while the systems and environments have not (personal communication). Logically, this makes it difficult for auditees to appropriately respond to the audit findings as they would differ between yearly audits. Even if the findings are consistent, the accountant may simply not know what to do with the IT-audit support findings (van Hornsveld-Clement, 2019). In both scenarios this means that auditor resources are wasted. At other instances, as explained by practicing auditors of the ADR, the findings arrive too late for the accountant to be able to appropriately respond (personal communication). They continue by stating that, as a result, it often occurs that the risks addressed and checked by the IT-auditors are simultaneously checked manually by the accountants (personal communication). In other words, duplicate work is conducted. Once again, this means that auditor resources are wasted. Thus, instead of IT-audit support providing the theoretically defined added value, it results in an added cost.

An important part of preventing this added cost and attaining this added value is the proper scoping of the IT-audit support activities. However, accurate scoping is often not realized. Bauer et al. (2018) highlight that "audit teams fail to test [GITCs] for critical systems" because accountants do not fully understand which key systems need testing and IT-auditors

do not know which systems are being relied on (p. 4). In other words, both disciplines do not know what systems must be tested to result in relevant findings the accountant can lean on. Additionally, on the other end of the spectrum, Schellevis and van Dijk (2014) and Meuldijk et al. (2007) observe that IT-audit support can include too many applications or systems in the scope as well. This results in a waste of auditor resources. A balance must be found with what should and what should not be included in the scope of IT-audit support. Interviews at the ADR indicate that this is one of the key challenges: how to make sure not too much IT-audit support is done while ensuring not too little is done either (personal communication). Without this proper balance in the IT-audit support scope, the added cost issue mentioned earlier is only compounded.

Due to the increased adoption and incorporation of IT into organizations, governments and their (financial) processes it is probable that IT-audit support will become increasingly important to the financial audit. This means that auditors must be able to utilize IT-audit support effectively and ensure that accountants are able to appropriately respond to IT-audit support findings. However, as shown above, IT-audit support is resulting in added cost and not added value. In other words, resources are being wasted and the outcomes of IT-audit support are not relevant to or usable by the accountant. It is critical, given the importance of IT-audit support, that this issue is addressed in order to maintain the integrity and reputation of the audit. This challenge forms the core of the research problem:

RP What are key factors influencing the effectiveness of IT-audit support activities in the financial audit within the context of the public sector?

Determining these factors can aid accountants and IT-auditors in understanding how to realize effective IT-audit support within the financial audit. This enables them to use the advantages IT-audit support provides while avoiding the pitfalls of ineffective work. Ideally this results in a positive feedback cycle as accountants realize what advantages IT-audit support can deliver them. Greater usage of IT-audit support also helps future proof the financial audit as the importance of IT continues to rise. Additionally, this research is an opportunity to link together the various academic theories and suggestions on IT-auditor and accountant interaction and collaboration as mentioned in subsection 1.1.3. It places these theories, which are often tested at a 'Big Four'[5] auditor, within the concrete context

[5]Term commonly used to refer to Deloitte, Ernst & Young, KPMG and PricewaterhouseCoopers.

of end-of-year financial audits within the public sector and verifies their applicability. These theories are, additionally, expanded by highlighting factors which have a larger influence on IT-audit support effectiveness. By focusing on the ADR context it is also possible to give a concrete application of theoretical research into the 'real' world. As such, understanding and quantifying what influences IT-audit support effectiveness is a valuable advantage for accountants, IT-auditors and academia.

1.2 Research approach

As described in subsection 1.1.4, the ADR serves as the context within which a solution to the research problem (RP) will be formulated. Within this context, multiple research questions have been designed. These questions each address a (sub)component of the RP and create a step wise approach through which an answer to the RP can be formulated. The supporting questions are as follows:

RQ1a How is IT-audit support effectiveness defined within the context of the ADR?

RQ1b How can IT-audit support effectiveness be measured and quantified?

RQ2 What factors have influenced IT-audit support effectiveness?

RQ3 How does each factor influence IT-audit support effectiveness?

The RP aims to quantify the impact that various factors have on IT-audit support effectiveness in order to derive an overview of key (i.e. high impact) factors. Firstly, RQ1a provides a formalized definition for IT-audit support effectiveness. Based on the formalized definition for IT-audit support effectiveness a method and model for measuring IT-audit support effectiveness is designed by answering RQ1b. This IT-audit support effectiveness measure enables the concrete quantification of how well IT-audit support functions. By aiming for a quantifiable measure, it is possible to have a concrete numerical comparison of the influence potential factors have on IT-audit support effectiveness. These factors are addressed by RQ2. RQ2 looks for a set of potential factors which have been found to impact IT-audit support effectiveness in terms of the definition formed by RQ1a. Lastly, by formulating an answer to RQ3 it is possible to receive an overview of the quantified impact that each factor has on IT-audit support effectiveness. By combining the answers to the supporting questions an

overview is generated of what factors have the greatest measured impact on IT-audit support effectiveness. In other words, the key factors that influence IT-audit support effectiveness. The remainder of this section will address the methodology used to address the RP. Additionally the chapters corresponding to the respective research questions[6] will elaborate further on the selected methodology where necessary.

Methodology

In order to derive a solution to the RP, a mixture of qualitative and quantitative approaches were used. The qualitative approach addressed RQ1a and formulated a definition for IT-audit support effectiveness. Additionally, RQ2 was approached qualitatively so as to elicit a set of potential factors which could influence IT-audit support effectiveness. The quantitative approach was used to formulate an answer for RQ1b. Lastly, the results for RQ1a, RQ1b and RQ2 were used to derive a quantitative solution to RQ3.

The RP is focused on IT-audit support effectiveness, and, because of this, the choice was made to sample within one institute, namely the ADR. As described in subsection 1.1.4, the ADR provides a diverse set of audits and auditees within a common framework. A common framework means that high-level concepts, such as the purpose of an audit, are consistent across the various samples. In other words, an explicit focus could be placed on IT-audit support effectiveness and its determinants without having to discount out-of-scope organizational or auditing differences. While this might mean that not all findings are directly generalizable to other organizations, the thought is that this does provide a more fine tuned model explicitly focused on IT-audit support. It provides auditors with a specialized tool for measuring and improving the effectiveness of incorporating (IT) specialists in the audit. In summary, by focusing on the ADR a consistent context and fixed scope is ensured while simultaneously having a dynamic environment within which factors can be compared. Thus, the first step in addressing the research problem was an in-depth description of the ADR and their audit process so as to create the context within which IT-audit support operates. This description can be found in chapter 2.

Based on the ADR's context a formalized definition of IT-audit support effectiveness was created. This definition, as generated by RQ1a, provided the framework within which RQ1b, RQ2, and RQ3 could be tack-

[6] RQ1a and RQ1b are addressed in chapter 3, RQ2 in chapter 4, and RQ3 in chapter 5.

led. In order to formulate an appropriate definition of IT-audit support effectiveness qualitative analysis was needed. This approach took into consideration both the context of the ADR as well as relevant literature. Academic and professional literature were analyzed to discover how they define audit effectiveness. Additionally, interviews with ADR employees highlighted how they think about IT-audit support effectiveness and the context within which IT-audit support operates. Such framing aided in ensuring a consistent definition of effectiveness throughout the remainder of this thesis. The key components of the definitions and insights gathered were then distilled into a single definition of IT-audit support effectiveness. All in all, by distilling the literature and placing it into the context of the ADR an answer was formulated for RQ1a. This answer formed the basis for developing a measure for IT-audit support effectiveness (RQ1b). Through the literature analysis and interviews conducted, indicators for IT-audit support effectiveness were also formulated. These indicators were then combined to formulate a classification or score of the IT-audit support effectiveness. This measure was used to aid in determining an answer for RQ3. More details on the methodology used and the actual findings for RQ1a and RQ1b can be found in chapter 3.

A qualitative approach was used to determine a set of potential factors (RQ2). In other words, a set of factors which can reasonably be thought to have an impact on IT-audit support effectiveness. Deriving this set of factors occurred through two exploratory tasks. First, semi-structured interviews were conducted with lead IT-auditors, signing accountants and independent quality controllers[7]. A semi-structured approach ensured thematic continuity while allowing the flexibility to explore and discuss the interviewee's opinion on IT-audit support and its effectiveness. The resulting transcripts were then used to extract interviewee observations and opinions as well as the level of support these had among the interviewees. These observations were used to generate an overview of commonly supported (views on) factors affecting IT-audit support effectiveness. Simultaneously, a literature analysis was conducted of works covering audit effectiveness. Commonly supported (views on) factors were aggregated and combined with the interviewee opinions to generate a list of relevant factors. Relevant factors are those which are thought to influence audit (support) effectiveness and for which it can be assumed they exist within the context of IT-audit support. See chapter 4 for a more detailed elaboration on RQ2, the methodology used and the final findings.

[7] See section 2.1 for a description of what these roles entail.

Quantitative analysis was needed in order to be able to empirically analyze the impact that the set of potential factors have on IT-audit support effectiveness (RQ3). A survey conducted among the auditors involved with the end-of-year audit at the ADR served as the basis. By diversifying among the respondents over experience, specialism and ministry it was possible to detect if there were any notable differences across the various factors identified in RQ2. IT-audit support effectiveness acted as the dependent variable and the various factors as the independent variables. The survey consisted of closed questions and covered demographics, effectiveness indicators and the proposed factors. Statistical analysis was conducted on the results of the survey. An elaborated description of the methodology[8] and findings of RQ3 can be found in chapter 5.

By applying the above described approaches a solution to the RP was formulated. Before addressing the specific research questions, chapter 2 first provides an overview of the audit process at the ADR. This serves as the common framework described at the beginning of this subsection. Then chapters 3, 4, and 5 address the specific research questions: respectively RQ1a and RQ1b, RQ2, and RQ3. Each of these chapters includes, where relevant, an overview of the academic and professional opinion as well as an elaboration on the methodology introduced in this subsection. Furthermore, these chapters present their respective findings and provide a preliminary analysis. Lastly, chapter 6 provides a summarizing analysis, presents future avenues of research and gives an overarching conclusion to this thesis.

[8]This approach was inspired by Arena and Azzone (2009). Arena and Azzone (2009) is one of the key works in a similar research field, namely determining the drivers of internal audit effectiveness.

Chapter 2

IT-audit support at the Auditdienst Rijk

The Auditdienst Rijk (ADR) is, as mentioned in subsection 1.1.4, the perfect testbed for discovering possible solutions to the research problem (RP). As the ADR has a consistent approach for the audit it is possible to analyze the influence that specific factors have on the effectiveness of IT-audit support. Before looking at how to measure IT-audit support effectiveness (chapter 3) or influencing factors (chapter 4) it is good to form an understanding of how the audit is conducted at the ADR. Therefore, this chapter will provide a detailed description of how the financial audit process is designed at the ADR. This description also highlights how the interaction between accountants and IT-auditors is designed and in what forms IT-audit support is incorporated into the audit.

There are some practical notes to keep in mind before going into detail on the audit and IT-audit support at the ADR. Firstly, this chapter focuses on the audit process as it was designed, documented and generally executed for the 2019 fiscal year. This audit was completed in March 2020. The models and descriptions presented in this chapter are based on the ADR's auditing manual, the Handboek Auditing Rijksoverheid (HARo) (Auditdienst Rijk, n.d.), as well as conversations and fact-checking sessions with ADR employees. All information presented is, unless explicitly mentioned otherwise, reducible to sections in the HARo. The examples given are based on the conversations with ADR employees as well as (anonymized) dossiers of earlier audits conducted by the ADR. Excepting quotations, no further explicit references will be made to the HARo, the analyzed dossiers

or the conversations conducted. Lastly, the Modeling Guidelines of the Camunda Best Practices[1] are followed wherever possible while modelling the various processes related to the audit in Business Process Model and Notation (BPMN 2.0) process descriptions[2]. This aids in creating a consistent, flexible and readable model of the audit process.

2.1 Audit overview

In order to ensure that the end-of-year audits adheres to the legal requirements encapsulated in the Comptabiliteitswet and the Besluit Auditdienst Rijk[3] the ADR promotes a uniform audit approach. This approach takes into account the regulations with respect to governmental finances[4] as well as the auditing standards of the respective Dutch trade organizations (NBA, NOREA and IIA). The Dutch accounting standards replicate those of the International Auditing and Assurance Standards Board wherever possible in accordance with Dutch laws and regulations (Koninklijke Nederlandse Beroepsorganisatie van Accountants (NBA), 2019). Furthermore, the auditing standards incorporate both Dutch and European accounting regulations and guidelines as well as the auditor Code of Ethics[5]. In this way the ADR's audit is on par with the latest international standards, trends and regulations.

The audit process, as described in this chapter, represents a single instance of the audit. In other words, the end-of-year audit of a single ministry for a single fiscal year. With respect to the client-auditee-auditor relationship a structure similar to that of an internal audit is adopted. A specific ministry serves as the auditee for the audit and a high-ranking official internal to that ministry, often the secretary general, represents the ministry's minister and operates as the client. Additionally, each ministry has an audit committee which advises the auditee on sound financial practices. Where possible the ADR strives to provide footholds upon which the audit committee's advice can be based. These serve to point the auditee in the right direction without prescribing a solution. The latter would not rhyme with the ADR's role as auditor.

[1] See https://camunda.com/best-practices/.

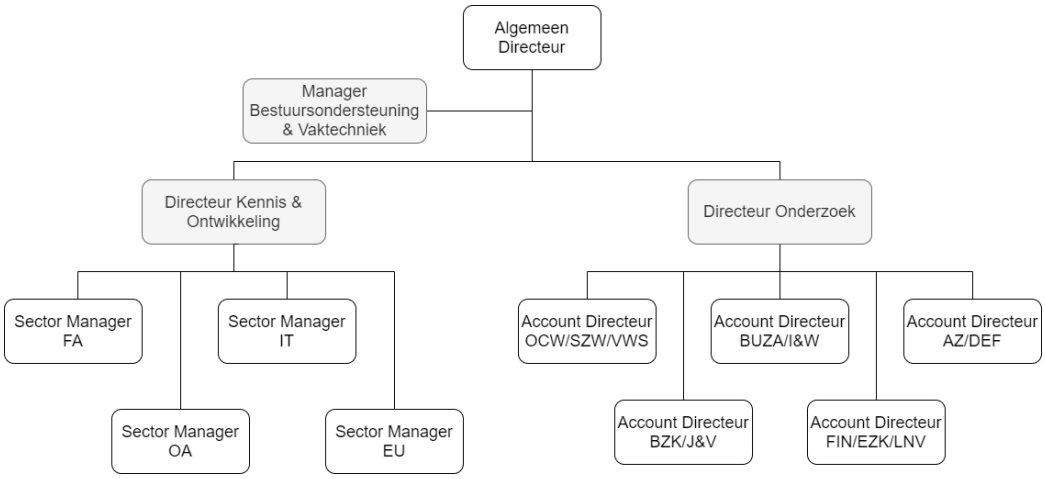
[2] See https://www.bpmnquickguide.com/view-bpmn-quick-guide/ for an introduction to the notation.

[3] see *Comptabiliteitswet 2016* (2017) and Ministerie van Financien (2018) respectively.

[4] See the Handboek Financiële Informatie en Administratie Rijksoverheid accessible at https://www.rijksoverheid.nl/onderwerpen/rijksoverheid/hafir.

[5] See International Federation of Accountants (IFAC) (2005).

Figure 2.1: *Organizational structure of the ADR (based on Auditdienst Rijk (2019, Figure 1)).*



* Colors alternate between hierarchical layers.

The auditee and client are expected to provide their ministry's (concept) financial report as well as fully cooperate with the auditors in providing the requested information. Should they refuse this cooperation the ADR is not able to reject the assignment due to their legal audit mandate. Instead, the Minister of Finance or the Algemene Rekenkamer[6] will intervene. The exact details are dependent on the context and situation, but an example could be the (threat of a) publication of a report for the House of Representatives (Tweede Kamer) highlighting this lack of cooperation. The (potential) political consequences of such a report provide strong encouragement to cooperate with the ADR.

A ministry's audit is not conducted by a single person. The scope is simply too large for a single auditor to be able to properly verify the integrity of a ministry's finances. For this reason the audits are conducted by a team of financial auditors and accountants[7]. When looking at the structure of the ADR, as described in Figure 2.1, these auditors operate from the account corresponding to the auditee[8]. Additionally, specialized experts,

[6] In general, the Algemene Rekenkamer always has a vested interest in the audit as they wish to depend on it for their audit reports. See subsection 1.1.4.

[7] The most important distinction between financial auditors and accountants is that the latter carries an official and protected which allows them to sign and ratify audit findings. Financial auditors do not have that authority.

[8] For example, the accountants auditing the Ministry of Defense fall under the responsibility of the Account Directeur AZ/DEF.

such as IT-auditors are called upon. These experts can either be specialized in a ministry ('account') or specialized in a system or topic ('horizontal'). Looking at the organizational structure, 'account' IT-auditors would fall under the same Account Directeur as the accountants, whereas 'horizontal' IT-auditors operate under the Sector Manager IT. Depending on the requirements and scope of the ministry being audited the composition of the team may change. For example, if an auditee recently completed the deployment of a complex Information Technology (IT) system such as Oracle the team may consist of more 'horizontal' IT-auditors specialized in Oracle. On the other hand, a small ministry with limited IT systems may consist almost entirely of financial auditors and accountants with only a small number of 'account' IT-auditors supporting them.

Despite the team effort, the final responsibility for the entirety of the audit and its findings falls upon the so-called 'signing accountant'. The ADR appoints a different signing accountant to each ministry. Additionally, each ministry is appointed a lead IT-auditor. This person is responsible for the IT-audit support activities and aids the accountant in understanding the relevant IT risks and the impact they may have on financial statements. Furthermore, each individual involved in the audit must provide an annual verification of their independence. In aid of this independence, ADR employees are also rotated over the ministries and horizontal teams or into other audit or assurance assignments every few years.

For succinctness, all 'account' and 'horizontal' personnel involved in the execution of IT-audit support activities in a single audit, as well as the lead IT-auditors themselves, will be referred to as IT-auditor. Furthermore, accountant will refer to all those involved in a single audit from the financial perspective, including the signing accountant. This simplification still emphasizes the interaction between accountants and IT-auditors within the audit while abstracting away from the exact individual. Additionally, it emphasizes the final authority of the signing accountant, being responsible for all the audit work regardless of who executed it. This convention recognizes the lead IT-auditor's responsibilities as well. The term auditor refers to either an accountant or an IT-auditor. Obviously, the work performed by any auditor will ultimately fall under the responsibility of the signing accountant.

Due to its recurring nature and legal mandate there is no explicit trigger for the process. The process must occur each year and, due to the time needed to conduct the audit, the instances (almost) immediately follow one another. After the completion of one set of audits, there is an ADR-

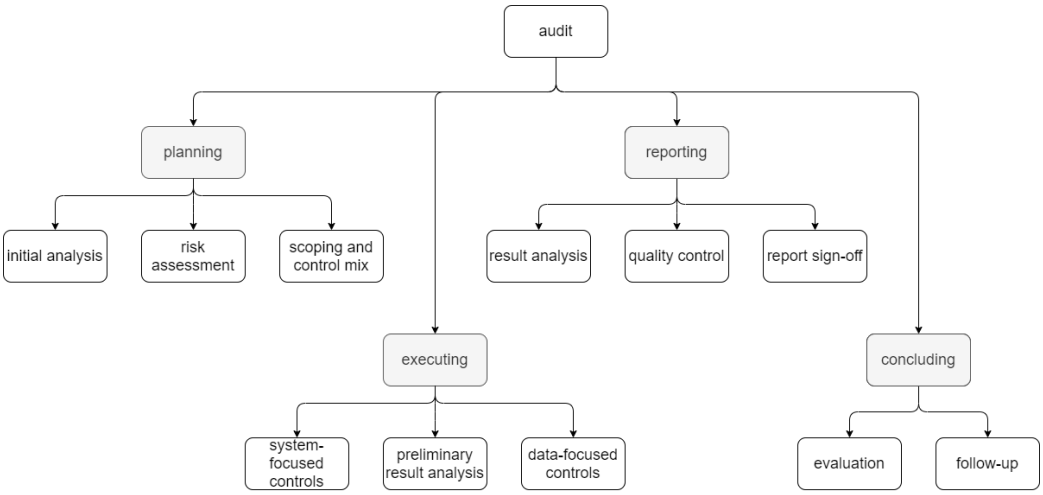
wide planning phase during which ADR personnel is divided across the various audits. Once the personnel is assigned to an audit that audit begins. Often this occurs in April. This continual flow of audits ensures that the ADR can meet their yearly deadline on the 15th of March for the audit of the preceding fiscal year. Ensuring that the audit report and all corresponding audit activities are completed with a sufficient quality level before this deadline is a key indicator of a successful audit.

Beyond achieving the March deadline, there are various indicators of sufficient audit quality and in extension overall audit effectiveness. Firstly, there is an independent quality control[9] which reviews the audit plan as well as the executed work and must approve it before the final audit report is completed. This review looks at the argumentation and evidence provided and documented by the auditor to determine whether it is complete and sound. The reviewer also discerns whether the accountant's conclusion is justified in accordance to the applicable norms and laws. Secondly, the Algemene Rekenkamer, who depends on the ADR's audit findings, also evaluates the audit and indicates whether they find the audit work of sufficient quality to depend upon (Algemene Rekenkamer, n.d.). Additionally, an interdepartmental committee Auditdienst Rijk, led by the secretary general of the Ministry of Finance, monitors the overall audit quality of the ADR (Ministerie van Financien, 2018). Lastly, as a member of various audit trade organizations, such as the IIA and NBA, the ADR is subject to external quality control from these organizations. These organizations verify whether the audits conducted by the ADR adhere to the standards, regulations and expectations of the respective trade organizations. Positive evaluations by the independent quality controller, the Algemene Rekenkamer, the committee Auditdienst Rijk and the respective trade organizations are interpreted by the ADR as indicators that the respective audit was of sufficient quality. In other words, whether the audits conducted by the ADR meet the standards, regulations and expectations belonging to their role and position. Next to audit quality, the ADR's management also measures the audit efficiency by tracking the number of recorded working hours needed for the audit

Throughout the audit the auditors, obviously, must interact with the auditee. Generally speaking interaction with the auditee occurs at two levels: managerial and operational. At the managerial level, the interaction is mostly limited and focused on the formal procedures of the audit and communication on the progress and findings of the audit. The ADR's

[9] See also subsection 2.4.2.

Figure 2.2: *A hierarchical overview of the processes involved in the financial audit at the ADR.*



management as well as the signing accountant and, if relevant, the lead IT-auditor are involved at this level. The vast majority of the auditors interact at the operational level. They will, for example, visit auditee facilities and interview operational employees or analyze auditee systems. At the operational level interaction with the auditee is as direct as possible. In other words, the auditor needing something from the auditee will communicate directly with the auditee.

From a global perspective the audit can be subdivided into four main phases: planning, executing, reporting and concluding. These phases are highlighted in gray in Figure 2.2 and form the scaffolding on which the process description is built. Figure 2.2 depicts each phase and (sub)process uniformly for the purpose of legibility. However, it is important to note that the duration or scope of the phases is not necessarily uniform. In practice, for example, the executing phase takes a significant amount of time compared to the other phases. Additionally, planning significantly impacts the other phases whereas concluding mostly has an impact on future audits. Each phase consists of various processes which play a role in realizing the goals of the respective phase. More details on the various phases will be provided in the subsequent sections, namely section 2.2 (planning), section 2.3 (executing), section 2.4 (reporting) and section 2.5 (concluding).

2.2 Planning the audit

The planning phase is critical in shaping the audit, the depth of analysis and the type of findings the auditors are able to uncover. In short, this phase is about determining the auditee's material risks and deciding what mix of manual and IT supported controls are needed to address these risks. Material risks address the risk of an issue or situation occurring which, if realized, "could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements" (International Auditing and Assurance Standards Board (IAASB), 2009, p. 73). In other words, different choices would have probably been made if the material issue had not been present. An example of a material issue is a misstatement of significant magnitude, say 5% of total costs and income for a budget article. Another example would be questionable financial behavior such as government concessions being granted to friends of the decision makers. The trustworthiness of the government's finances hinges on the absence of such material issues. Thus the audit must show that all material risks have been addressed and the planning phase is the first step in ensuring this. Three processes have been identified which work in concert to realize the goals of the planning phase. These processes, depicted as child nodes of the planning phase in Figure 2.2, are initial analysis, risk assessment and scoping and control mix.

2.2.1 Initial analysis

The financial audit aims to verify the trustworthiness of a government ministry's financial statements. However, considering the vast scope of a government ministry and the complexity of government finances this is not simple. Hence, as a first step, an understanding of the auditee's financial statements and their associated processes and systems is needed. This provides the auditors with general insights into how the auditee operates and what risks are associated with this mode of operation. From there it is possible to determine what audit activities are within scope, e.g. what activities are needed in order to be able to verify the financial statements. Lastly, this initial analysis aids the accountants in determining the need for and scope of IT-audit support during the audit.

In Figure 2.3 a BPMN 2.0 style process description of the initial analysis process is found. A BPMN 2.0 process description describes the various (sequence of) steps within the process, the players involved and the interaction which occurs between the various players. Each (type of) player in

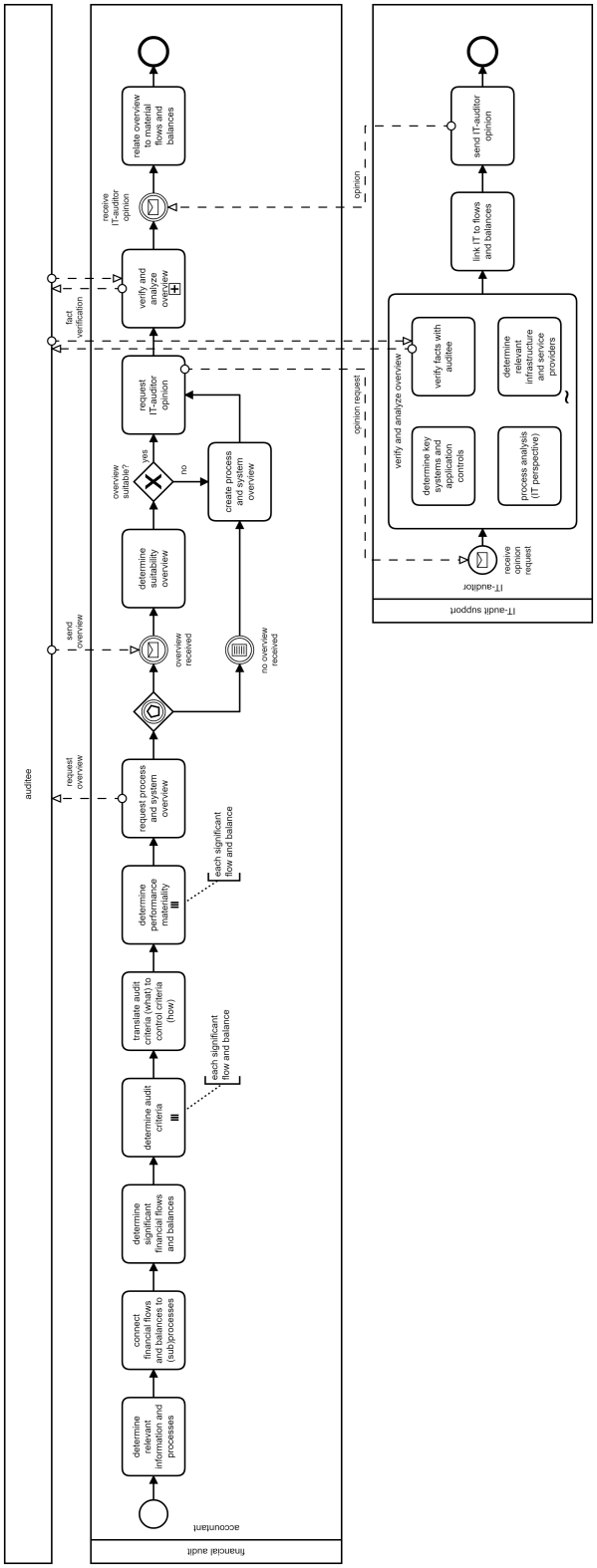


Figure 2.3: *A BPMN 2.0 process description of the initial analysis process within the planning phase of the audit.*

the process is given their own lane with each activity in that lane being executed by said player and all interaction between lanes refers to explicit communication between players. When considering the organizational typology given in Figure 2.2 and the various types of auditors involved it is important to note that not each specific individual has their own lane. As noted section 2.1, the audit is conducted by a team and depending on the ministry the composition of that team may change. Additionally, when specifically considering IT-auditors, the same task may be executed by an 'account' or a 'horizontal' IT-auditor dependent on the audit and the auditee. Thus, the lanes describe only the discipline (financial or IT) involved in accordance to the nomenclature introduced in section 2.1[10]. Such an approach also ensures that the process description is generalizable to all the financial statement end-of-year audits conducted by the ADR. This approach will not only be used for Figure 2.3, but also for all other BPMN 2.0 process descriptions given in this chapter.

As is evident from figure Figure 2.3 this process begins with the accountants. The accountants are tasked with determining what processes are relevant for the financial audit and how these processes are related to the auditee's financial flows and balances. In order to do this the accountants begin with analyzing the auditee's end-of-year financial report and determining what processes are involved. Due to the scope of the auditee it is not possible to audit every single statement and thus the audit focuses on the significant flows and balances. These are determined based on the processes involved. The significance of a flow or balance is based on the importance of the said flow or balance for the ministry's general operation and financial statements. This can be based on numerical significance or contextual significance. Numerical significance refers to the scope of a flow within financial statements. For example, if the subsidy flow is only 0.1% of a budget article while welfare payments cover 30% of the same budget article the latter is obviously much more significant. Contextual significance denotes that a flow or balance is significant due to contextual factors. Suppose there had recently been a subsidy scandal within the auditee. Then the subsidy flow from the previous example would still be taken into consideration due to its contextual significance.

For each of the selected flows and balances the relevant audit criteria are then determined and translated to control criteria. Audit criteria refer to what must be tested and control criteria refer to concretely how the audit

[10] Accountant refers to all those involved from the financial perspective and IT-auditor refers to all those involved from the IT perspective.

criteria will be tested. More concretely audit criteria are generic criteria which must be addressed during the audit if a certain flow or process is tested. Control criteria are the translation of the general audit criteria to the specific flows selected. For example, an audit criterion could be that te reported flows, incomes or expenses must have actually existed. Control criteria would then prescribe controls which show that the audit criterion is met. For instance, control criteria would check whether welfare payments were indeed paid out to people needing welfare, were paid out in this financial year and by the department responsible for the specific financial flow or budget article. Through these example control criteria it can be shown that the welfare payment flow indeed meets the audit criterion.

Next to the audit and control criteria, the performance materiality is determined for the various flows and balances. Performance materiality refers to the thresholds used to determine whether a misstatement, issue or risk is deemed to be material. The performance materiality will play an important role later on in subsection 2.2.2. Additionally, it aids in the scoping of the audit tasks to be scheduled and helps determine which processes should be focused on during the audit. In general, the performance materiality is based on the best practices within the ADR as documented in the HARo. These best practices provide multiple thresholds for which the most applicable threshold is selected for the respective flow or balance. For example, for budget articles below 250 million euros an initial[11] performance materiality of 10% is used. In other words, the net sum of deviations for this budget article must be at least 25 million euros for the misstatements to be regarded as material.

With this information in hand the auditor requests a detailed overview from the auditee of the relevant processes and the systems and activities that make up such a process. If no suitable overview already exists the accountants must make one themselves. Where possible, however, the existing overviews present within the auditee are used. Using the auditee's overview not only allows for time savings but the existence or quality of such an overview also gives initial insights into the level and quality of the auditee's internal controls.

At this moment the IT-auditors become involved in the initial analysis process. At the request of the accountants they analyze the overview from an

[11]Note that this is the initial threshold. Depending on regulatory factors or other thresholds that might also apply the final performance materiality might differ. The exact details for this are, however, out of scope for this thesis.

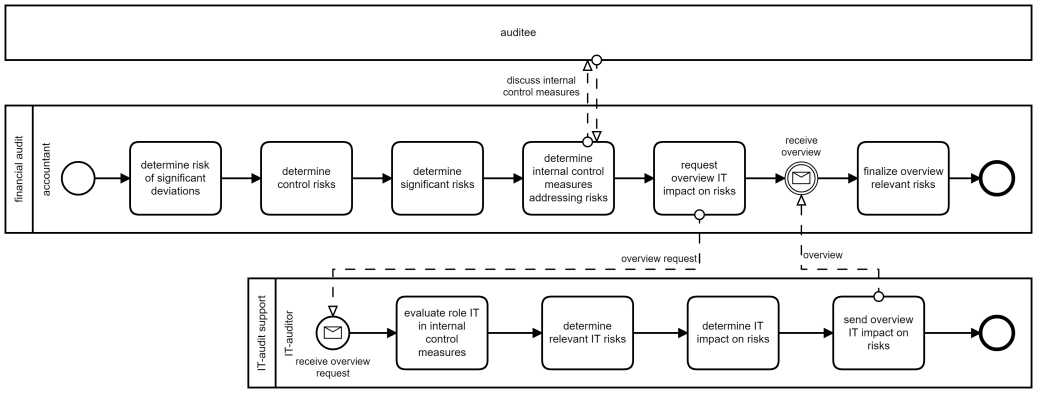
IT perspective in order to be able to determine what systems are key to the audit. Generally, the accountant talks an 'account' IT-auditor through the information gathered so far and asks the IT-auditor to then analyze it in more detail. The IT-auditors' analysis, in short, consists of a look at what IT systems are critical to the accuracy and integrity of the financial statements. This also means that these systems are (in)directly linked to the flows and balances identified by the accountants. The results of the analysis and the IT-auditors' determination of what systems are relevant to the audit are then documented in the dossier and shared and discussed with the accountants. The accountants, who have also conducted their own analysis of the process overview, link their analysis with the IT-auditors' analysis and relate it all to the flows and balances. At the conclusion of this process the auditors thus have an overview of the relevant processes and (IT) systems. The auditors also understand how these relate to the flows and balances and have determined the criteria defining what is material and what sort of controls are needed. This provides the foundation needed to conduct a more in-depth risk analysis.

2.2.2 Risk assessment

Now that the auditors have formulated an overview of the auditee's processes and systems and how they play a role in the financial statement it is possible to assess the risks related to the audit. Understanding the relevant risks helps the auditors direct the focus of their work. In other words, they know what flows and balances, controls and other audit activities warrant extra attention. Additionally, it places the auditee's risk-reducing control measures in perspective. The end-goal of the risk assessment process is an overview of the relevant risks for the audit. This overview should enable the auditors to determine the audit's key focus areas as well as the (type of) controls needed to address the risks.

The auditors assess multiple types of risks related to the financial audit. The starting point, as also shown in Figure 2.4, concerns the risk of significant deviations of flows and balances. Concretely, this is the risk that a deviation in a flow or balance exceeds the performance materiality threshold established in the previous process. Using the performance materiality example, this would be the risk that there is more than 25 million euros of deviations on that budget article. The auditors then determine the control risks. Control risks are a function of the risk of significant deviation and the risk that such a deviation is not detected. In other words, the control risk is the risk that there is a significant deviation which was not detected

Figure 2.4: *A BPMN 2.0 process description of the risk assessment process within the planning phase of the audit.*



by the auditor. The lower the control risks, the more certain we can be that the auditor's observations on the trustworthiness of the financial statements match reality. As a result the control risk must be minimized to an acceptable level. The ADR, for example, maintains a maximum control risk of 5%. The control risk could be reduced, for example, by expanding the scope of the audit activities. Scope expansion could occur, for instance, by using an IT tool to control all welfare payments instead of sampling a few welfare payments manually.

Knowing the risk of significant deviations and the control risks the auditors can now determine the significant risks. These are the risks which warrant special attention. This could, for example, be the case for complex financial flows or processes. Due to their complexity the risk is higher that deviations are not detected and thus an extra look could be warranted. Another example could be a fraud-prone subsidy program for which the risk of material deviation is higher. In other words, the significant risks highlight flows or balances which require a more in-depth analysis by the auditors.

As a next step, and in collaboration with the auditee, the accountants determine what internal control measures are in place at the auditee which already address the risks detected in the previous steps. This is done by looking through the auditee's procedures and documents as well as through interviews with relevant employees. Under the direction of the lead IT-auditor, the relevant 'account' and 'horizontal' IT-auditors will also look at the risks and control measures. They do this in order to analyze the role that IT plays in addressing these risks as well as the added

risks that the involvement of IT might bring. For example, an IT control could be in place to prevent duplicate invoices. The IT-auditors would then analyse what would be needed to ensure this control can be relied upon. In other words, what IT risks must be addressed during the audit to confirm the proper operation of the control. In regards to the duplicate invoice example, an IT risk could concern the risk of a (temporary) deactivation of the automated control preventing duplicate invoices. At the end of this process the lead IT-auditor sends the overview to the accountants and discusses it with them. The accountants then combine all of the gathered information into an overview of the relevant risks to be addressed during the audit. This overview contains the risks along with their probability and their impact on the integrity of the financial statements and the related supporting (IT) systems and processes.

2.2.3 Scoping and control mix

With the completion of the risk assessment the final process in the planning phase can be entered. The scoping and control mix process translates the risks into a set of expected audit end products. In other words, it results in a plan highlighting what should be done to provide the signing accountant with sufficient evidence of the trustworthiness and integrity of the auditee's financial statements. Initially, the emphasis is placed on determining and planning the system-focused controls. These allow the auditors to determine the reliability of the (IT) systems and processes which result in the financial statements. If those systems are reliable the auditors are more efficiently able to increase the depth and breath of the audit scope in comparison to purely using data-focused controls[12]. In a later process data-focused controls will be scheduled to address potential uncovered issues and those risks not sufficiently covered by the system-focused controls. During the scoping and control mix process the accountants also determine to what extent they wish to rely on IT-audit support. This is highly dependent on the IT complexity of the system in scope, but in general it can be expected that all end-of-year financial statement audits of a government ministry will involve IT-audit support. The set of controls to be executed, including the outline of approach and the audit end products, forms the audit's control mix. The process of coming to this control mix is depicted in Figure 2.5.

In order to come to a control mix, the auditors must first translate each

[12]See section 2.3 for a more in-depth explanation on the difference between system-focused and data-focused controls.

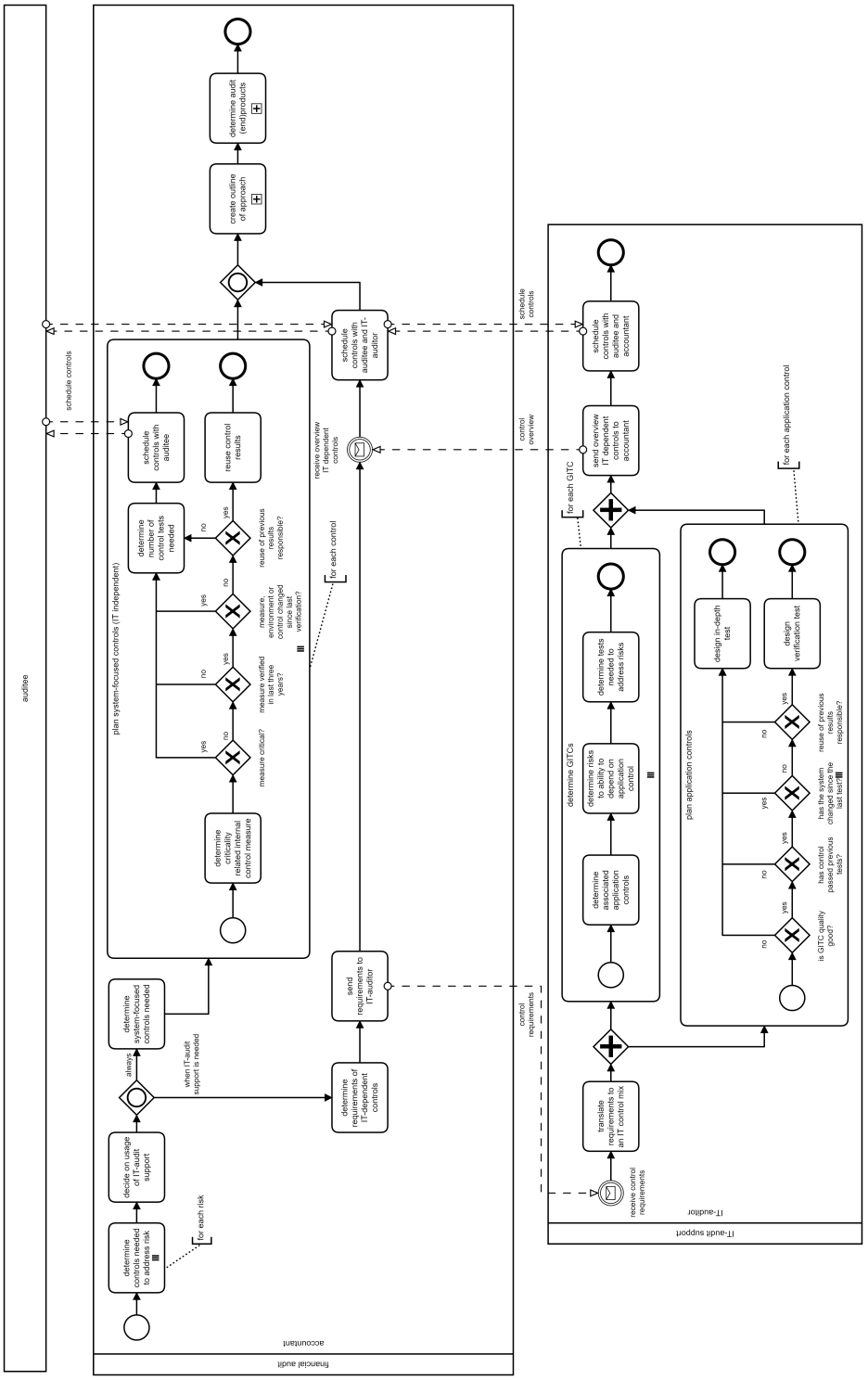


Figure 2.5: *A BPMN 2.0 process description of the scoping and control mix process within the planning phase of the audit.*

risk into a set of controls. These controls describe how the risk can be addressed, how to detect it or how to prevent or mitigate the risk. For instance, in order to address the risk of incorrectly granted subsidies, a control could look at whether all subsidy approvals were confirmed by an authorized individual who was not the individual who initially approved the subsidy. Based on the proposed control measures the accountants determine whether and in what form they would like to make use of IT-audit support. The example given above, can easily be enforced by an Enterprise Resource Planning (ERP) system. IT-audit support would then be used to confirm that this automated control was properly configured and functioning throughout the time period in question.

When opting into IT-audit support usage, the accountants need to communicate to the IT-auditors what assurances they need to be able to rely on the IT-audit support results. This is done through establishing a set of requirements describing the assurances they need. For example, consider the segregation of duties in the welfare payments process. The accountant would want the assurance that the individual initiating the transfer of money to a person on welfare payments is not the same individual who determines whether someone is eligible for welfare. The requirements would then state that IT-audit support must prove that such a dual role is not possible in the IT systems used for the welfare payments process. Due to the recurring nature of the audit these requirements can often be re-used and adapted from earlier instances in which such an assurance was needed.

For the IT independent controls the accountants enter the sub-process of determining how in-depth the controls must be tested. Auditors are, under certain conditions, allowed to reuse control results from the previous year's audit. In order to do this they must analyze the critically of the measure, the amount of time elapsed since the last in-depth control and the stability of the systems and environment the control operates in. If results cannot be reused the auditors determine the scope of the control verification based on how often the auditee, on average, depends on the control. For example, a daily executed control is tested more often than a control triggered once a year. This approach is also used as it is not possible to verify the correct operation of a control more often than the amount of times the control was used. Where needed, the testing of the controls, e.g. through on site test days, is scheduled with the auditee.

Having received the accountants' requirements, the IT-auditors translate these into a set of application controls and general IT-controls (GITCs). As

described in section 1.1, application controls verify the integrity of a specific process step or application. In the welfare payments example an application control would check that a user has a certain authorization before the user is allowed to mark someone as eligible for welfare payments. Additionally, a GITC, which is more generic and addresses the entire system, would look at the user management and confirm that it is not possible for a user to have the 'determine eligibility' and 'payout welfare' authorizations at the same time. Typically, application controls directly address risks related to financial statements. The failure of such a 'determine eligibility' authorization check, for example, can directly be translated to a consequence for the financial statements: someone without the proper authorization has been spending government money. GITCs, on the other hand, more commonly do not directly address financial statement risks. For example, a GITC could look into the configuration of firewalls to ensure undesired network access is prevented. However, faulty firewalls do not directly translate to a consequence for the financial statements. The impact is much more indirect as it merely means that the system might have enabled someone to circumvent the system's application controls. This is also the reason why properly functioning GITC are critical when using application controls. Failed GITC leave room for the possibility that digitized procedures and application controls were bypassed or in some other way abused. In other words, as noted by Schellevis and van Dijk (2014), properly functioning GITCs must be in place should the auditors wish to depend on application controls.

Similarly to IT independent system-focused controls, it is possible for IT-auditors to adjust the scope of their controls when certain conditions are met. These allow them to reuse the results of previous years or to only verify the continued operation of the controls as opposed to having to conduct in-depth tests each year. The scope of application control testing is largely dependent on the quality of the GITCs as well as the stability of the system within which the control operates. Based on the IT-auditors's assessments a test is designed for each application control. For the GITCs, the scope of the testing is based on the application controls dependent on the GITC. In other words, the IT-auditors look at what aspects of the GITCs must be tested to be satisfied that the application controls can depend on the respective GITCs. Based on this the IT-auditors determine how the GITCs must be tested. A summary of how the IT-auditors will test the general and application specific controls is sent to the lead IT-auditor who then discusses it with the accountants. Together, the auditors schedule these controls with the auditee.

At the end of the process the accountants summarize the developed and scheduled controls into an outline of approach. Additionally, they define the end products of the audit. The approach and end products also include a description of any risks that are not covered by the system-focused controls. These will be addressed by the data-focused controls. Often the outline of approach and the end products are combined into a so-called control matrix accessible to all involved auditors. This serves as a point-of-reference to what will be audited and how this will be done. The control matrix describes, for each relevant flow and balance, the related risks and their impact and likelihood. Additionally, it describes the internal controls the auditee uses to address these risks. Where applicable, the system-focused controls and data-focused controls used are also mentioned for each relevant flow and balance. All together the formulation of the outline and end products in this control matrix brings the planning phase of the audit to a close. The auditors now have an overview of what they aim to test in order to be able to verify the integrity of the auditee's financial statements. Additionally, they have an understanding of the risks which could challenge the financial statement integrity and how they aim to address them.

2.3 Executing the audit

In the execution phase of the audit, the auditors actively investigate the auditee and execute the control activities as planned in the previous phase. The existence and continual operation of each control is verified and compared to the relevant standards and norms. At the conclusion of this phase the auditors have a complete overview of the audit findings and the accountant is able to determine what the final audit judgement will be. The executing phase begins with the system-focused controls (subsection 2.3.1) and, after a preliminary analysis (subsection 2.3.2), ends with the data-focused controls (subsection 2.3.3).

System-focused controls look at the systems and processes in place and aim to verify whether they have properly addressed the applicable risks. The data-focused controls analyze the actual numbers in the financial statements to see if they are trustworthy. When a system-focused control properly functions it means that the risks it addresses were prevented. In other words, the (negative) impact those risks could have on the financial statement integrity is not present. Note that it might be necessary to verify multiple system-focused controls before a risk is fully addressed. If prop-

erly addressed, it also means that there is no need to execute data-focused controls with respect to the risks covered by the system-focused control Additionally, system-focused controls can generally cover a wider breadth of transactions and other process steps than (manual) data-focused controls.

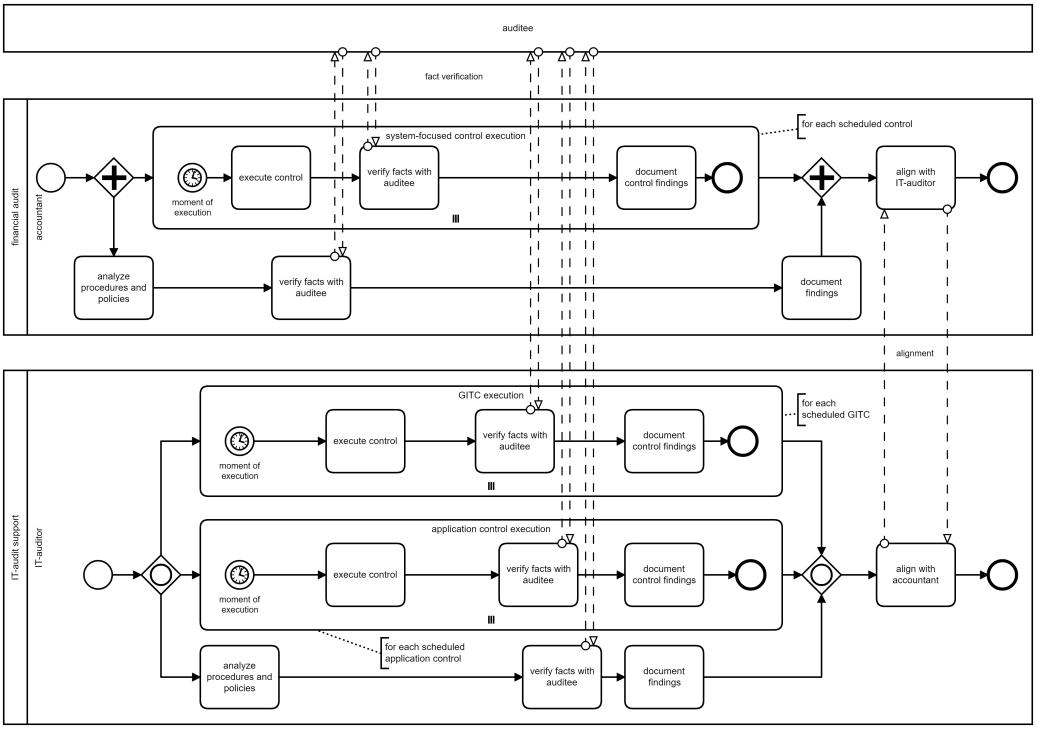
To give an example, suppose that the system-focused controls verified that the ministry's digital purchasing system will never enable someone to purchase a product unless a second individual with the proper authorizations approves the purchase. Then the accountant knows that all purchases made within the purchasing system, which could be tens of thousands of purchases, were properly authorized. To achieve the same degree of certainty with data-focused controls the auditor would have to check every single one of those purchases to confirm they were properly authorized. In other words, the proper functioning of system-focused controls can significantly decrease the amount of data-focused control activities needed. While this is a useful advantage, it is important that the (long-term) time savings of executing less data-focused controls is kept in balance with the time investment of verifying a system-focused control. Additionally, the less digital the process in question is, the less likely it is that the auditor can depend on system-focused controls. Generally, however, data-focused controls compensate for failed system-focused controls or address risks for which no system-focused controls were executed.

2.3.1 System-focused controls

As the name implies this process describes the execution of the system-focused controls. These controls, as determined and planned in the previous phase, are tested and verified by the auditors. At the end of this phase the accountants and IT-auditors discuss and align the test results. Additionally, the lead IT-auditor is responsible for tracking the progress of the IT-audit support activities and keeping the signing accountant up to date.

The process of executing the system-focused controls, as shown in Figure 2.6, consists of a selection of sub-processes which are executed for each of the scheduled controls. In essence, each process operates along the same principles: the control is executed, fact verification occurs and the findings are documented. Fact verification with the auditee ensures that both the auditors and auditee are aligned and in agreement on the factual observations made by the auditors. It should be clear that this

Figure 2.6: *A BPMN 2.0 process description of the system-focused controls process within the executing phase of the audit.*



alignment is about the factual observations and is not about aligning opinions on whether something is satisfactory or not. In other words, it is about whether both parties agree that situation 'X' occurred and not about agreeing on whether the occurrence of 'X' is good or bad. The auditors are solely responsible for determining and documenting their findings on the sufficiency of the executed controls. A simplified example of what the steps involved in the execution of system-focused controls could look like can be found in Table 2.1.

In addition to the execution of the scheduled controls both accountants and IT-auditors also analyze the procedures and policies in-place at the auditee. These highlight the manual controls and structures in place at the auditee. Such manual controls could, for example, be used to compensate for risks not covered by the system-focused controls. Additionally, they could also address situations in which no digitized solution is implemented at the auditee. A very basic example of an in-place policy could be the policy that computers must always be locked when the logged-in user is not present. This helps address the risk of unauthorized access

Table 2.1: *A simplified example of the steps involved in a system-focused control.*

Purpose	Verify whether all purchases were approved under the 'four-eyes' principle.
Execution	1. Confirm settings of the purchasing module always enforce request for approval. 2. Confirm approval can only be given by those with the proper authorization for approving orders of that budget. 3. Confirm approval cannot be given by the person requesting it. 4. Confirm above settings were always active during the period covered by the audit 5. Observe that the 'authorization setting' (step 2) was not active in the 12^{th} week of the year.
Verification	1. Confirm auditee knows that the 'authorization setting' was temporarily inactive. If yes, request reasoning behind the inactivation. 2. Confirm what mitigating factors auditee might have taken during this period.
Findings	1. 'Four-eyes' principle generally upheld. 2. Additional controls needed to confirm nothing went wrong in the 12^{th} week. 3. Additional controls needed to confirm no other settings were deactivated during the audit period.

to financial systems. Upon the successful execution of all of the controls and the analysis of the procedures and policies the accountants and IT-auditors align their conclusion. Afterwards the auditors are ready for the next process.

2.3.2 Preliminary result analysis

After the execution of the system-focused controls the results are analyzed and a first impression is formed on the existence of deviations. The found deviations, and more importantly, their impact on the risk assessment conducted form the basis for any needed adjustments to the audit plan. In

other words, whether additional system-focused controls need to be executed and what data-focused controls should be scheduled. Thus, the preliminary analysis not only gives an early indication for the integrity of the auditee, but it also narrows down the scope of the work to be executed in the data-focused controls process. As shown in Figure 2.7, the preliminary result analysis is shaped by two main sections: the analysis of the system-focused control results and the adjustments to the audit plan.

The analysis of the system-focused control results centers around one key aspect, namely the existence of notable deviations. Notable deviations are those deviations which concern the auditors and for which it is not expected that data-focused controls alone are sufficient to address them. It could also be that the auditors simply do not have enough information to be able to make a proper judgment on how to respond to the found deviation. In these cases the auditors determine what additional information or assurances would be needed and perform an additional in-depth analysis to receive those assurances. Continuing the simplified example given in Table 2.1, the analysis into whether any other settings were deactivated during the audit would be an example of a scenario requiring additional in-depth analysis. How this process, and most importantly the interaction between accountants and IT-auditors occurs exactly is obviously dependent on the nature of the deviation. The example of needing to look into the deactivation of other settings could probably best be looked at by IT-auditors. An additional look into the auditee's internal controls might, on the other hand, be more likely to fall under the accountant's responsibility. Most importantly, the disciplines need to communicate with one another and discuss how these additional controls should be realized. Similarly to the system-focused controls, the facts are aligned with the auditee while the auditors alone translate the results into audit findings.

All of the deviations, whether additional analysis was needed or not, are also analyzed with respect to their impact on the risk assessment. The preliminary results could have introduced new risks which were not considered during the risk assessment phase. Thus, it is confirmed whether the current audit plan is, given the new results, still sufficient to address the present risks. If that is not deemed the case, the accountants can adjust the audit plan. An adjustment could include the scheduling of additional (data-focused) controls. For example, in line with the case in Table 2.1, a data-focused control could be scheduled which analyses the purchases orders to see if there was an unnatural increase in purchase amounts during the 12^{th} week. Alternatively, the issue could be analyzed through IT enabled data or log analysis. The audit plan adjustments needed depend on

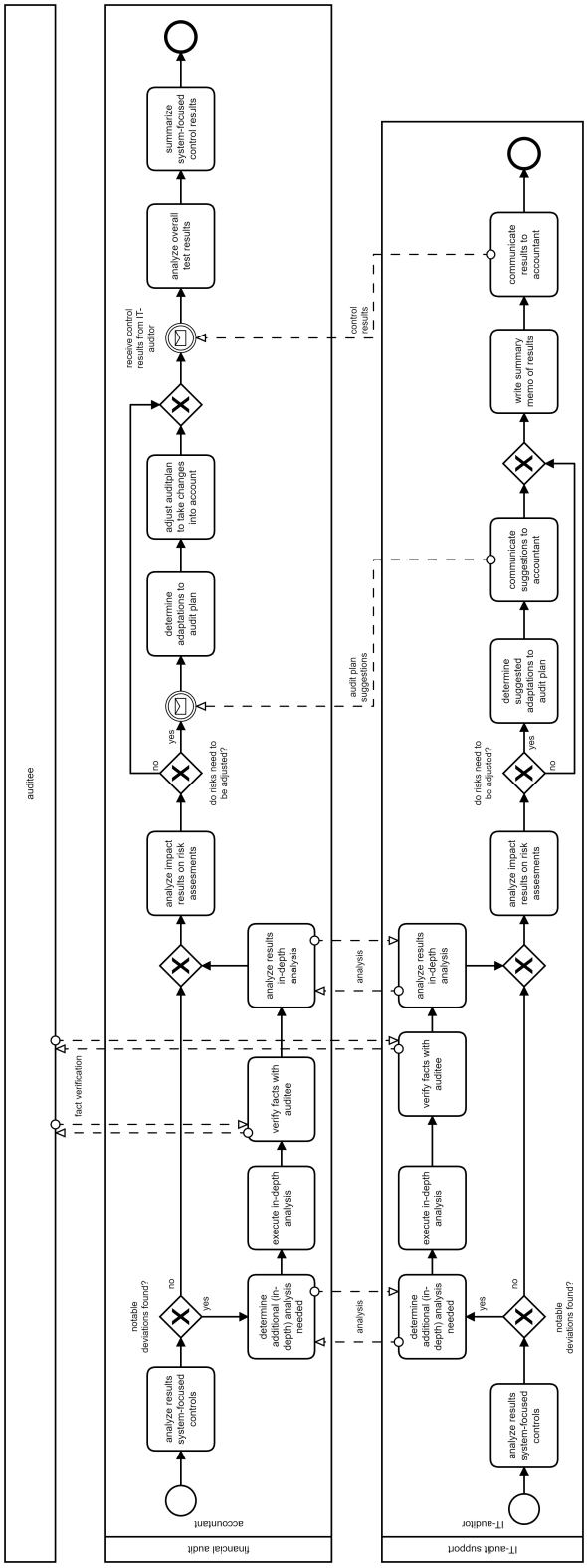


Figure 2.7: *A BPMN 2.0 process description of the preliminary result analysis process within the executing phase of the audit.*

the materiality of the remaining risks. The IT-auditors, usually through the lead IT-auditor, may suggest adaptations to the plan. However, the signing accountant determines what adaptations, if any, will be incorporated. This is so because the signing accountant is ultimately responsible for determining what evidence is needed and sufficient to confirm the (lack of) integrity of the auditee's financial statements. A last step in the preliminary result analysis process concerns the documenting and summarizing of the system-focused control results.

2.3.3 Data-focused controls

The last process within the executing phase concerns the data-focused controls. Essentially the aim is to analyze the financial flows and statements in order to detect material mistakes and deviations. Due to the large scope and number of financial statements this would traditionally occur on the basis of samples. However, the advent of IT has also enabled tools which can analyze complete sets of financial statements. To put it explicitly, IT has allowed auditors to increase the depth and scope of their data-focused controls.

As shown in Figure 2.8, the first step is to determine, based on the preliminary analysis, the exact data-focused controls which need to be executed and the scope of each data-focused control. The accountants select these controls based on the assurances they still need to be able to confirm the integrity of the financial statements. Therefore, the set of data-focused controls is dependent on the risks defined in subsection 2.2.2 and the analysis of the system-focused controls as described in subsection 2.3.2. Generally, the auditing standards and best practices , as documented in the HARo, are used to determine what the required detail level of these controls needs to be. After determining what data-focused controls to execute, the accountants determine how they wish to execute these controls and what (IT) tools they need for this. In this process the IT-auditors are mainly concerned with providing the accountants with the tools they need. Additionally, IT-auditors may perform data or system analyses at the accountants request. Regardless of how the data-focused controls are executed, the facts are verified with the auditee and the accountants and IT-auditors align the control results.

With regard to the actual execution of the data-focused controls, the accountants have a variety of tools at their disposal. This can include in-depth numerical calculations in the form of number analysis or post cal-

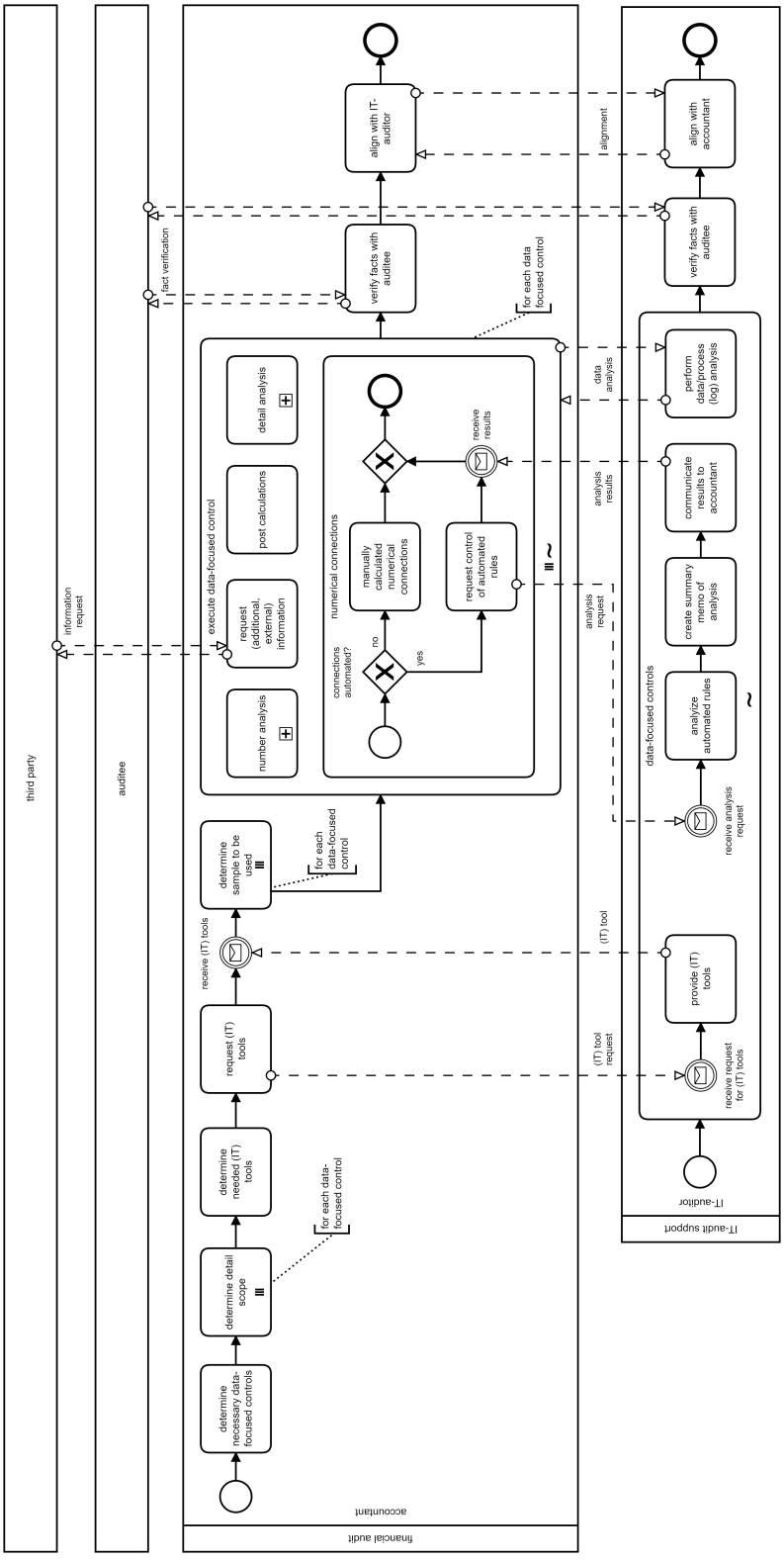


Figure 2.8: *A BPMN 2.0 process description of the data-focused controls process within the executing phase of the audit.*

culations on the one side, or fact checking with third parties on the other. Post calculations, for example, entail the recalculation of the various financial statements outside of the auditee's financial systems to confirm that the reports generated by these systems are indeed correct. With regard to the interaction between accountants and IT-auditors the analysis of numerical connections is a noteworthy method for data-focused controls. Numerical connections concern the analysis of how a value traverses through the process. A concrete example could be the analysis of how the price of a product goes from initial purchase request in the internal purchasing system to the finalization of the paid invoice in the accounting system. This analysis would then confirm that purchase identifier is consistent throughout the process and that any price deviations are in line with the purchasing policies. As these processes tend to make use of complex IT systems, IT-audit support can be of tremendous value to the accountants when opting for an analysis of the numerical connections. Which IT-auditor will conduct this analysis is dependent on the domain or system specific knowledge that is needed.

Large scale data analysis also has significant potential for increasing the scale and detail level at which accountants can perform data-focused controls. Data analysis can, for example, be used to quickly detect an outlier in the set of all purchase orders. Generally, a data analysis focused 'horizontal' team will provide the accountant with a dashboard within which the accountant can then use to detect outliers themselves. Note, however, that a continual back and forth is needed between the two disciplines before the dashboard is of sufficient quality that it meets the standards needed to be able to serve as audit evidence. As the creation of such a dashboard often spans multiple audits in a process beyond the scope of this chapter the decision has been made to summarize this into a single 'perform data/process (log) analysis' activity. Traditionally, IT-audit support does not play a large role in the data-focused controls process, but the ADR notes that this is changing as they harness and implement IT innovations. Data analysis may thus gain a more prominent role in future variants of the data-focused controls process.

2.4 Reporting on the audit

The reporting phase is concerned with formulating a conclusion on the integrity of the auditee's financial statements. In order to achieve this the overall audit results are analyzed and the auditors formulate an opinion

on the financial statement integrity. So as to ensure the audit's quality the quality control process plays an important role in this phase. At the conclusion of the reporting phase the auditors have delivered a management-signed report in which they highlight their conclusions on the auditee. This includes their overall opinion on the auditee's integrity as well as an overview and analysis of the notable findings. To come to this conclusion there are three key processes, namely, result analysis (subsection 2.4.1), quality control (subsection 2.4.2) and report sign-off (subsection 2.4.3).

2.4.1 Result analysis

The result analysis process operates, at the start, very similarly to the preliminary result analysis process as described in subsection 2.3.2. However, in the reporting phase the analysis process goes into greater detail. Not only are the control results analyzed for notable deviations, but there is also a control for fraud risks[13] as well as an in-depth analysis of the auditee's financial management. At the end of the phase, the auditors should have a complete understanding of the audit results as well as the auditee's financial reports, general policy execution and adherence to the auditee's legal financial requirements. Additionally, the auditors have an understanding of the implications that the controls have for the auditee's financial management. The entire process can be seen in Figure 2.9.

After having analyzed the results of both the system-focused and data-focused controls the auditors align to ensure that the accountants have not missed anything. The accountants then note any remaining notable deviations from the norms. Should these be present, they will conduct an in-depth analysis to further understand these deviations or to take away any existing uncertainties. As determined by the accountants, IT-audit support can play an important role in this. Should this be case, the process will proceed in a similar manner as when IT-audit support is used for system-focused or data-focused controls. The exact details, obviously, depend on the deviation at hand and the context within which this deviation is found. Afterwards, or immediately if no additional analysis is needed, the accountants look into whether any significant fraud risk is present. Suspected fraud must be reported, but due to the seriousness of such allegations additional controls are first executed. The additional controls serve to provide additional confirmation of and evidence for the fraud

[13] Do note that detecting fraud is not the primary purpose of this audit. Any fraud detected will be investigated, but the purpose is not to detect all instances of fraud. This responsibility rests within the individual ministries themselves.

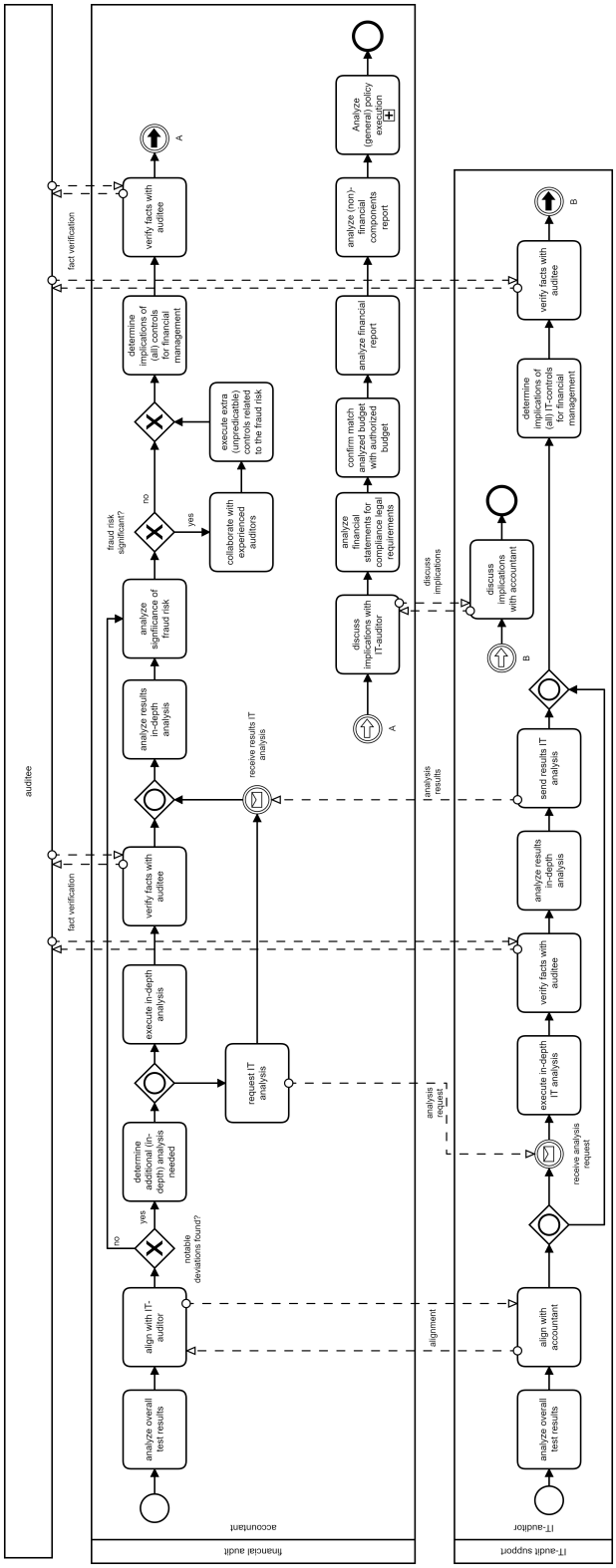


Figure 2.9: *A BPMN 2.0 process description of the result analysis process within the reporting phase of the audit.*

allegations or the lack thereof. This occurs in collaboration with other experienced auditors not already involved in the current audit so as to provide an independent second opinion. Lastly, the extra fraud controls must be unpredictable so as to ensure those suspected of fraud are not warned in advance of the extra controls. Such a warning would allow eventual fraudsters to adapt their behavior and hide potential evidence.

In conclusion of the fraud analysis the auditors look into the implications that the (IT) controls have for the auditee's financial management. In other words, do the control findings have any implications for the integrity of the auditee's financial flows and balances. For example, lacking integrity of the GITC could indicate issues with the suitability of the application controls. This, in turn, opens up the possibility that mistakes and inaccuracies are present in the financial statements. Ideally, the data-focused controls have verified that mistakes and inaccuracies, regardless of whether they were fraudulent in nature, were not present. It can, however, also occur that the data-focused controls detect (additional) issues or cannot provide enough assurance that no issues were present. This would indicate that the integrity of the auditee's financial statement cannot be guaranteed when it comes to the risks addressed by the failing controls. Thus, it is evident that the control findings can have (serious) implications for the integrity of the financial flows and balances. Note, however, that a single issue does not have to immediately result in a negative audit finding. This is dependent on the materiality and context of the issue as determined during the quality control process described in subsection 2.4.2. After alignment with the IT-auditors, the accountants also look into the legal and budgetary requirements related to the financial statements. For example, do the analyzed financial statements correspond to the auditee's budgets and financial reports. This also includes a general analysis of the non-financial components of the financial report as well as the auditee's policy execution. By analyzing all these components the accountants have a complete view of the auditee's risks and control measures as well as their financial handling.

2.4.2 Quality control

Audit reports carry significant authority as they serve as judge over the integrity of a ministry's actions. An incorrect report, e.g. approving incorrect behavior or giving an undeserved negative judgement, can result in significant consequences for both the ministry involved as well as the public opinion. For these reasons, it is critical that the quality of the audit

is verified. The quality control process in the reporting phase aims to address this by providing an additional control on the audit approach and results. Through this process, described in Figure 2.10, the ADR aims to ensure the accuracy of the findings and to significantly decrease the likelihood of (accidental) misjudgements.

The process starts with another analysis of the controls and their results. The accountants analyze whether the set of control measures was indeed enough to give them the assurance they need to form a conclusion on the financial statement integrity. In other words, whether the signing accountant believes that the evidence gathered provides sufficient support for the audit conclusion the signing accountant wishes to make. If not, additional controls can be executed. This could occur, for example, if the accountants feel that the system-focused controls do not provide sufficient assurance with regard to a specific financial risk. The exact nature of these additional controls is obviously audit specific but the process can be expected to follow the relevant control execution processes discussed earlier in this chapter. After a satisfactory control mix is guaranteed, the control results are analyzed by both the accountants and the IT-auditors. Generally the IT-auditors will prepare their opinion and then share and discuss it with the accountant. On the basis of the IT-auditor's suggestions and their own opinion the accountants have the option to execute some more controls if they deem it necessary for a proper and fair judgement. These additional controls could, for instance, be used to gather additional evidence for a certain finding.

Quality control also looks at the long term trends and, as such, the results are also compared with those of the previous year. The additional controls and comparisons, in combination with the deviations found during the audit, form the basis for detecting the financial mistakes and uncertainties the audit has brought to light. Depending on their seriousness the mistakes are either reported and regarded out of scope (trivial mistakes) or taken into detailed consideration (non-trivial mistakes). The materiality of the mistake is used to determine whether it should be taken into additional consideration. For the non-trivial mistakes a root-cause analysis is conducted by the accountants. The aim of this root cause analysis is to discover how it can be ensured that the (non-trivial) mistakes will not be repeated in the future. If the accountants believe that IT may have contributed to the mistake's occurrence, IT-auditors will also be involved in the root cause analysis. After the analysis the accountants will also discuss the situation with the auditee and reconsider the control measures in place at the auditee. Should the control measures, in light of the mistakes

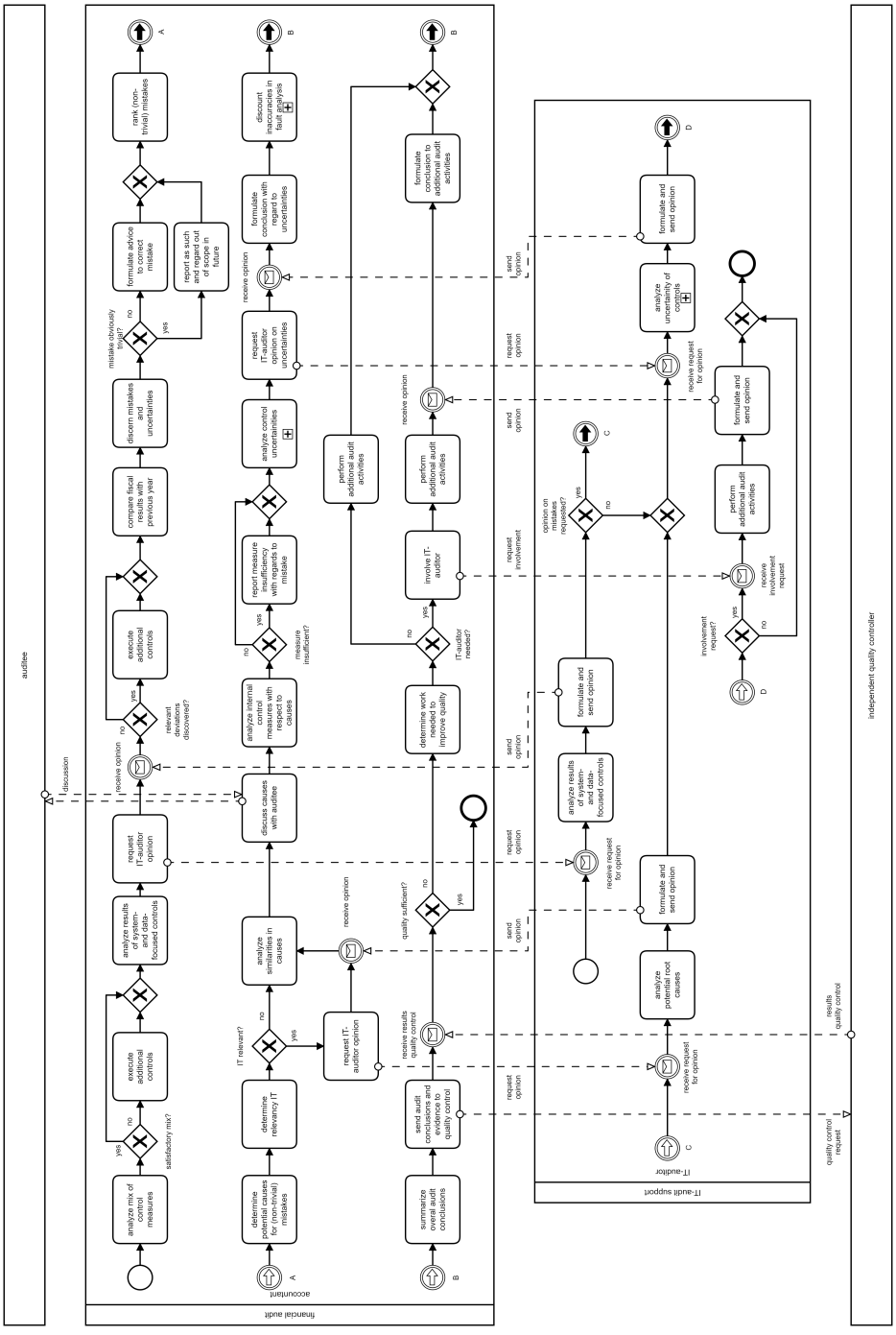


Figure 2.10: *A BPMN 2.0 process description of the quality control process within the reporting phase of the audit.*

and their root causes, be deemed insufficient this is reported along with the mistake's impact on the audit opinion.

The next steps in the quality control process concern any financial uncertainties that the audit may have brought to light. Financial uncertainties refer to flows and balances where the auditors could not find sufficient assurance through the controls on their dependability and integrity. This can occur, for example, if certain system-focused controls failed and the data-focused controls cannot give enough guarantee that the financial flows are fully in accordance to the regulations. Their significance and impact on the audit results are considered by both accountants and IT-auditors. IT-auditors are involved due to the potential role that IT plays in causing these uncertainties. On the basis of the analysis the accountants attempt to quantify these uncertainties. As auditors are still, in many cases, dependent on samples, the inaccuracies detected, due to mistakes or uncertainties, must be discounted to the entire sample. This discounting wraps up this aspect of the quality control process.

The last phase of the quality control process concerns the independent quality controller. This controller, external to the audit, verifies whether the audit was conducted in accordance to the laws, regulations and standards. As described in section 2.1, this controller confirms the quality and effectiveness of the audit. Should the quality controller not be satisfied the accountants will be required to conduct additional audit activities. Depending on the nature of the shortcomings the IT-auditors may also be involved. As the nature of the quality controller's findings can differ greatly between audits this aspect of the audit is not modelled in further detail. The most important note is that the independent quality controller must be satisfied before the audit can be finalized[14]. If (or once) the quality is deemed to be sufficient the quality control process is completed.

2.4.3 Report sign-off

The last process in the reporting phase is concerned with formalizing the audit report and its findings. Upon completion of this process the report will be handed over to the client. Looking at Figure 2.11 it is evident that, with a single exception, the process is quite straightforward. This straight-

[14]If the quality controller and auditors cannot resolve potential issues they have the opportunity to request that the 'vaktechniek' (professional practices) department of the ADR provides a binding judgement on the issue. As this process is highly dependent on the context and situation this scenario was not incorporated into Figure 2.10.

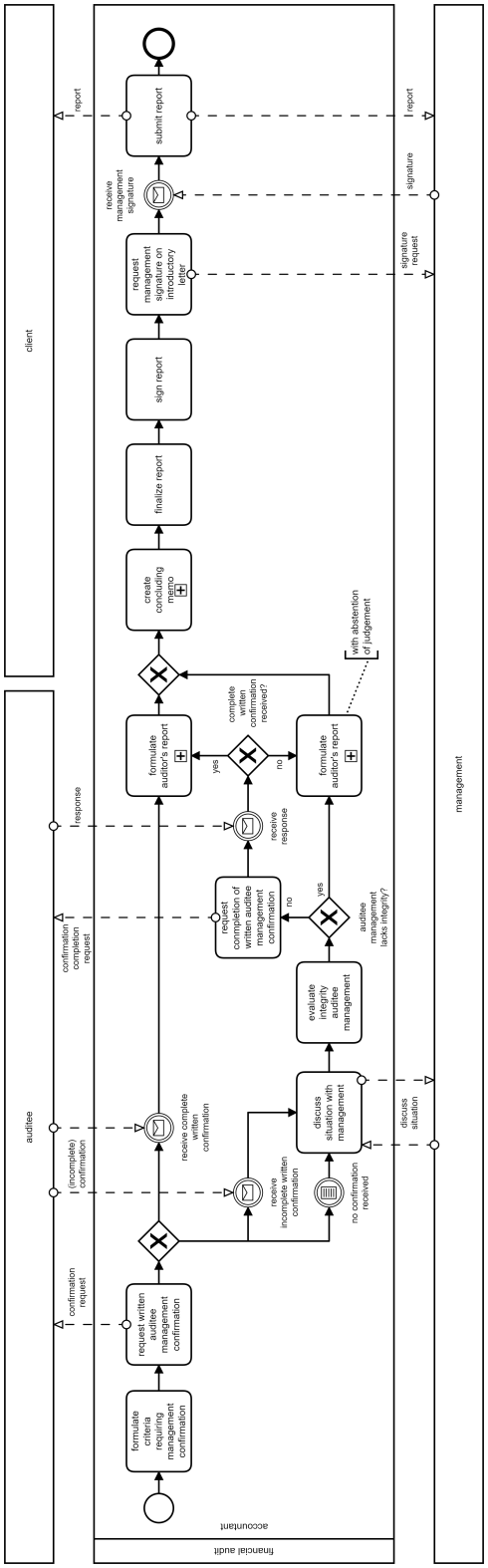


Figure 2.11: *A BPMN 2.0 process description of the report sign-off process within the reporting phase of the audit.*

forward 'happy path' will first be highlighted, and then the exception will be discussed.

The first step in finalizing the audit concerns the auditee's management confirmation. This confirmation has the purpose of confirming in writing that the auditee's management fulfilled their obligations with respect to the audit. In other words, the auditee's management was truthful and transparent and ensured that the financial flows and balances were complete and in accordance with the applicable financial standards and regulations. Additionally, they provided the auditors with all of the relevant information and access needed to conduct the audit. Other topics, such as fraud or potential lawsuits or claims must also be addressed. The Auditdienst Rijk (n.d.) describes in detail what this confirmation must entail and on which standards these are based. The most important thing to note is that, for the happy path, the confirmation must be complete. Upon receiving a complete confirmation the accountants formulate their final audit report and create a concluding memo summarizing the report.

With the completion of the concluding memo the audit report is complete. All that remains in this process are the official signatures of the relevant authorities. Firstly, the legally entitled and ADR assigned signing accountant signs the report. This lends their authority to the audit and denotes that the signing accountant accepts the responsibility for the report's contents. In other words, the signing accountant stands behind the findings and believes that sufficient evidence is available to confirm them. Secondly, the ADR's management signs the report's introductory letter. This indicates that the ADR, as an entity, supports the report and stands behind the signing accountant. Having the relevant signatures, the report is then submitted to the client. Additionally, the ADR's management receives a copy[15]. The ADR's legal mandates require that the audit report of a fiscal year is submitted by the 15th of March of the next year[16]. All processes and phases preceding this step must, therefore, be conducted early enough such that this deadline can be achieved.

[15]Note that the client and not the ADR is owner of the report. As described in section 2.1, the client is part of the auditee. This means that the auditee has jurisdiction over the eventual publication of the audit report. The ADR does, however, publish general observations on all the audits conducted that year and the Algemene Rekenkamer, as external auditor, also delivers their findings on the legality of the auditee's financial conduct to the Dutch parliament.

[16]For example, the audit report for the 2019 fiscal year must be submitted by the 15th of March 2020.

As stated earlier, an important exception exists to the ideal process flow. This exception concerns the auditee's management confirmation and their refusal or inability to provide the complete confirmation as requested. If the auditee cannot or will not provide the complete confirmation as requested the accountants first discuss the situation with the ADR's management. On the basis of this discussion, the auditee's integrity is evaluated. Should the auditee's management be deemed to have integrity they are given another chance to complete the confirmation. If this complete confirmation is provided the process continues along the earlier described 'happy path". If the auditee's management is deemed to lack integrity or they still fail to provide the requested confirmation another approach is taken. The auditors will still complete their report. However, instead of providing a concluding judgement they will deliver an abstention of judgement. Essentially, the accountants are stating that is was not possible to come to a proper judgement given the evidence provided. In other words, the accountants will not confirm the integrity of the auditee's financial statements. All resulting (political) consequences are then the auditee's to deal with.

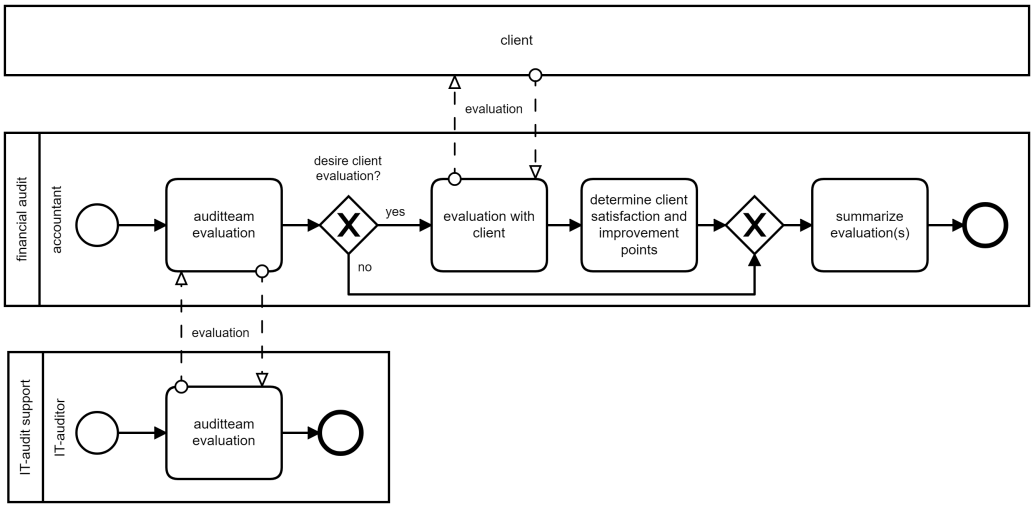
2.5 Concluding the audit

The last phase in the audit is concerned with the audit's aftermath. This phase generally occurs during the weeks after the March 15 deadline. The first process (subsection 2.5.1) is concerned with evaluating the audit and looking at potential improvements for the next audit. The second process (subsection 2.5.2) looks at the the completion of the dossier and the client's response to the audit report received in the report sign-off process. Upon the completion of these two processes the audit is concluded.

2.5.1 Evaluation

Looking at Figure 2.12, it is evident that the evaluation process is simple in design and consists of three phases. Firstly, the accountants and IT-auditors evaluate the audit and their collaboration. The exact details differ between audits but generally auditors evaluate the audit within their sub teams. For example, the 'horizontal' team executing the Oracle GITC evaluates together. Then the team leads, the lead IT-auditor and the signing accountant evaluate the overall audit and incorporate the sub team evaluation conclusions into an overall audit evaluation. Ideally, this evaluation will also result in concrete ideas on how to improve IT-audit support use-

Figure 2.12: *A BPMN 2.0 process description of the evaluation process within the concluding phase of the audit.*



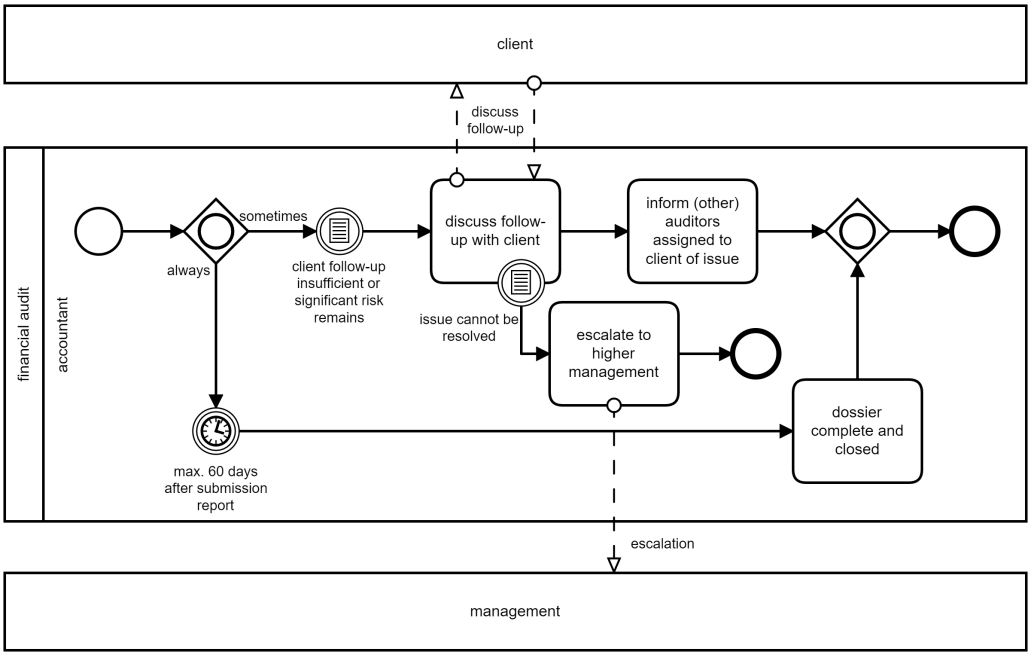
fulness in future audits. Secondly, if desired, the signing accountant evaluates with the client. This has the aim to see how the audit (process) can be improved to increase the client's satisfaction with the audit. An increased client satisfaction generally leads to an improved likelihood that the client will also act upon the findings in the audit report. Lastly, all of the evaluations conducted are summarized. In this summary any improvement points are noted and translated into future actions.

2.5.2 Follow-up

The final process, as shown in Figure 2.13, is concerned with the audit trail as well as the client's follow-up. Firstly, on the practical side, it is important that the auditors complete and finalize the audit's dossier so as to ensure a proper evidence trail. Upon submission of the report, the auditors have at most 60 days to complete this. Secondly, on the more serious side, the follow-up process describes how to respond to insufficient client follow-up. Auditors have the option to intervene when they believe that the client has inappropriately responded to the audit findings or that significant risk remains despite a client follow-up .

When auditor intervention occurs, the auditors first aim to resolve the issue directly with the client. They discuss why they believe the intervention is warranted and strive to come to a conclusion or action plan with the client on how to proceed. After they have come to a conclusion the

Figure 2.13: *A BPMN 2.0 process description of the follow-up process within the concluding phase of the audit.*



involved auditors will inform any other auditors assigned to the client. In this way, these other auditors are aware of the issue and the proposed steps to resolve it. Additionally, they can also take it into consideration for their own audits. Should the concerned auditors and the client not be able to resolve the issue, or the proposed conclusions not be enacted upon, the accountants can escalate to a higher level of management at the ADR. Together they will aim to develop an approach for the situation. The escalation process is not modelled further since the exact situation strongly influences how the escalation process continues.

Chapter 3

IT-audit support effectiveness

Understanding how the end-of-year financial statement audit is designed and executed within the Auditdienst Rijk (ADR)[1] has created a framework within which IT-audit support effectiveness can be addressed. This framework allows for the discovery of the key factors that influence IT-audit support effectiveness. However, it is not possible to do so without a definition of IT-audit support effectiveness. This chapter addresses this by looking into the first two research questions. These questions, first introduced in section 1.2, are as follows:

RQ1a "How is IT-audit support effectiveness defined within the context of the ADR?"

RQ1b "How can IT-audit support effectiveness be measured and quantified?"

As a starting point, the Oxford Online Dictionary and the Collins COBUILD dictionary were consulted to see how they define effectiveness. This provided a first direction into what aspects are important and should be taken into account when defining IT-audit support effectiveness. In essence the dictionaries defined effectiveness as "the quality of being effective" (OED Online, 2020b). In other words, in order to be able to define effectiveness it is critical to look at what it means to be effective. From that basis a measure of effectiveness can be formed. The Collins dictionary observes that "something that is effective works well and produces the results that were intended" (Collins COBUILD, n.d.). Or, as OED Online

[1] See chapter 2.

(2020a) notes, something "that is attended with result or has an effect" (def. 6.c). Defining and measuring IT-audit support effectiveness should thus be centered on framing and quantifying the objectives and results of IT-audit support.

From this conceptual basis an in-depth analysis was conducted to define (a measure for) effectiveness with the context of IT-audit support. This in-depth analysis consisted of four phases. First, academic literature was consulted to see how they address effectiveness within the audit (section 3.1). Second, vaktechniek, the ADR's professional practices department, was approached to share how they, as the ADR's final authority on audit theory and execution, thought about IT-audit support effectiveness (section 3.2). Third, multiple auditors actively involved in the end-of-year financial statement audit and IT-audit support were interviewed (section 3.3). These interviews highlighted the insights and perspectives of active IT-audit support practitioners. In the last phase, described in section 3.4, all the gathered observations are combined into concrete answers for RQ1a and RQ1b.

3.1 Literature

As is evident from the dictionary definitions, it is important to focus on framing and defining what it means for IT-audit support to have results, to have an effect. However, the concept of IT-audit support is not common in academic literature on audits. Nevertheless, IT-audit support does have many parallels with different kinds of audits. As the ADR is an internal auditor there is an obvious connection to internal auditing. Additionally, parallels can be found in the external audit, due to the emphasis on financial statement auditing, and, obviously, with the Information Technology (IT) audit. Thus, an analysis of effectiveness in the context of internal, external and IT audits should bring to light how effectiveness can be framed within the context of IT-audit support. This assumption forms the basis of the methodology used to find and analyze relevant academic works.

The ideas on and definitions of effectiveness from the academic perspective were extracted from the most relevant works available on Google Scholar and Scopus. A search was conducted for "INTERNAL AUDIT" AND EFFECTIVENESS, 'EXTERNAL AUDIT" AND EFFECTIVENESS and "IT AUDIT"AND EFFECTIVENESS[2]. The first 15 results, when sorted by relevance, were selected per search engine and search term. This resulted in

[2]The search term AUDIT AND EFFECTIVENESS was not included in the final results as

84 unique works to be considered. All papers for which it was not possible to access the full text via the university or government subscribed databases were discarded. During this check for full texts all works on medical audits were also removed. After both of these steps 52 works remained.

As the focus was on defining and quantifying effectiveness all works which did not explicitly formalize or define effectiveness in the full text were discarded. In order to quickly determine whether a work provided a definition of effectiveness each work was searched for the phrase 'effective'. This phrase covers the most common forms of the term effective: e.g. 'effective', 'effectively' or 'effectiveness'. The sentences around each search result were then scanned to see if they contained a definition. If a definition for effectiveness was found the work was kept, otherwise it was discarded. After analyzing all of the 52 remaining works a total of 11 unique works remained which defined effectiveness. This set of works, listed in Table 3.1, was considered as the academic perspective on defining or measuring IT-audit support effectiveness.

As is evident by the amount of selected works (11 out of the 84) only a few works explicitly describe what (audit) effectiveness is. In fact, Arena and Azzone (2009) even states that "there is no generally acknowledged or operational measure" for audit effectiveness (p. 48). Nevertheless, with the works taken into consideration it is still possible to make useful observations on how audit effectiveness could be defined and how important it is. These observations can then be translated to the context of IT-audit support. Both Turetken et al. (2019) and Lenz and Hahn (2015) note that, regardless of how fast or cheap an audit is conducted, it is worthless and futile if it is not effective. This becomes obvious when considering how Chambers (1992) defines effectiveness, namely as "doing the right thing" (as cited by Turetken et al., 2019, p. 6). Logically speaking, doing the wrong thing very well is not of added value as that is not what is needed or desired by the stakeholders. As such, in order to be effective it is critical that an audit focuses on doing the right thing. This reasoning can also be extended to IT-audit support in that effective IT-audit support does the right thing.

It is, however, important to keep in mind that the right thing for an audit

13 of the 15 the top results for this search query in Google Scholar all referred to audit committees. These are not in scope for this thesis as audit committees are not involved in IT-audit support. Of the remaining two results one was already covered by the other search terms. The other was concerned with the medical audit, i.e. vastly out of scope.

Table 3.1: *Academic works referenced with respect to defining or measuring effectiveness.*

Authors	Year	Title
Almaliki, Rapani, and Khalid	2018	The effect of accounting information system on internal audit effectiveness; testing the moderating role of experience
Antonio, Laela, and Alhadi	2020	Personal competence and internal audit effectiveness: The moderating effect of islamic spiritual quotient: A case study of islamic financial institutions in Indonesia
Arena and Azzone	2009	Identifying Organizational Drivers of Internal Audit Effectiveness
Badara and Saidin	2014	Internal audit effectiveness: Data screening and preliminary analysis
Barišić and Tušek	2016	The importance of the supportive control environment for internal audit effectiveness - the case of Croatian companies
Cohen and Sayag	2010	The Effectiveness of Internal Auditing: An Empirical Examination of its Determinants in Israeli Organisations
Lenz and Hahn	2015	A synthesis of empirical internal audit effectiveness literature pointing to new research opportunities
Mihret and Admassu	2011	Reliance of External Auditors on Internal Audit Work: A Corporate Governance Perspective
Mihret, James, and Mula	2010	Antecedents and organisational performance implications of internal audit effectiveness: Some propositions and research agenda
Tackie, Marfo-Yiadom, and Oduro Achina	2016	Determinants of Internal Audit Effectiveness in Decentralized Local Government Administrative Systems
Turetken, Jethefer, and Ozkan	2019	Internal audit effectiveness: operationalization and influencing factors

is not necessarily the same as the right thing for IT-audit support. When it comes to defining the right thing, and thus in extension when something is effective, there is a common theme within literature. The works analyzed highlight how predetermined objectives and targets are used to define the right thing. Effectiveness is then based on the ability to meet these goals and the extent to which these goals are met (Almaliki et al., 2018; Antonio et al., 2020; Arena & Azzone, 2009; Badara & Saidin, 2014; Barišić & Tušek, 2016; IIA Professional Practices Committee, 2016; Turetken et al., 2019). As Dittenhofer 2001 observes, effectiveness is about the "level of achievement of a desired state and set goals" (as cited by Barišić & Tušek, 2016, p. 1020). In order to properly define IT-audit support effectiveness, these predefined objectives would need to be attuned to the specific IT-audit support context. IT-audit support's predefined objectives thus define what the right thing is. Effectiveness would then be determined by the auditor's ability to realize the specified IT-audit support objectives. In other words, whether the auditors have achieved the desired IT-audit support outcome.

Defining effectiveness through the degree of achievement does complicate things when placed into the context of the audit. While systematic "measure can be used to gauge [internal audit] effectiveness", the actual effectiveness is ultimately dependent on the "expectations of relevant stakeholders" (Dittenhofer 2001 as cited by Tackie et al., 2016, p. 186). What Dittenhofer means is that 'checking the boxes' alone is not a wholly sufficient measure of effectiveness but that the stakeholders also need to perceive and accept this. For example, if management does not accept or respond to the internal audit findings then what was the point of conducting the (internal) audit in the first place? Translating this to IT-audit support, if the accountant does not make use of the IT-audit support findings then why was IT-audit support even done? Have they then 'checked the wrong boxes'? As Albrecht, Howe, Schueler and Stocks (1998) note, effectiveness must "be measured against the expectations of the relevant stakeholders" (as cited by Cohen & Sayag, 2010, p. 297-298). Both Mihret and Admassu (2011) and Barišić and Tušek (2016) propose similar conclusions and emphasize management's acceptance of the audit findings and recommendations. Thus, it is not only important that desired objectives are met but also that these objectives (are perceived to) meet the stakeholder's expectations. Or, as Mihret et al. (2010) frames it, the (internal) audit can be "considered effective when it is value adding" (p. 15). In summary, to be effective IT-audit support must also be perceived as providing (the expected) added value for the accountants.

In conclusion, when looking at academia and how they define and measure audit effectiveness both objective and perceptive factors come into play. Factors which can be translated to the context of IT-audit support. A context within which IT-auditors are executing a set of activities with the aim of supporting the accountants in the end-of-year financial statement audit. More specifically, as noted in chapter 2, this means providing a conclusion on whether IT can be used to address certain audit risks. Within this context, the observations from academia can be summarized as follows: effective IT-audit support fully achieves the predefined objectives and is perceived by accountants to provide added value.

3.2 Vaktechniek

The ADR's 'vaktechniek' department is the department within the ADR which serves as the final authority on audit norms and guidelines. During the quality control process in the audit[3], for example, they provide binding judgments on any potential issues between auditors and quality controllers. In other words, when it comes to the audit, its process and the relevant laws and regulations this department is the expert authority within the ADR. For this reason, they were asked about their opinion on audit and IT-audit support effectiveness.

Vaktechniek stated that "in an effective [end-of-year financial statement] audit all material errors are discovered and corrected [and the financial statement] legality is explained" while taking predefined tolerances into account (personal communication). With respect to these tolerances, the ADR has adopted a set of thresholds to be met within their audit approach[4]. For example, they require the accountant to have 95% certainty on the legality of the financial statements (Auditdienst Rijk, n.d.). However, difficulties arrive in how to measure this. "The accountant cannot measure if he saw everything", so how can the accountant be sure all material errors are discovered (personal communication)? Additionally, how would you measure having achieved 95% certainty? Even if the degree of certainty could be measured, measuring effectiveness is still a challenge. If issues arise, an accountant could simply expand the scope of the audit and the activities so as to meet that 95% threshold again (personal communication). In accordance with the literature definitions, the objectives have then been adapted during the audit to ensure they still meet the def-

[3] see subsection 2.4.2.

[4] See subsection 2.2.1 and subsection 2.2.2 for more on these thresholds.

inition of effectiveness. As such, effectiveness within the end-of-year financial statement audit is not straightforward and currently not explicitly measured within the ADR.

To a certain extent, the same could also be said for IT-audit support. If the accountants can depend on the IT-audit support findings then the accountants have to execute less data-focused controls and hence improve the efficiency of their audit (personal communication). One could then surmise that IT-audit support was effective. However, then IT-audit support could be regarded as ineffective whenever the accountants cannot depend on the IT-audit support findings. That is not a reasonable conclusion when considering that IT-audit support is tasked with providing a judgment on the as-is situation and not with ensuring a positive judgment (personal communication). In other words, defining IT-audit support effectiveness purely in terms of its impact on the audit has complex implications. This is especially true when considering how difficult it is to define audit effectiveness.

The vaktechniek department did, however, mention a possible solution through the strong parallel IT-audit support has with the IT audit. Considering the nature of IT-audit support, in that it can often be regarded as a miniature IT audit, such a parellel is not unreasonable. This parallel could be used to apply principles of IT audit effectiveness to IT-audit support. They suggest that within an IT audit the effectiveness can be based upon the relevance and soundness of the audit findings along with the effort (efficiency) need to come to these findings. Sound findings are findings which are formed in accordance to the relevant professional practices, guidelines and regulations (personal communciation). Thus, an effective IT audit provides timely and sound findings which are relevant to the client. Translating this to the context of IT-audit support this means that effective IT-audit support provides a timely and sound conclusion upon which the accountant can build upon in the overall audit.

A key nuance which vaktechniek emphasized is that the nature of the conclusion might influence the stakeholder perceptions on IT-audit support effectiveness. As hinted at earlier, IT-audit support can result in either a negative or a positive finding. A positive finding denotes an IT-audit support conclusion that IT is sufficiently able to address the intended risks. A negative finding denotes the conclusion that IT is not sufficiently able to address these risks. A negative finding would imply that the accountant would need to perform additional audit activities. This can have a negative impact on the overall audit efficiency and increase the workload

needed to reach the same degree of effectiveness. Nevertheless, IT-audit support itself does not change based on the type of finding. It has still satisfied the objectives and provided a timely conclusion. Thus the stakeholders' perceptions should not be the only measure for effectiveness. If stakeholder perceptions were the only measure it could lead to the undesirable situation in which false positives are given in order to receive positive effectiveness evaluations. Within the context of IT-audit support, stakeholders refers to those depending on IT-audit support as well as those executing IT-audit support activities.

Two important conclusions can be made on the basis of the vaktechniek's observations. First, it is important to be aware of the role of IT-audit support within the overall audit. The overall audit will strongly influence the sort of objectives IT-audit support receives. Additionally, it will influence how the accountants will perceive the added value of the IT-audit support findings. Secondly, with respect to actually defining and measuring IT-audit support effectiveness parallels can be found with the IT audit. In accordance to this, effective IT-audit support will provide timely and sound conclusions in accordance to the objectives regarded by the accountant as relevant.

3.3 Interviews

Interviews provided the opportunity to gain insights into how active IT-audit support practitioners think about IT-audit support and IT-audit support effectiveness. They show what concerns auditors have in practice about IT-audit support effectiveness and what they judge to be the most important indicators of effectiveness. So as to cover a wide range of perspectives nine different employees were interviewed across different roles and audits. Three different end-of-year financial statement audits of the 2019 fiscal year were selected with each audit covering a different government department with its own (sub)processes and IT systems. This also means that each audit had differing scopes and degrees of dependency on IT-audit support.

Within the three different audit, three employees with differing roles were selected. The interviewees were either a (lead) IT-auditor, (signing) accountant or independent quality controller. For each selected audit there was, as a result, an interviewee performing IT-audit support activities (IT-auditor), an interviewee depending on the IT-audit support findings (accountant) and an interviewee evaluating the quality of IT-audit support

(quality controller). Additionally, between the employees selected a variation could be found in gender, audit experience and cross-disciplinary experiences[5]. Through this interview setup a diverse set of opinions and perspectives could be found within the common context of IT-audit support.

The interviews were conducted in April 2020, shortly after the conclusion of the 2019 end-of-year financial statement audit. The auditors have, therefore, had the opportunity to reflect on their experiences with IT-audit support in the previous year. A common framework for the interviewees was set-up and can be found in Appendix A. This framework served as starting point for the interviews. Nevertheless, the choice was made to follow a semi-structured approach so as to leave room to explore and focus on those issues or comments the interviewee found particularly important when it comes to IT-audit support. The interviews were, however, still structured enough to ensure that the usage, scoping and effectiveness of IT-audit support would be addressed within each interview.

All of the interviews were transcribed and observations on IT-audit support were extracted from the transcriptions and compared. If an observation had support from at least 50% of all of the interviewees it was taken into consideration for addressing a research question. Additionally, observations were also taken into consideration which did not meet this 50% threshold but within which 100% of the interviewees within a role (IT-auditor, accountant or quality controller) were in agreement. For such observations the respective discipline will always be explicitly mentioned. All of the observations which met one or both of these criteria were then coupled to RQ1a, RQ1b and RQ2. The remainder of this section focuses on the observations related to RQ1a and RQ1b. The observations relevant to RQ2 will be addressed in section 4.2.

The aim of the audit is to provide reasonable assurance on the financial statement integrity. As such, the interviewees noted that the audit and IT-audit support design should focus on those risks and assertions which are important to and material for the financial statements. In other words, IT-audit support objectives should be sharply focused on creating value for the accountant. The accountants and IT-auditors need to (jointly) consider what is useful and needed from IT-audit support as opposed to looking at what would be nice to have. A lead IT-auditor aptly noted that this might mean that the scope of the IT-audit support objectives needs to be reduced during the audit as it becomes clearer for the auditors involved

[5]For example, an accountant moving to an IT-auditor role or vice versa.

what is most relevant. This is closely coupled to the IT-auditors' fear that their IT-audit support findings are not used by the accountants. Their fear is complemented by the accountant belief that all audit activities should be focused on 'must haves' and not 'nice to haves'. What this means is that effective IT-audit support should be sharply focused on those 'must haves'. In other words, effective IT-audit support has objectives which are designed so as to maximize the relevance to and added value for the accountants.

Another aspect highlighted by the interviewees regards the IT-audit support evidence upon which the findings are based. Findings must be sound and, as interviewees noted, this means that the evidence needs to match the accountant's (quality) requirements. For example, the majority of interviewees noted that when using application controls it is critical that the general IT-controls (GITCs) are also executed. Additionally, according to 100% of the quality controllers, all evidence must also be fully documented in the dossiers. Otherwise, as one accountant recounts, the team has to reject the IT-audit support findings because the evidence provided did not meet the accountant's requirements.

As also mentioned by vaktechniek in section 3.2, effectiveness requires more than the proper scoping of the objectives to match the accountant's expectations. A repeating theme among the interviews concerned the importance of the timing of IT-audit support. In-fact 50% of the observations explicitly involved timeliness. Oft-cited worries by interviewees included running out of time or not being able to provide assurance in a timely manner. IT-auditors and accountants noted that it is critical that an accountant knows as early as possible what the IT-audit support findings are. When considering the audit process this is logical as a later (negative) finding makes it more difficult for the accountant to plan and execute any needed compensating activities before the March 15 deadline. Therefore, timeliness is critical if IT-audit support is to be regarded as effective. An important nuance, stressed especially by the quality controllers, is that the quality of the results is still very important and should not suffer in an attempt to realize timeliness. A such, the IT-audit support objectives and deadlines should be such that a timely and high quality IT-audit support conclusion is still possible.

In summary, two major themes were brought to light during the interviews when considering IT-audit support effectiveness. The first concentrated around ensuring that IT-audit support provides value to the accountants. It is not enough that the objectives are soundly met, the findings

must also add value to the audit. Secondly, it is important that IT-audit support is able to provide its conclusions in a timely manner. Thus, in accordance to the interview observations, effective IT-audit support meets its objectives in a timely and sound manner such that it adds value to the overall audit.

3.4 Conclusion

Through the academic observations (section 3.1), the expert opinions (section 3.2) and the practitioner experiences (section 3.3) it is now possible to formulate an overall definition for what IT-audit support effectiveness is and how it can be measured. As the final definition for and indicators of IT-audit support effectiveness are a synthesis of the key points noted in the previous sections these will first be reiterated. Effective IT-audit support fully achieves the predefined objectives and is perceived by accountants to be relevant and provide added value. Additionally, the findings are provided in a timely manner and provide sound evidence for these findings.

The observations made in the previous sections can be categorized as either factual (objectives soundly met, timeliness) or perceptual (added value, relevance). The factual components allow for the concrete observation of whether the agreed upon tasks are soundly done within the allocated time. In other words, whether the right thing was done. As noted in section 3.1, doing the right thing forms the basis of effectiveness. As such, the argument is made that effectiveness should be formulated in terms of whether the right thing was done. In other words an answer to RQ1a can be formulated as follows:

Effective IT-audit support fully achieves its specified objective within the time frame agreed upon.

Adapting this to the most common objective within IT-audit support it can be noted that effective IT-audit support provides a timely and substantiated conclusion on whether IT properly addresses the risks which the accountant wanted to be covered by IT[6].

The perceptual criteria add nuance and play a large role in measuring ef-

[6] As described in subsection 2.2.3 a concrete example would be that GITC and application controls properly prevent certain risks from occurring (e.g. welfare payment abuse). Alternatively IT analyses can be used to detect the occurrence (or absence) of certain risks (e.g. a high volume of irregular purchases).

Table 3.2: *Indicators for IT-audit support effectiveness (RQ1a and RQ1b).*

Key	Indicator	Measure
I-1	Fulfillment Degree	Degree of IT-audit support objectives soundly met (11 point scale: none met (0) $\longrightarrow$ all met (10)).
I-2	Timeliness	Adherence to agreed upon deadlines (11 point scale: far too late (0) $\longrightarrow$ on time (10)*).
I-3	Added Value	Perception that IT-audit support findings† were of added value to the audit (11 point scale: greatly reduced value (0) $\longrightarrow$ greatly increased value (10)).
I-4	Stakeholder Satisfaction	Degree to which stakeholders‡ are satisfied with IT-audit support (11 point scale: very unsatisfied (0) $\longrightarrow$ very satisfied (10)).

* The scale ends at 'on time' as earlier completion only denotes efficiency and does not imply a higher effectiveness.

† Both positive and negative findings.

‡ Stakeholders refer to those responsible for executing IT-audit support as well as those who depend on the IT-audit support findings.

fectiveness. They go beyond merely checking the right boxes to observing whether the stakeholders involved are satisfied and the work done was actually of added value. Within the context of IT-audit support the stakeholders are defined as those dependent on IT-audit support as well as those executing the IT-audit support activities. These perceptual criteria are important since, as observed earlier, how stakeholders perceive something is just as important as meeting all of the objective requirements for effective IT-audit support. Therefore, when measuring IT-audit support effectiveness these perceptions need to be taken into account as well. In essence, these perceptual criteria act as modifiers for effectiveness. If IT-audit support fully adheres to the definition given in response to RQ1a but those executing IT-audit support or depending on its findings are not satisfied or find that it does not add value to the audit the (perceived) effectiveness will decrease. Likewise, if the findings arrived far too late but were of significant added value IT-audit support may still be perceived as (somewhat) effective. Due to these nuances, multiple indicators are needed to properly gauge the (perceived) IT-audit support effectiveness.

In order to measure IT-audit support effectiveness and thus address RQ1b, four indicators were created. These indicators can be seen in Table 3.2. Each indicator is scored on an 11-point scale (min score 0, max score 10).

A higher number denotes a higher degree of effectiveness. This scale was selected as it provides sufficient room for nuance while being easy to understand and transform. The latter is especially important when taking into account how the various indicators come together to form a single effectiveness score. The first two indicators (I-1 and I-2) measure the objective adherence to the IT-audit support effectiveness definition. The other two indicators (I-3 and I-4) measure the perception of effectiveness and modify the overall degree of effectiveness.

In determining the relationship between the indicators a few rules were established. Firstly, IT-audit support can only be 100% effective if all indicators are at their maximum score. Secondly, the score consists of a factual (I1 + I2) and a perceptual (I3 + I4) component. The perceptual component moderates the impact of the factual component on the effectiveness score. If IT-audit support does not adhere to the definition of effective IT-audit support (i.e. low scores on the factual component) it cannot be possible to have a high effectiveness score. This is rule three. Similarly, rule four states that something perceived to be ineffective (i.e. low scores on the perceptual component) cannot result in a high effectiveness score. Together, these rules resulted in Equation 3.1.

$$\text{degree of effectiveness (\%)} = \frac{\text{I-1} + \text{I-2}}{20} \cdot \frac{\text{I-3} + \text{I-4}}{20} \tag{3.1}$$

To aid in understanding the effectiveness score, Table 3.3 shows a few example IT-audit support effectiveness scores for a selection of scenarios. The first set of scenarios are fictional extremes which demonstrate the four rules which led to Equation 3.1. The rule number provided describes the rule being demonstrated. The second set of scenarios, indicated by rule N/A, are randomly sampled from indicator measurements as scored by ADR employees[7]. These provide an example of how effectiveness is measured in a real life setting.

[7] See chapter 5.

Table 3.3: *Example scores for IT-audit support effectiveness in accordance to Equation 3.1.*

Rule	I-1*	I-2*	I-3*	I-4*	Effectiveness
I,II	10.00	10.00	10.00	10.00	100%
I,II	9.00	10.00	10.00	10.00	95%
I,II	10.00	9.00	10.00	10.00	95%
I,II	10.00	10.00	9.00	10.00	95%
I,II	10.00	10.00	10.00	9.00	95%
II, III	5.00	5.00	10.00	10.00	50%
II, III	0.00	0.00	10.00	10.00	0%
II,IV	10.00	10.00	5.00	5.00	50%
II,IV	10.00	10.00	0.00	0.00	0%
N/A	6.00	8.00	7.00	7.00	49%
N/A	7.00	7.00	8.00	7.00	52%
N/A	8.00	7.00	7.00	7.00	52%
N/A	5.00	5.00	9.00	8.00	42%
N/A	6.00	4.00	5.00	5.00	25%

* I1 = Fulfillment Degree, I2 = Timeliness, I3 = Added Value, I4 = Stakeholder Satisfaction

Chapter 4

Factors which have influenced IT-audit support effectiveness

The next step in addressing the RP is to determine what potential factors can have an influence on IT-audit support effectiveness. In order to determine this the academic and professional opinion is analyzed to discover what factors have had an impact. This analysis addresses RQ2 as introduced in section 1.2:

RQ2 "What factors have influenced IT-audit support effectiveness?"

The academic perspective on what factors or themes play a role in IT-audit support effectiveness is discussed in section 4.1. This analysis expands on the literature analysis conducted in section 3.1 and discusses how the academic observations can be transposed to the context of IT-audit support. Additionally, so as to determine the professional opinion on IT-audit support effectiveness, RQ2 was also addressed as part of the interviews discussed in section 3.3. In section 4.2 the relevant observations from these interviews with respect to factors influencing IT-audit support effectiveness will be discussed. Section 4.3 brings together the observations from both academic and professional perspectives and formulates a list of factors which have influence on IT-audit support effectiveness. These factors will then be used in chapter 5 to answer RQ3 and, in extension, the RP.

4.1 Literature

IT-audit support is not a common term within academia. As such, the academic perspective focuses on works addressing effectiveness in the context of an audit or the usage of specialists within the audit. The former has many parallels with IT-audit support. IT-audit support, just like an audit, strives to provide assurance on the integrity of an organization or one of its systems or processes by verifying that all relevant risks are properly addressed by the auditee. The latter, the usage of specialists, concerns the relationships between accountants and those specialized in other disciplines (e.g. taxes or Information Technology (IT)). IT-audit support, wherein IT-auditors work on behalf of the accountant, is a prime example of such specialist usage. The chosen academic perspective is, therefore, very relevant for IT-audit support despite IT-audit support itself not being a common term. The academic literature used to address RQ2 had been found during the two earlier literature searches conducted for section 1.1 and section 3.1. All together this resulted in 20 academic works, listed in Table 4.1, from which the overarching conclusions presented in this section are derived.

The first thing to keep in mind when it comes to IT-audit support is the starting mindsets and perceptions of the auditors involved. The majority of auditors expect that IT will play an increasingly important role in the audit (Vendrzyk & Bagranoff, 2003). However, what role IT should play differs greatly between the disciplines. As Veth (2009) and Vendrzyk and Bagranoff (2003) note, accountants have a strong financial focus in which IT is a tool whereas IT-auditors emphasize the analysis and improvement of IT processes and system. Practically, this means that IT-audit support often results in findings beyond the scope of the financial audit (Meuldijk et al., 2007). To put it in other words, the differing perceptions on the role that IT-audit support should play within the audit influences its suitability and added value. Logically, this influences the organizational and auditor support for incorporating IT-audit support into the audit. Such support is important as it greatly moderates the influence that factors have on effectiveness (Endaya & Hanefah, 2013; Turetken et al., 2019). Thus it is logical that the differing perceptions must be resolved. Aligning the perceptions on IT-audit support also positively influences the effectiveness. As noted by Lenz and Hahn (2015), "effectiveness requires a shared understanding of what makes [the audit] a value-added activity" (p. 23). Altogether, this means that both disciplines need to be in agreement on what the objective and purpose of IT-audit support is in order to realize effectiveness.

Table 4.1: *Academic works referenced with respect to factors influencing effectiveness.*

Authors	Year	Title
Antonio, Laela, and Alhadi	2020	Personal competence and internal audit effectiveness: The moderating effect of islamic spiritual quotient: A case study of islamic financial institutions in Indonesia
Arena and Azzone	2009	Identifying Organizational Drivers of Internal Audit Effectiveness
Axelsen, Green, and Ridley	2017	Explaining the information systems auditor role in the public sector financial audit
Baheri, Rosidi, and Nurkholis	2017	Competencies and independence of auditors on the effectiveness of internal audit in public universities of Indonesia
Bauer and Estep	2014	The IT Auditor Function on Financial Statement and Integrated Audits: Description of Practice and Avenues for Future Research
Bauer, Estep, and Malsch	2018	One Team or Two? Investigating Relationship Quality between Auditors and IT Specialists: Implications for Audit Team Identity and the Audit Process
Bellino, Wells, and Hunt	2007	Auditing Application Controls
Bhaskar, Schroeder, and Shepardson	2018	Integration of Internal Control and Financial Statement Audits: Are Two Audits Better than One?
Boritz, Robinson, Wong, and Kochetova-Kozloski	2017	Auditors' and Specialists' Views About the Use of Specialists During an Audit
Brazel and Agoglia	2007	An examination of auditor planning judgements in a complex accounting information system environment
Endaya and Hanefah	2013	Internal Audit Effectiveness : An Approach Proposition to Develop the Theoretical Framework
Lenz and Hahn	2015	A synthesis of empirical internal audit effectiveness literature pointing to new research opportunities
Meuldijk, Broskij, and Neeteson	2007	Accountant en IT-auditor - Samenwerking in de praktijk
Nwankpa and Datta	2012	Perceived Audit Quality from ERP Implementations.
Schellevis and van Dijk	2014	Jaarrekening controle in het mkb: IT audit geïntegreerd in de controle-aanpak
Stoel, Havelka, and Merhout	2012	An analysis of attributes that impact information technology audit quality: A study of IT and financial audit practitioners
Turetken, Jethefer, and Ozkan	2019	Internal audit effectiveness: operationalization and influencing factors
van Hornsveld-Clement	2019	Versterken samenwerking accountant en IT-auditor in de jaarrekeningcontrole bij interne auditdienst met wettelijke taak (Msc. Thesis)
Vendrzyk and Bagranoff	2003	THE EVOLVING ROLE OF IS AUDIT: A FIELD STUDY COMPARING THE PERCEPTIONS OF IS AND FINANCIAL AUDITORS
Veth	2009	Externe assurance-regels voor het interne IT-audit beroep

A significant part in achieving this shared understanding is the proper scoping and planning of IT-audit support. In fact, Axelsen et al. (2017), Nwankpa and Datta (2012) and Stoel et al. (2012) all observe the importance of (agreement on the) planning and methodology of audit activities. When done collaboratively with auditors from both disciplines it also ensures IT-audit support provides added value for the accountants (Schellevis & van Dijk, 2014). In other words, realizing high quality and added value IT-audit support activities requires the involvement of auditors from both disciplines. This also reduces the overall audit workload and improves the scope and efficiency of the financial audit (Bellino et al., 2007; Nwankpa & Datta, 2012). Additionally, when IT-audit support is not of high quality it impairs the overall audit and its effectiveness (Bhaskar et al., 2018; Turetken et al., 2019). Thus, both disciplines need to be actively involved in the planning and scoping of IT-audit support so as to realize high quality IT-audit support findings.

However, as Bauer et al. (2018) and Vendrzyk and Bagranoff (2003) observe, it is often difficult to translate IT-audit support findings to an impact on the financial statements, especially when it concerns general IT-control (GITC). Vendrzyk and Bagranoff (2003) give the example of the delayed deactivation of users with remote access when they leave the company. Such a finding is obviously a concern as unwarranted activities may have occurred. However, what are the implications of this for a specific financial statement? How should the accountant respond to this finding? Such issues can make it difficult to understand how IT-audit support adds value to the financial audit (Bauer & Estep, 2014). This is regretful as accountants are less likely to depend on IT-audit support if they do not understand it (Axelsen et al., 2017). Additionally, if accountants are depending on IT-audit support without understanding it the risk of material misstatements is increased (Bauer et al., 2018). Furthermore, each discipline emphasizes its own processes, skills and experience when it comes to facets influencing audit quality (Stoel et al., 2012). To address these issues and achieve effective IT-audit support auditors need to have a cross-disciplinary understanding.

Before being able to excel in cross-disciplinary cooperation, however, auditors need to be capable within their own discipline. Regardless of how great both disciplines can work together, if they are lacking in their own department the audit will still be ineffective. Baheri et al. (2017), Endaya and Hanefah (2013) and Antonio et al. (2020) all show how the auditor's competence, performance and communicative capabilities are positively coupled to effectiveness. Additionally, the affiliation with professional au-

diting organizations, especially of the higher ranking executives and auditors, is also coupled to an increased audit effectiveness (Arena & Azzone, 2009). All of these observations are quite logical, in that audit competence is more likely to lead to high quality results. Nevertheless, such observations do highlight the importance of ensuring that auditors are highly skilled and trained.

Due to the cross-disciplinary nature of IT-audit support the ability to communicate across disciplines is important. As Bauer et al. (2018) note, a mutual understanding between the disciplines is needed in order to realize added value with IT-audit support. Such an understanding can only arise if each discipline is able to understand why and how the other discipline operates. The importance of this is argued by Brazel and Agoglia (2007). They note that the accountant's IT capabilities are critical in being able to determine the proper response to IT-audit support findings (Brazel & Agoglia, 2007). This has direct consequences for the overall audit as an incorrect response can lead to inefficiencies in the audit in the best case or an incorrect audit conclusion in the worst case. Likewise, an IT-auditor's ability to understand what the accountant needs allows them to deliver findings which are applicable to the accountant (van Hornsveld-Clement, 2019). The added advantage of this cross-disciplinary affinity is that it allows IT-audit support to be focused on the complicated IT systems and risks. Accountants with IT affinity can cover the basics themselves (Meuldijk et al., 2007). IT-audit support can be scoped so as to tackle those issues which best respond to the accountant's needs. Furthermore, this helps the accountants determine when to involve IT-auditors and when not to do so (Axelsen et al., 2017). The fact remains that the signing accountant remains accountable for all audit work, including IT-audit support (Bauer & Estep, 2014). A cross-disciplinary understanding can help the signing accountant understand when and how to use IT-audit support. In conclusion, in effective IT-audit support both disciplines have cross-disciplinary knowledge and are, as a result, better equipped to plan, scope, execute and conclude the IT-audit support activities.

Being skilled in one's own discipline and being able to understand and talk in the other discipline's context alone is, however, not sufficient for effective IT-audit support. Academia notes that the relationship and interaction between the disciplines also plays a role. The majority of auditors, according to Boritz et al. (2017), are not satisfied with specialist usage, such as IT-audit support. Boritz et al. (2017) notes that the differing perceptions on (the degree of) involvement of IT-auditors in the audit play a significant role in this. These perceptions stem in part from the relationship be-

tween the disciplines. A poor relationship, often coupled with an 'us vs. them' mentality, greatly impacts the audit and decreases its effectiveness and quality (Bauer et al., 2018). A bad relationship means that auditors are not motivated to work together and use their skills and expertise to ensure that IT-audit support is effective. This is also noted by Lenz and Hahn (2015) who states that "interpersonal factors are regarded critical in determining [audit] effectiveness" (p. 24). In fact, good coordination and communication between the disciplines helps create an understanding of how the disciplines impact and influence each other (Bauer et al., 2018). Additionally, it brings learning opportunities and additional challenge and motivation for auditors (Meuldijk et al., 2007). It not only improves the IT-audit support quality and added value but also allows and motivates the auditors to work on and improve their own skills (Meuldijk et al., 2007). Furthermore, a good relationship leads to better integration and open and frequent communication (Bauer et al., 2018). To put it all together, the quality of the relationship between the auditors directly influences the effectiveness of IT-audit support.

To bring it all together, multiple factors have been highlighted by academia which have an influence on IT-audit support effectiveness. Practically, effectiveness can be influenced by the degree to which both disciplines are involved in and in agreement on the planning and scoping of IT-audit support. Additionally, auditors's need to be skilled and knowledgeable in their own discipline. Lastly, as van Hornsveld-Clement (2019) concludes, frequent and open communication between auditors as well as cross-disciplinary knowledge and training are key.

4.2 Interviews

Interviews were held in order to discern what active practitioners of IT-audit support think about factors influencing IT-audit support effectiveness. These interviews were held with nine auditors holding various roles within the Auditdienst Rijk (ADR): accountant, IT-auditor and independent quality controller. These interviews addressed the role of IT-audit support within the audit, effectiveness and potential influencing factors as well as the relationship between accountants and IT-auditors. From the transcription of the interviews the statements related to factors influencing effectiveness and having at least 50% of total interviewee support or 100% support within a role were taken into consideration. This section highlights the observations extracted from the statements taken into

consideration and summarizes them into four themes. A more detailed description on how the interviews were conducted can be found in section 3.3 and Appendix A.

Two important components of effective IT-audit support are the proper scoping and timing of the IT-audit support activities. This requires agreement and clarity between the disciplines on what activities will be performed. As all of the accountants and many of the IT-auditors asked: does IT-audit support sufficiently focus on the 'must haves'? Is it clear what data or information the accountants need and is the integrity of those source systems guaranteed? Are the right controls being executed and do the GITCs hold? Is the IT-auditor involved in the planning of IT-audit support? All of these questions highlight factors that auditors think influence IT-audit support effectiveness. Additionally the timeliness in reporting back to the accountant was continually emphasized. As one interviewee put it, it is critical that the accountant knows as early as possible whether the IT-audit support findings can be depended upon. Concretely, what these interviewees noted is that, in order to achieve effective IT-audit support there needs to be clarity on what needs to be done and when.

However, the difficulty auditors face in translating between the two disciplines form a big challenge. Interviewees from all disciplines noted how difficult it is to understand the implications of the other discipline's work and how they can translate IT-audit support findings to financial implications. Especially those accountants with less affinity with IT noted they struggled with this. This is an important observation as almost all interviewees noted that being able to understand and speak the other discipline's language is key to effective IT-audit support. Auditors need to have a basic understand of the other discipline. The interviewees note this is needed in order to be able to comprehend what risks need to be addressed by IT-audit support and how the findings influence the further progression of the overall audit. On the basis of interviewee support[1] it can be argued that cross-disciplinary knowledge and translation are an important factor of effective IT-audit support.

Cross-disciplinary knowledge, however, is useless if the auditors do not communicate with each other. All IT-auditors and accountants stressed the importance of continual communication between the disciplines. It is important that they keep each other in the loop and regularly update and inform one another on the audit progress. This helps align the per-

[1]Each statement related to cross-disciplinary knowledge had a minimum support of 67% across all roles. Half of the related statements had 89% support.

ceptions on and priorities for IT-audit support and plays a role in ensuring the stakeholders are satisfied. The cross-disciplinary knowledge mentioned earlier also plays a role in the communication between the disciplines. The interviewees noted that, as they (initially) do not speak or understand each other's language, there tends to be a natural incomprehension between IT-auditors and accountants. This incomprehension can be addressed through improving cross-disciplinary knowledge and through approachable and regular interaction. The latter encourages auditors to ask questions and learn from one another. To summarize, the interaction between the auditors in effective IT-audit support is regular, approachable and based upon a mutual cross-disciplinary understanding.

Lastly, the (organizational) distance between the auditors and their integration, or lack thereof, in the audit team influences effectiveness. The accountants and IT-auditors interviewed perceived a large difference in effectiveness between IT-audit support executed by 'horizontal' IT-auditors and IT-audit support executed by 'account' IT-auditors[2]. The interviewees propose that this is the case because 'horizontal' auditors are further separated from the team and thus communication between and interaction with the auditors is much more complicated. In fact, the interviewees and especially the IT-auditors proposed that the IT-auditors, or minimally the lead IT-auditor, should be involved in and a part of the audit team. The key observation is that the (perceived) distance between the auditor executing IT-audit support activities and those depending on the findings should be minimized so as to enable effective communication between the parties involved.

To summarize the interviewee observations there are four key themes when it comes to factors leading to IT-audit support effectiveness. Firstly, it should be clear for all auditors involved what should be done and when it needs to be done. Additionally, the auditors need to have a basic understanding of the other discipline and have the ability to translate between IT and accounting. Thirdly, continual communication and approachable interaction is needed to make effective use of this cross-disciplinary knowledge. Lastly, the integration of IT-auditors in the audit seems to have a positive effect on the interaction between the disciplines.

[2] 'Horizontal' IT-auditors are specialized in a system or topic whereas 'account' IT-auditors are specialized in a government ministry. See section 2.1 for more on this distinction.

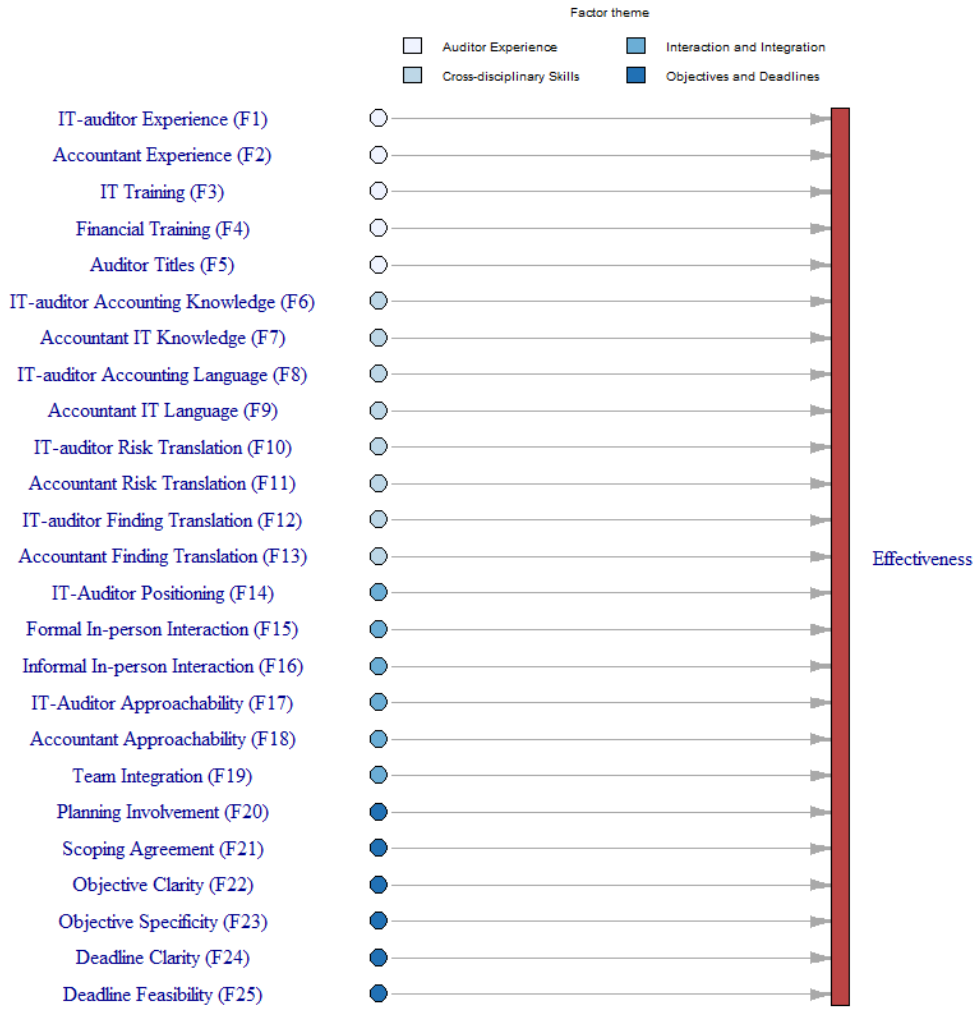
4.3 Conclusion

As shown by both academia and practicing auditors, multiple factors influence IT-audit support effectiveness. Firstly, the knowledge, experience and skills of the auditors in both their own discipline as well as the other discipline play a role. Secondly, the relationship and interaction between the auditors as well as the degree of integration within the team seem to influence effectiveness. Lastly, the degree of involvement in, agreement on and clarity of the planning and scoping are important. This section translates these themes into a set of concrete factors whose impact on IT-audit support effectiveness will be analyzed in chapter 5. A general overview of these factors and their relationship with IT-audit support effectiveness can be seen in Figure 4.1. This overview will be enhanced in chapter 5 to highlight the exact influence that each factor has on IT-audit support effectiveness. The factors in Figure 4.1 are also discussed per theme in the remainder of this section and shown in detail in Table 4.2. Table 4.2 can be found at the end of this chapter.

There are three concrete measures which reflect the influence that auditor knowledge, skills and experience can have on IT-audit support effectiveness. Firstly, there is the years of experience that an auditor has: more experience commonly translates to higher skill levels and increased knowledge. Secondly, the degree of training the auditors have received in relevant fields (e.g. IT and finance) highlights the opportunities they have had to gain new knowledge and skills. Lastly, certification through the professional auditor organizations (NOREA and NBA in the Netherlands) indicates that the auditors meet the minimum skill and knowledge thresholds to be able to independently conduct an audit. Together, these factors are able to provide insights in the impact that auditor knowledge and skill has on effectiveness. Table 4.2 shows these factors and how they are measured using keys F-1 through F-5. Additionally, they are depicted in Figure 4.1 under the theme Auditor Experience.

A second grouping of factors concerns the auditors' ability to understand and communicate in each other's language. In other words, are auditors able to apply their cross-discplinary knowledge in actual working conditions? Can they translate financial risks to IT-audit support objectives and IT-audit support findings to audit implications? Do they have the ability to talk with one another on the same level? These questions can all be translated into factors on how the discipline's cross-disciplinary skills and capabilities are perceived and their influence on effectivess. The factors are shown using keys F-6 through F-13 in Table 4.2 and using the theme

Figure 4.1: *Factors and their relationship with IT-audit support effectiveness.*



Cross-disciplinary Skills in Figure 4.1.

The relationship between and integration of the disciplines can be concretized into factual and perceptive components. The first factual factor is where the IT-auditors operates from: are they part of the 'account' or are they 'horizontal' specialists? Additionally, the frequency and form of in-person[3] interactions with the other discipline are taken as a factual factor. Form refers to either formalized interactions such as meetings or presentations or informal interactions such as during lunch or in the hall-

[3]In-person denotes interactions which would have been in-person if social distancing, caused by the Covid-19 pandemic, had not been in effect.

way. Perceptually, it is about how approachable the various discipline's are perceived to be and whether the auditors feel as if they are a part of the team. Together these factors, shown as keys F-14 through F-19 in Table 4.2 and theme Interaction and Integration in Figure 4.1, concretize the impact the interactions between auditors have on IT-audit support effectiveness.

Lastly, the involvement, agreement and clarity of the IT-audit support objectives and deadlines are translated to factors F-20 through F-25 in Table 4.2. In Figure 4.1, they are depicted under the theme Objectives and Deadlines. These factors look into whether auditors are in agreement on the clarity, specificity and feasibility of the IT-audit support objectives and activities. In other words, do the various disciplines agree on the scoping and planning of IT-audit support? Through these factors the concrete impact of planning and scoping on IT-audit support can be measured.

Table 4.2: *Factors influencing IT-audit support effectiveness (RQ2).*

Key	Factor	Measure
F-1	IT-auditor experience	Years of experience (none,$\leq$2, 3-5, 6-10, $\geq$11).
F-2	Accountant experience	Years of experience (none,$\leq$2, 3-5, 6-10, $\geq$11).
F-3	IT training	IT training received (none, basic, intermediate, extensive).
F-4	Financial training	Financial training received (none, basic, intermediate, extensive).
F-5	Auditor titles	Attained titles (RA, RE, both, none).
F-6	IT-auditor accounting knowledge	Perception of IT-auditors' understanding of accounting (10 point scale: insufficient $\longrightarrow$ sufficient).
F-7	Accountant IT knowledge	Perception of accountants' understanding of IT (10 point scale: insufficient $\longrightarrow$ sufficient).

Continued on next page

Table 4.2 – continued from previous page

Key	Factor	Measure
F-8	IT-auditor accounting language	Perception of IT-auditors' ability to speak the accountant's language (10 point scale: insufficient $\longrightarrow$ sufficient).
F-9	Accountant IT language	Perception of accountants' ability to speak the IT-auditor's language (10 point scale: insufficient $\longrightarrow$ sufficient).
F-10	IT-auditor risk translation	Perception of IT-auditors' ability to translate audit risks to IT-audit support activities (10 point scale: insufficient $\longrightarrow$ sufficient).
F-11	Accountant risk translation	Perception of accountants' ability to translate audit risks to IT-audit support activities (10 point scale: insufficient $\longrightarrow$ sufficient).
F-12	IT-auditor finding translation	Perception of IT-auditors' ability to translate IT-audit support findings to audit implications (10 point scale: insufficient $\longrightarrow$ sufficient).
F-13	Accountant finding translation	Perception of accountants' ability to translate IT-audit support findings to audit implications (10 point scale: insufficient $\longrightarrow$ sufficient).
F-14	IT-auditor positioning	Placement of IT-auditor in the organization ('account', 'horizontal').
F-15	Formal in-person interaction	Frequency of formalized interaction between disciplines ($\leq$1x/month, 2-3x/month, 1x/week, 2-4x/week, daily).
F-16	Informal in-person interaction	Frequency of informal interaction between disciplines ($\leq$1x/month, 2-3x/month, 1x/week, 2-4x/week, daily).

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Table 4.2 – continued from previous page

Key	Factor	Measure
F-17	IT-auditor approachability	Perception of IT-auditors' approachability (10 point scale: unapproachable ⟶ approachable).
F-18	Accountant approachability	Perception of accountants' approachability (10 point scale: unapproachable ⟶ approachable).
F-19	Team integration	Auditor perception of the extent to which they feel a part of the audit team (10 point scale: not integrated ⟶ integrated).
F-20	Planning involvement	Involvement in planning process (10 point scale: not involved ⟶ involved).
F-21	Scoping agreement	Cross-disciplinary agreement on IT-audit support scope (10 point scale: disagree ⟶ agree).
F-22	Objective clarity	Clarity of IT-audit support objectives (10 point scale: unclear ⟶ clear).
F-23	Objective specificity	Specificity of IT-audit support objectives (10 point scale: vague ⟶ specific).
F-24	Deadline clarity	Clarity of IT-audit support deadlines (10 point scale: unclear ⟶ clear).
F-25	Deadline feasibility	Feasibility of IT-audit support deadlines (10 point scale: infeasible ⟶ feasible).

Chapter 5

Key factors determining IT-audit support effectiveness

Armed with a method of measuring IT-audit support effectiveness and a list of potential factors which influence this effectiveness it is possible to quantify the impact that these factors have[1]. With this quantification it is possible to address RQ3 which can, in turn, be used to formulate an answer to the RP. For clarity, the last remaining research question and the overall problem being addressed are:

RQ3 "How does each factor influence IT-audit support effectiveness?"

RP "What are key factors influencing the effectiveness of IT-audit support activities in the financial audit within the context of the public sector?"

Determining the key factors occurred in two phases. First a survey was created based on the effectiveness indicators and factors and sent to all employees of the Auditdienst Rijk (ADR) involved in IT-audit support and the financial end-of-year audit. This survey was initially sent via email and then an additional post was placed on the ADR's intranet promoting the survey. Together this resulted in a total of 52 respondents. This corresponds to approximately 30%[2] of the auditors at the ADR who are involved with IT-audit support within all end-of-year financial statement

[1] See chapters 3 and 4 respectively.

[2] No exact knowledge was available on how many auditors are involved in IT-audit support in a given audit. So as to prevent false (over)confidence the most conservative estimate mentioned in conversation with auditors was used.

Table 5.1: *General overview of the survey responses.*

Role	No.	%	I1*†		I2*†		I3*†		I4*†		Effectiveness‡§
All	40	100.00%	7	8	6	6	8	8	7	7	50.50%
Accountants	19	47.50%	7	8	6	8	8	7	7	7	52.50%
IT-auditors	21	52.50%	7	6	6	6	8	8	7	7	47.00%
IT: 'horizontal' (F14)	10	47.62%	7	7	6	6	8	9	7	8	52.00%
IT: 'account' (F14)	11	52.38%	6	6	6	4	7	8	6	7	38.50%

* I1 = Fulfillment Degree, I2 = Timeliness, I3 = Added Value, I4 = Stakeholder Satisfaction

† The left value is the median over all (sorted) responses for a given Role. The right value is the mode over all responses for a given role.

‡ This is the average of the effectiveness score over the median indicator scores and the effectiveness score over the mode indicator scores. The effectiveness scores are computed using Equation 3.1 .

§ An overview of the frequencies of effectiveness scores can be found in Table B.5.

audits in a given fiscal year (personal communication). An overview of the survey and the exact questions asked can be found in section B.1. The results of the survey were then statistically analyzed and a model was created which describes the relationship between the (key) factors and effectiveness. This statistical analysis is presented in section 5.1 and then in section 5.2 the implications of this analysis for RQ3 and the RP are discussed.

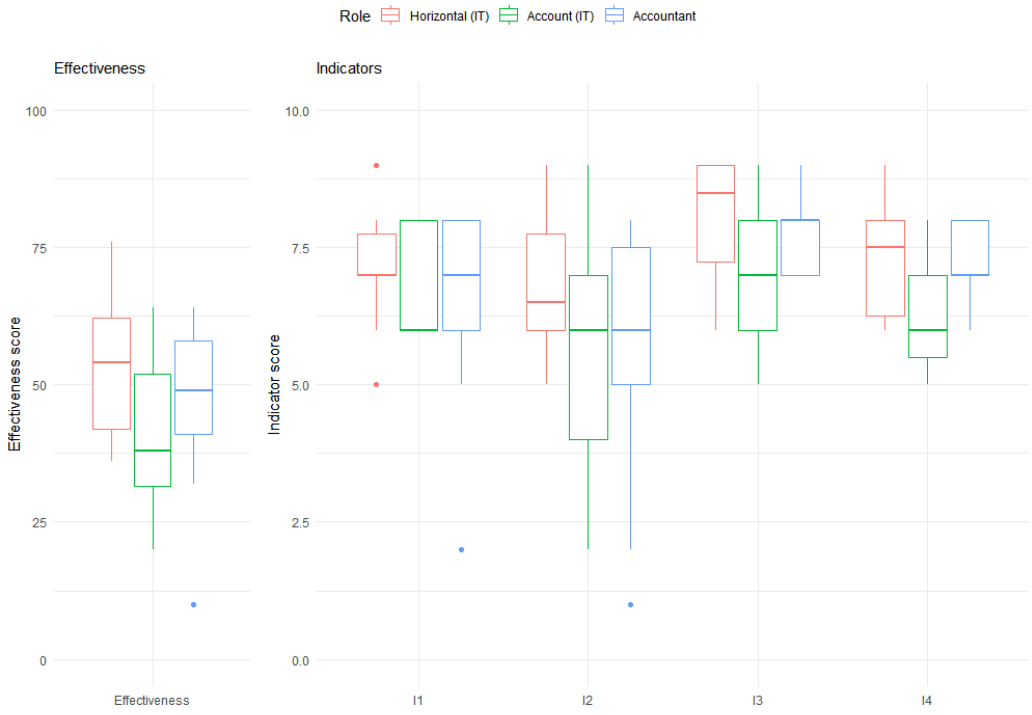
5.1 Statistical analysis

The survey analysis, conducted in the R programming language, started with preparing and cleaning the survey response results. The first step involved the removal of invalid[3] or incomplete responses. This decreased the sample size from 52 to 40 responses. On the basis of these valid responses a summary was generated so as to gain initial insights into how effectiveness was rated. This summary, represented in Table 5.1, shows that, despite the relatively small sample size, there is an even spread between the two disciplines as well as between the two types of IT-auditors. Looking at the effectiveness score, based on the median and mode[4] indicator scores, it is evident that the overall effectiveness scores are not very

[3]Invalid responses are responses submitted by individuals who have not been involved in IT-audit support since 2017.

[4]Due to their ordinal nature only non-parametric measures can be used.

Figure 5.1: *IT-audit support effectiveness and indicator score boxplots.*



I1 = Fulfillment Degree, I2 = Timeliness, I3 = Added Value, I4 = Stakeholder Satisfaction

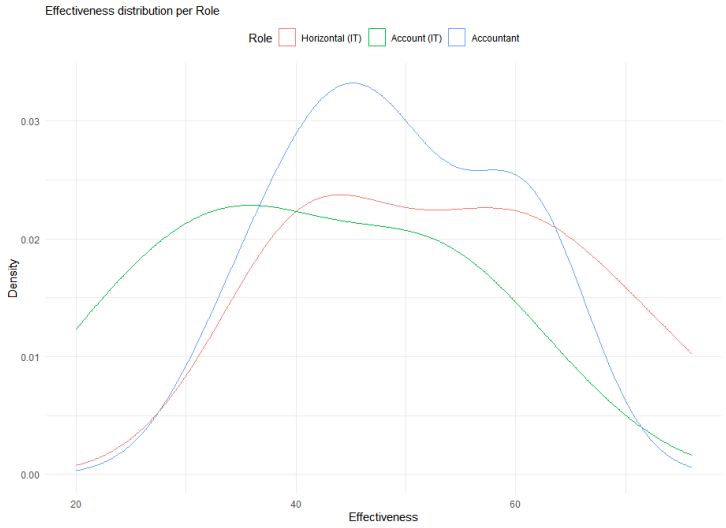
high. This confirms the general sentiment found in subsection 1.1.5.

Boxplots were computed to further investigate the large differences in Effectiveness scores between the disciplines. These plots, shown in Figure 5.1, provide a visual indication of how the Effectiveness and Indicator scores are distributed among the disciplines. The plots also highlighted outliers for Fullfillment Degree (I1), Timeliness (I2) and Effectiveness. As one respondent was responsible for all of the accountant outliers, this respondent was removed from the data set[5]. The other outliers, among the 'horizontal' IT-auditors, were not removed form the data set. Their singular deviations had no significant impact on the Effectiveness distribution.

Looking at the overview in Table 5.1 or the plots in Figure 5.1, it seems as if there is a large difference between how different roles score IT-audit

[5]Removing this respondent had no impact on the median and mode indicator scores as presented in Table 5.1. Therefore, no new overview is included.

Figure 5.2: *IT-audit support effectiveness distribution density per role.*



support effectiveness. This is most notable when comparing 'horizontal' and 'account' IT-auditors. The distribution of effectiveness, as shown in Figure 5.2, also highlights this and suggests that there might be perceptual differences between the roles with respect to IT-audit support effectiveness. The Kruskal-Wallis test was conducted in order to quantify the differences between accountants, 'account' IT-auditors and 'horizontal' IT-auditors and test whether these differences are significant[6]. A significant outcome for the Kruskal-Wallis test indicates that a significant difference exists between the groups (Mangiafico, 2016). The Kruskal-Wallis test, however, reported that the difference in Effectiveness between the roles was not significant ($\chi^2(2) = 4.1413$, $p = 0.1261$). As such, it is not possible to definitively conclude that there are significant perceptual differences between the auditor roles on how to interpret IT-audit support effectiveness.

As a next step, and with the outcome of the Kruskal-Wallis test in mind, summary data was computed over the entire response set for each indicator and factor. These summaries are depicted in Table 5.2. As certain factors were split into multiple survey questions this resulted in a total of 30 factors instead of the 25 given in section 4.3. These factors were split so as to be able to discover whether auditors scored their 'account' and

[6]Due to the non-normal distributions (see Figure 5.2) the Kruskal-Wallis test was used instead of the more commonly used one-way Anova test.

Table 5.2: *IT-audit support effectiveness indicator and factor overviews.*

(a) *IT-audit support effectiveness indicators overview.*

	Indicator	Min	1st Q.	Median	3rd Q.	Max	Mode
	Effectiveness	20	38	49	60	76	42
I1	Fulfillment Degree	5	6	7	8	9	8
I2	Timeliness	2	5	6	7	9	6
I3	Added Value	5	7	8	8	9	8
I4	Stakeholder Satisfaction	5	6	7	8	9	7

(b) *IT-audit support effectiveness factors overview.*

	Factor	Min	1st Q.	Median	3rd Q.	Max	Mode
F1	IT-auditor Experience	None	None	Less than 3 years	More than 10 years	More than 10 years	None
F2	Accountant Experience	None	None	6 to 10 years	More than 10 years	More than 10 years	More than 10 years
F3	IT Training	Basic	Intermediate	Intermediate	Extensive	Extensive	Extensive
F4	Financial Training	None	Basic	Intermediate	Extensive	Extensive	Extensive
F5	Auditor Titles	None	None	RA or RE	RA or RE	RA and RE	None
F6a	'Account' IT-auditor Accounting Knowledge	2	5	6	7	8	6
F6h	'Horizontal' IT-auditor Accounting Knowledge	3	6	7	8	8	7
F7	Accountant IT Knowledge	2	5	6	6	8	6
F8a	'Account' IT-auditor Accounting Language	2	5	6	7	7	6
F8h	'Horizontal' IT-auditor Accounting Language	4	6	7	8	8	7
F9	Accountant IT Language	3	5	6	7	8	6
F10a	'Account' IT-auditor Risk Translation	3	6	6	7	8	6
F10h	'Horizontal' IT-auditor Risk Translation	5	6	7	8	9	7
F11	Accountant Risk Translation	3	6	6	7	8	6
F12a	'Account' IT-auditor Finding Translation	3	5	6	7	8	6
F12h	'Horizontal' IT-auditor Finding Translation	3	6	7	7	9	7
F13	Accountant Finding Translation	3	6	6	7	9	6
F14	IT-auditor Positioning	Horizontal (IT)	Horizontal (IT)	Account (IT)	Accountant	Accountant	Accountant
F15	Formal In-person Interaction	1x/month or less	1x/month or less	2-3x/month	1x/week	Daily	1x/month or less
F16	Informal In-person Interaction	1x/month or less	2-3x/month	2-3x/month	2-4x/week	Daily	2-3x/month
F17	IT-auditor Approachability	6	7	8	8	10	8
F18	Accountant Approachability	6	7	8	8	9	8
F19	Team Integration	4	6	8	8	10	8
F20	Planning Involvement	0	5	6	8	10	6
F21	Scoping Agreement	2	6	7	7	9	7
F22c	Objective Clarity	4	7	7	8	9	7
F22d	Objective Clarity Documentation	5	6	7	7	9	7
F23	Objective Specificity	3	6	7	8	8	7
F24	Deadline Clarity	4	6	8	8	9	8
F25	Deadline Feasibility	4	6	6	8	8	6

'horizontal' IT-auditor colleagues differently[7]. Additionally, before computing the summary data, IT-auditor Positioning (F14) was converted to an ordinal factor such that a higher rank was given to those closest to the accountant[8]. This simplifies the statistical analysis as all factors are now ordinal while still capturing the core idea behind the factor[9].

From the overviews presented in Table 5.2 multiple observations can be made. Firstly, it can be observed that there is more accounting experience (F2 with a median of '6 to 10 years') than Information Technology (IT) auditing experience (F1 with a median of 'less than 3 years'). Additionally, nearly all auditors have received some form of IT training (F3 with a minimum of 'basic' training) and financial training (F4 with at least 75% having 'basic' training). Furthermore, the perceptual indicators (I3 and I4) tend to the upper half of the possible scores with a minimum score of 5 and a maximum of 9. The same can be concluded with respect to Fulfillment Degree (I1). The factual indicator of Timeliness (I2), on the other hand, has a wider range with a minimum of score 2 and a maximum of 9. The majority of the factors also have this wide range with both very low and very high scores. The exception to this is Approachability (F17 and F18) which have scores ranging from 6 to 10, indicating that auditors are perceived to be at least somewhat approachable.

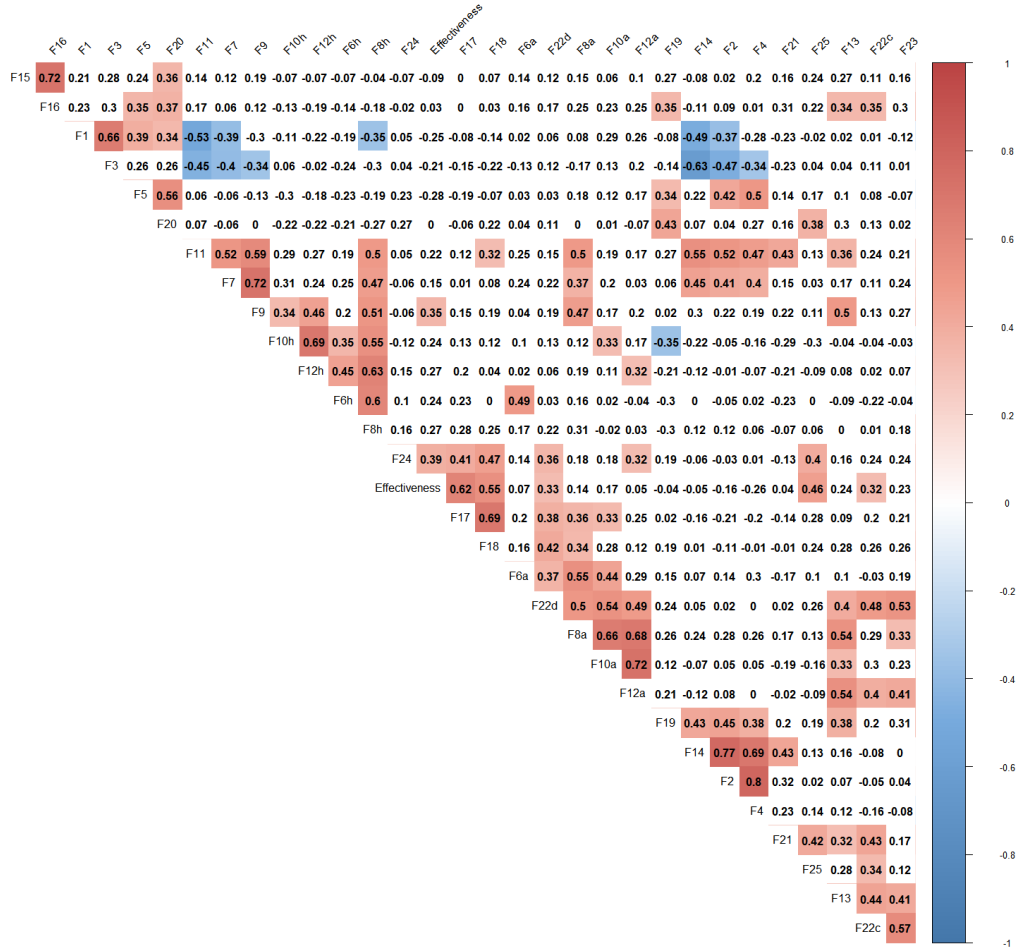
The Spearman rank correlations were then computed in order to better understand the associations between the various factors and effectiveness. The results are visually depicted in Figure 5.3 with significant rank correlations ($p < .05$) being given a colored background. From this overview no significant associations (correlation ≥ 0.70 with $p < .05$) exist between any factors and Effectiveness. A few factors do seem to play some role (correlation ≥ 0.40 with $p < .05$). These are IT-auditor Approachability (F17), Accountant Approachability (F18) and Deadline Feasibility (F25). The rank correlations in Figure 5.3 provide a first glimpse into the impact that factors have on IT-audit support effectiveness. In a sense this provides a rough answer to RQ3. Nevertheless, further analysis was conducted to

[7]For example, IT-auditor Accounting Knowledge (F6) was split into 'Account' IT-auditor Accounting Knowledge (F6a) and 'Horizontal' IT-auditor Accounting Knowledge (F6h).

[8]This means that 'horizontal' IT-auditors < 'account' IT-auditors < accountants. While the factor is about IT-auditor Positioning, accountants were also given a score so as to allow for a comparison across the entire data set. Not doing so would require the removal of nearly half of the responses due to missing data.

[9]Namely the influence of integration and interaction between the disciplines on IT-audit support effectiveness. See section 4.3.

Figure 5.3: *Spearman rank correlations of IT-audit support effectiveness factors.*



Only relationships with $p < .05$ are given a colored background.

gain greater insights into which factors play a large role in determining IT-audit support effectiveness (RP).

While the Spearman rank correlations did not show significant associations between factors and Effectiveness, it did highlight significant associations between factors. This hints at multicollinearity. Multicollinearity can be a problem as it tends to reduce the accuracy of estimating individual (regression) coefficients (James, Witten, Hastie, & Tibshirani, 2013). In other words, it reduces the ability to estimate an individual factor's influence on IT-audit support effectiveness. The approach used later in this chapter, random forests, can partially compensate for this by limiting the

influence of the dominant predictor[10] (James et al., 2013). Nevertheless, multicollinearity was still addressed before implementing random forests as it reduces the need for compensating measures[11]. Additionally, it also allows for factor reduction and hence a simpler model to analyze.

To address this multicollinearity, factors with a significant correlation ($\geq$ 0.70 with $p < .05$) were analyzed and combined[12]. The majority of the combined factors operated on the same ordinal scale. For these factors the level of the original factors was averaged and used to determine the value of the combined factor. For the factors operating on different scales one of the factors was used as the value for the combined factors and the other factors were dropped.

The process of combining factors was repeated until almost no pairs of factors remained which had significant correlations. The significant correlation between IT-auditor Positioning (F14) and Accountant Experience (F02_4) was not removed. This collinearity was manually introduced while converting IT-auditor Positioning (F14) into an ordinal factor due to the ordinal scale awarding a higher value to accountants[13]. Removing this factor, by combining experience with organizational positioning, would result in a significant loss of data and therefore this rank correlation was not compensated for. All of the final combined factors and their original sources, as well as the method of combination, can be found in Table 5.3. Additionally, the correlogram of the final Spearman's rank correlation is found in Figure 5.4.

Having updated the factors involved, the rank correlations with Effectiveness should also have updated. However, when considering the updated rank correlations, as depicted in Figure 5.4, there are still no significant

[10]This is done by limiting the number of factors which can be used to form a tree (James et al., 2013). As noted later in this chapter, tuning this can lead to performance improvements.

[11]Less compensating actions also means that there are less limits on the tuning parameters and thus more room for performance improvements.

[12]Often the Variance Inflation Factor (VIF) is used to detect multicollinearity. However, this requires quantitative data instead of the ordinal data available. Converting all of the ordinal factors to quantitative variables through the use of dummy variables would introduce +/-250 new variables. Gaining statistically significant observations with these 250 variables is not realistic considering the size of the data set. The common alternative for ordinal data, chi-squared analysis, cannot be used as the data set does not meet the chi-squared analysis requirements. For this reason, the relatively simple approach of using rank correlations to detect multicollinearity was used. Any remaining multicollinearity can then be compensated for through the use of random forests.

[13]Who by nature of their job tend to have more Accountant Experience (F02_4).

Table 5.3: *IT-audit support effectiveness factor reconfiguration to address multicollinearity.*

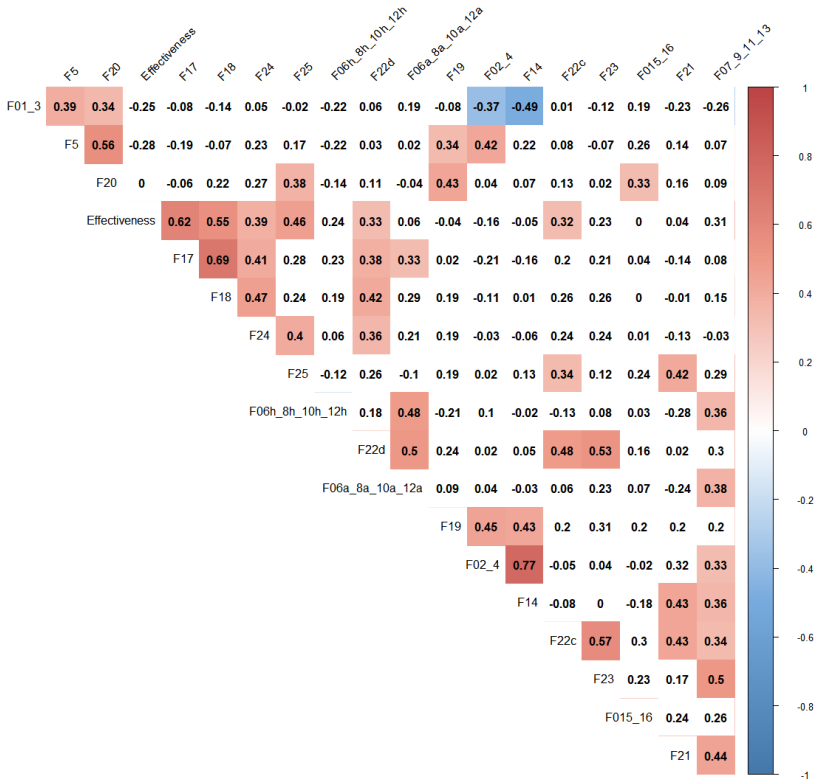
	New Factor	Original Factors	Method
F01_3	IT-auditor Experience	F1, F3	Dropped F3.
F02_4	Accountant Experience	F2, F4	Dropped F4.
F06a_8a_10a_12a	'account' IT-auditor cross-disciplinary skills	F6a, F8a, F10a, F12a	Average of original factor levels.
F06h_8h_10h_12h	'horizontal' IT-auditor cross-disciplinary skills	F6h, F8h, F10h, F12h	Average of original factor levels.
F07_9_11_13	Accountant cross-disciplinary skills	F7, F9, F11, F13	Average of original factor levels.
F015_16	In-person interaction	F15, F16	Average of original factor levels.

associations (correlation ≥ 0.70 with $p < .05$) with Effectiveness. Considering factors with some association (correlation ≥ 0.40 with $p < .05$) a few can still be considered: IT-auditor Approachability (F17), Accountant Approachability (F18) and Deadline Feasibility (F25). This list is the exact same as in the original rank correlation scores. In other words, while the merging of factors has reduced the multicollinearity and simplified the model, it does not seem to have had a major impact on the rank correlations with Effectiveness.

As no significant rank correlations exist between a factor and IT-audit support effectiveness, decision trees were implemented in order to determine which factors are most influential. More specifically, the random forest approach was used. In contrast to many other approaches, decision trees support ordinal data without requiring dummy variables (James et al., 2013). This makes them well suited for the data at hand which primarily consists of ordinal data. Using dummy variables on this set is not realistic as the small sample set is too small with respect to the number of dummy variables needed. One thing to note is that a single decision tree has a lower predictive accuracy when compared to other approaches such as linear regression (James et al., 2013). However, James et al. (2013) note that random forests can be used to counteract this and increase the predictive performance. A random forest is essentially a large set of randomly generated low-bias decisions trees which are averaged to compute a low variance prediction (James et al., 2013). A useful advantage is that the random forest will not overfit even as the number of trees in the forest increases (James et al., 2013).

When creating a random forest there are two key characteristics to keep

Figure 5.4: *Updated Spearman rank correlations of IT-audit support effectiveness factors.*

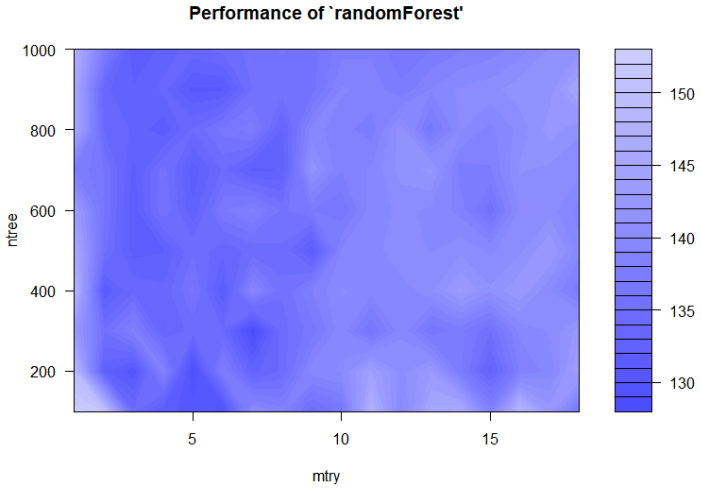


Only relationships with $p < .05$ are given a colored background.

in mind: the number of trees in the forest and the number of random predictors to use when building a tree in the forest (James et al., 2013). By limiting the latter it is possible to counteract the influence of highly correlated predictors (factors) and increase the reliability of the forest (James et al., 2013). This also aids in counteracting any remaining multicollinearity. A tuning algorithm was used in order to determine the optimal amount of random predictors (mtry) and trees (ntree). This algorithm performs a grid search on all possible combinations of mtry ($\in [1, 18]$) and ntree ($\in [100, 200, 300, \ldots, 1000]$) and selects the parameters which resulted in the lowest tuning error. In Figure 5.5a the final performance for each combination of mtry and ntree is shown. This tuning, conducted over a 70/30 training/validation split of the survey data, resulted in the best performing forest having 7 random predictors (mtry), 300 trees (ntree) and a tuning performance of 128.3972. Additionally, as shown in Figure 5.5b, the random forest's mean squared error stabilized at 148.9376.

Figure 5.5: *Random forest performance.*

(a) *Random forest tuning results.*



(b) *Best random forest mean squared error (MSE).*

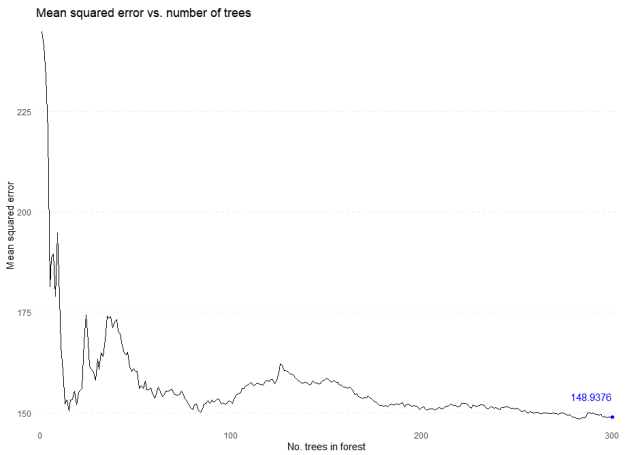
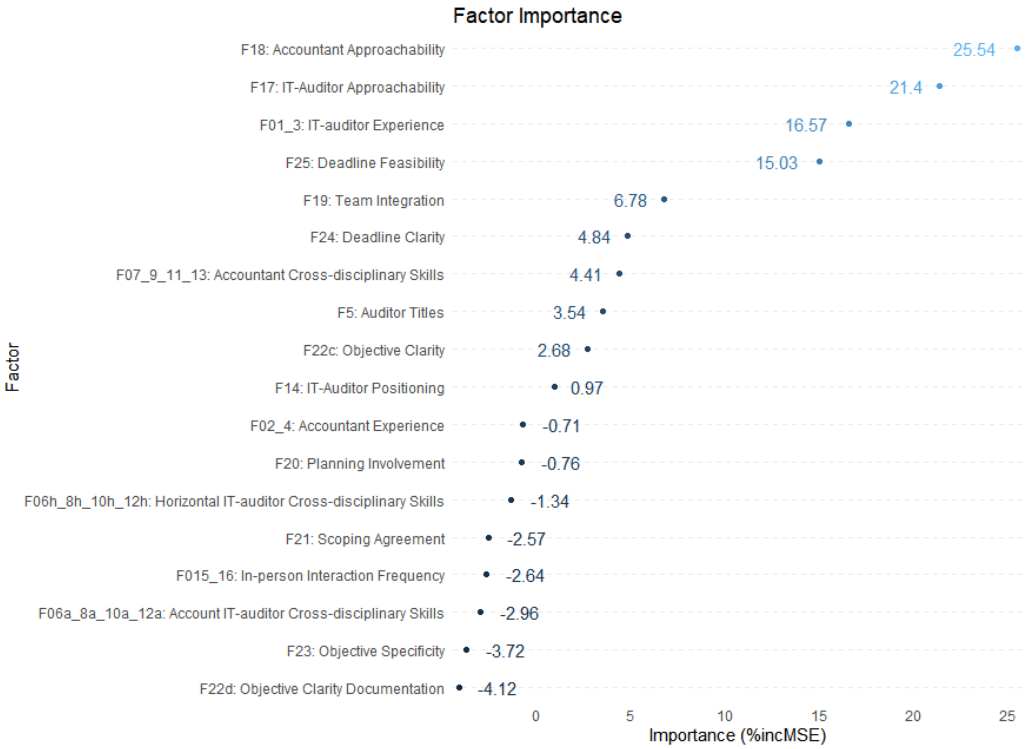


Figure 5.6: *IT-audit support effectiveness factors importance analysis.*



In order to determine the importance of a factor, and thus provide an answer to RP, the permutation importance (%incMSE) was computed. The permutation importance describes the importance factor as the percentage with which the mean squared error increases if that factor were not included in the forest[14]. A factor's permutation importance thus describes how much the error rate would decrease if that factor were included in the model. As such, a higher permutation importance implies the factor played a greater role in determining the IT-audit support effectiveness. The visualized outcome of the importance analysis can be found in Figure 5.6. The visualization provides an answer to what factors are most influential in determining IT-audit support effectiveness (RP).

[14]See Strobl and Zeileis (2008) for a discussion on measuring variable importance in random forests.

Figure 5.7: *Factor influence on IT-audit support effectiveness (RQ3, RP).*

5.2 Conclusion

In the previous section a statistical analysis was conducted with the aim to address the influence that the factors discovered in chapter 4 have on IT-audit support effectiveness. The impact of each factor on IT-audit support can be deduced through the random forest created. In combination with the Spearman rank correlations, a general feeling for each factor's influence on IT-audit support is available. This information serves as an answer to RQ3. More interestingly, however, is the notion of the most influential factors. By knowing which factors are most influential the overall research problem (RP) can be addressed.

As an answer to RP, the relationship between each factor and IT-audit support effectiveness is depicted in Figure 5.7. Additionally, Table 5.4

Table 5.4: *Factor influence on IT-audit support effectiveness (RQ3, RP).*

	Factor	Importance	Rank Correlation
F18	Accountant Approachability	25.54	0.55*
F17	IT-auditor Approachability	21.40	0.62*
F01_3	IT-auditor Experience	16.57	-0.25
F25	Deadline Feasibility	15.03	0.46*
F19	Team Integration	6.78	-0.04
F24	Deadline Clarity	4.84	0.39*
F07_9_11_13	Accountant Cross-disciplinary Skills	4.41	0.31
F5	Auditor Titles	3.54	-0.28
F22c	Objective Clarity	2.68	0.32*
F14	IT-auditor Positioning	0.97	-0.05
F02_4	Accountant Experience	-0.71	-0.16
F20	Planning Involvement	-0.76	0.00
F06h_8h_10h_12h	Horizontal IT-auditor Cross-disciplinary Skills	-1.34	0.24
F21	Scoping Agreement	-2.57	0.04
F015_16	In-person Interaction Frequency	-2.64	0.00
F06a_8a_10a_12a	Account IT-auditor Cross-disciplinary Skills	-2.96	0.06
F23	Objective Specificity	-3.72	0.23
F22d	Objective Clarity Documentation	-4.12	0.33*

*$p < .05$

tabulates each factor's permutation importance and their rank correlation with IT-audit support effectiveness in order of decreasing importance. The permutation importance describes how influential the factor is whereas the rank correlation signifies what type of impact it has. A positive correlation implies that a higher factor score leads to a higher effectiveness score whereas a negative correlation would lead to a lower effectiveness score.

On the basis of the permutation importance it can be concluded that Accountant Approachability (F18), IT-auditor Approachability (F17), IT-auditor Experience (F01_3) and Deadline Feasibility (F25) are the most influential factors. These four are selected due to their relatively high importance scores and the large gap between their scores and the next most important score. Combining this with the Spearman rank correlations it can be observed that F18, F17 and F25 all have a positive association with effectiveness whereas F01_3 has a negative association[15]. Additionally, it can

[15]It should be noted, however, that this association is small and not significant.

Table 5.5: *Influential factors and indicator correlations.*

	Factor	I1*	I2*	I3*	I4*
F18	Accountant Approachability	0.29	0.52†	0.27	0.31
F17	IT-auditor Approachability	0.41†	0.49†	0.46†	0.42†
F01_3	IT-auditor Experience	-0.07	-0.25	-0.23	-0.31
F25	Deadline Feasibility	0.34†	0.47†	0.22	0.32†

* I1 = Fulfillment Degree, I2 = Timeliness, I3 = Added Value, I4 = Stakeholder Satisfaction
† Correlation has a p-value $< .05$.

be observed that the random forest aligns with the Spearman rank correlations[16] in noting the influence of Accountant Approachability (F18), IT-auditor Approachability (F17) and Deadline Feasibility (F25).

The importance of the positively correlated factors (F18, F17 and F25) is quite logical when considering the context of IT-audit support. Both Accountant Approachability (F18) and IT-auditor Approachability (F17) are indicators of the quality of the relationship between the two disciplines. As argued in chapter 4, a good relationship is important for successful cooperation between auditors. When auditors are approachable, the likelihood is increased that they will discuss the IT-audit support progress and any issues that might have come to light. This in turn, gives the accountant a better view on the intricacies of IT-audit support and its findings and how they can address this to ensure IT-audit support effectiveness. Additionally, IT-auditors have a better feel for what the accountant's needs are. When considering the impact these factors have on the specific effectiveness indicators, as shown in Table 5.5, it is interesting to note that approachability is significantly associated with IT-audit support timeliness ($p < .05$). This suggests that with higher approachability auditors are indeed willing to discuss potential issues early on so as to guarantee that timeliness is indeed ensured.

Interestingly, as seen in Table 5.5, IT-auditor Approachability (F17) plays a more important role than Accountant Approachability (F18) when it comes to the perceptual indicators of effectiveness (I3 and I4). A potential argument for this could be that more approachable IT-auditors make it easier for the accountants to share and discuss what assurances they need from IT-audit support. Potentially, accountants also find it easier to ad-

[16] See Figure 5.3.

just the IT-audit support objectives and correct misunderstandings when IT-auditors are approachable. Such a theory would also explain why IT-auditor Approachability (F17) also has a higher rank correlation with Fulfillment Degree (I1) than Accountant Approachability (F18). This higher Fulfillment Degree (I1) could also play a role in the increased relationship between IT-auditor Approachability (F17) and the Added Value (I3) and Stakeholder Satisfaction (I4) indicators. Despite this difference between IT-auditor Approachability (F17) and Accountant Approachability (F18), it should be evident that, given their importance scores, both play a large role in ensuring effective IT-audit support.

When considering Deadline Feasibility (F25) its importance to IT-audit support effectiveness is quite logical. If the IT-audit support objectives must be met under infeasible deadlines[17] it can be expected that either the deadlines will not be met[18] or the objectives will not be fully met[19]. Such a relationship is also evident in Table 5.5. Additionally, more feasible deadlines are also correlated with higher Stakeholder Satisfaction (I4). This makes sense as feasible deadlines allow the auditors sufficient time to meet all of the stakeholder's expectations. All in all, it is clear that Deadline Feasibility (F25) plays an important role in realizing IT-audit support effectiveness.

The model also suggests that IT-auditor Experience (F01_3) has a large impact on IT-audit support effectiveness. When considering how it impacts IT-audit support effectiveness, it has a negative, albeit insignificant ($p = .125$), influence. This would suggest that higher IT-auditor Experience (F01_3) leads to lower IT-audit support effectiveness. An assumption that, at first glance, is not very logical. It would be expected that more experience leads to better IT-audit support and hence higher effectiveness. Therefore, it is surprising that this factor is so influential, especially when considering that it has no significant rank correlation with effectiveness.

Supposing that the negative rank correlation indeed holds for IT-auditor Experience (F01_3) and effectiveness, this relationship can partially be explained when considering the differences between 'account' and 'horizontal' IT-auditors. As shown in Table 5.1, there is a large difference between 'account' and 'horizontal' IT-auditors with respect to their overall effectiveness scores (38.5% vs 52.0%). Similarly, there is a large difference in

[17] Low scores for Deadline Feasibility (F25).
[18] Low scores for Timeliness (I2).
[19] Low scores for Fulfillment Degree (I1).

IT-auditor experience (F01_3) between the two[20]. Only two 'horizontal' IT-auditors (20%) have more than 5 years of IT audit experience whereas only three 'account' IT-auditors (27%) have less than 5 years of IT audit experience. Looking at the overall Effectiveness and IT-auditor Experience (F01_3) scores for each discipline this would suggest that more experienced IT-auditor are more critical of IT-audit support effectiveness.

Such a relationship could be feasible when considering that more experienced IT-auditors might be more cynical of the value that IT-audit support brings or the scope of work actually needed. In other words, experience has shown them all the potential issues and faults to be found in the work they do. With that mind experienced IT-auditors score IT-audit support effectiveness lower whereas inexperienced IT-auditors are, in that regard, more naive and might overestimate IT-audit support effectiveness. As an alternative theory, less experienced IT-auditors might be more motivated to go above and beyond in order to gain a foothold within the organization. As a result of their additional effort they achieve a higher IT-audit support effectiveness in comparison to their more experienced counterparts.

This theory on the relationship between experience and effectiveness, however, does not seem to hold for accountants. The vast majority of the accountants have a lot of experience but simultaneously their discipline has the highest IT-audit support effectiveness score (52.5%). However, this does not paint the entire picture as every accountant has had at least 6 years of auditing experience[21]. In other words, there is no inexperienced group of accountants to compare with. Whether the theories on IT-auditor Experience (F01_3) also apply to Accountant Experience (F02_4) warrants additional research. This additional research could also serve to confirm whether the relationship between IT-auditor Experience (F01_3) and IT-audit support effectiveness holds. Nevertheless, with the data currently available and the high importance score of IT-auditor Experience (F01_3), it is clear that the influence of IT-auditor Experience (F01_3) on IT-audit support effectiveness cannot be ignored.

In conclusion, the impact that factor has on IT-audit support effectiveness can be derived from its permutation importance and rank correlation. This information, as depicted in Figure 5.7 and summarized in Table 5.4, an-

[20] See Table B.6 in section B.2.

[21] For the vast majority this is at least 6 years of financial audit experience. The few respondents with less than 6 years of financial audit experience have had at least 6 years of IT audit experience.

swers RQ3 by noting the influence that each factor has. Additionally, this information highlights which factors are most influential and thus provides an answer to RP. As shown above, the factors with the greatest impact on the measured effectiveness are Accountant Approachability (F18), IT-auditor Approachability (F17), IT-auditor Experience (F01_3) and Deadline Feasibility (F25).

Chapter 6

Conclusion

Within the context of the end-of-year financial statement audit, Information Technology (IT) has grown to play a significant role. However, due to IT's enormous complexity and scope, accountants are increasingly dependent upon IT-auditors in order to verify the integrity of the auditee's financial statements. The work executed by IT-auditors for the accountants within the financial statement audit is defined as IT-audit support. Realizing positive, added-value and effective IT-audit support is a significant challenge which must be addressed. This is especially important since the dependency on IT in the audit and within the auditees is only expected to increase. Altogether, this formed the motive for the research in this thesis. By forming an understanding on the key factors which influence IT-audit support effectiveness, tools and knowledge become available with which auditors can enhance the performance and role of IT-audit support[1].

In addressing this problem an audit process description was created, an effectiveness measure was formulated and influencing factors were derived and analyzed. The process description highlighted the various phases in the audit[2] and the interactions which occur between the accountants and IT-auditors. This served as the framework within which IT-audit support effectiveness could be addressed[3].

A measure of effectiveness was created within this framework which en-

[1] See section 1.1 for a detailed explanation of the issue at hand.

[2] Namely, planning (section 2.2), executing (section 2.3), reporting (section 2.4) and concluding(section 2.5).

[3] See chapter 2 for a detailed description of this process.

capsulated and combined both the factual and perceptual components of IT-audit support effectiveness so as to create a single effectiveness score[4]. The factual components consider to what degree the predefined IT-audit support objectives are achieved and the timeliness of the IT-audit support conclusions. Perceptually, IT-audit support effectiveness is defined as the perceived added value IT-audit support has provided for the auditors and the degree to which they are satisfied with IT-audit support. This effectiveness score can be used throughout future studies and within organizations to measure and track the effectiveness of IT-audit support within the audits conducted. Additionally, it was used in this thesis to discern which factors were most influential with respect to IT-audit support effectiveness. Lastly, this measure enables organizations to receive concrete feedback on the impact that (management) policies have on the effectiveness of IT-audit support.

Various themes or sets of factors were discovered to have potentially influenced IT-audit support effectiveness[5]. These themes considered auditor knowledge and skill, their cross-disciplinary capabilities and the interaction and integration between the two auditor disciplines. Additionally, the clarity, feasibility and specificity of IT-audit support's objectives and deadlines were considered. Together, these themes, and more specifically the factors describing them, serve as a basis for the discussion on which factors are the key influencers of IT-audit support effectiveness. This was determined by combining the effectiveness measure and the discovered themes through statistical analysis[6]. This analysis identified which factors were of greatest influence within the context of the Auditdienst Rijk (ADR).

The analysis conducted led to the conclusion that effective IT-audit support requires approachable accountants and IT-auditors operating within feasible IT-audit support deadlines. Focusing on these three factors[7] enables auditors to make large steps in improving IT-audit support effectiveness. Additionally, it was discovered that an increased IT-auditor Experience[8] seems to lead to a more critical perception of IT-audit support effectiveness. This moderating factor of experience is important to be aware of, but does require additional research to discern the concrete implications

[4] See chapter 3.
[5] See chapter 4.
[6] See chapter 5.
[7] Explicitly, Accountant Experience (F18), IT-auditor Experience (F17) and Deadline Feasibility (F25).
[8] Explicitly, IT-auditor Experience (F01_3).

of a potential relationship between experience and effectiveness. Nevertheless, by understanding these four factors and acting upon them organizations are able to improve the role and quality of IT-audit support within the audit due to its increased effectiveness.

6.1 Limitations

While the tools and observations created provide interesting opportunities for research and for measuring and improving the effectiveness of IT-audit support, there are a few things to keep in mind. Firstly, the sample set upon which these observations are based is quite small. A larger sample set, perhaps spread across various audit institutions, might change the influence and importance of various factors. This expansion could also allow for greater analysis into the link between auditor experience and IT-audit support effectiveness.

The factors initially discovered also did not fully consider any potential multicollinearity. While many of the factors could be reconfigured around this issue post-survey, future versions of this research might want to address the issue beforehand. For example, by reconsidering the factors and survey questions asked to simplify the set of factors and reduce the potential for multicollinearity. Nevertheless, both the structure of the survey and the created effectiveness measure make it possible to repeat this research on a regular basis or on a larger data set. This could serve as a confirmation of the observations given in this thesis. Additionally, when automated, it can provide a valuable tool to organizations to track and discover what, in their context, the best approach would be to improve their IT-audit support effectiveness.

Another aspect to keep in mind concerns the context within which this research was conducted. The ADR, and their public sector financial audit, operates differently from other audit institutes and organizations. The scope, for example, is vastly larger. This is also true for the time span within which the audit is conducted. Ideally, future research would replicate this study in a variety of audit institutes, nations and sectors. Additionally, it might serve to address the research problem within the various specific phases of the audit. For example, the requirements and expectations that accountants have of IT-audit support could be different in the planning phase than in the reporting phase[9]. Due to the time con-

[9] See section 2.2 and section 2.4 respectively.

straints and the small set of respondents available these avenues were not explored within this thesis.

6.2 Future work

The concepts presented and discussed in this thesis provide many avenues for additional research. As discussed in section 6.1, the scope of the research can be expanded into other organizations or sectors. Additionally, interesting opportunities exist when expanding the concept of IT-audit support (effectiveness) into the various phases of the audit process. Potentially, this work could even be expanded into other scenarios and processes within which specialist support is used. Three specific avenues for future research will be discussed in more detail.

Firstly, the audit process description described in chapter 2 not only provides context, but it also serves as a valuable starting point for future analysis. It can allow the ADR, for example, to analyze how their processes could be adapted so as to allow the process-dependent influencing factors to have a more positive impact on effectiveness. Furthermore, a starting point is given for more complicated (automated) process analyses such as anomaly detection. This could be used to detect if an audit is not going as planned or is more likely to result in ineffective IT-audit support. In this way, the process description provides a foundation for future research.

Secondly, the observations and concepts discussed in this thesis can also be used to expand the research on IT-audit support effectiveness into other domains within audit literature, such as computational auditing. In short, this is about using the auditee's value-cycle and organizational typology[10] in conjunction with mathematical models to conduct the audit and achieve greater assurance and effectiveness[11]. This theory could be used, for example, to discern whether factors such as the auditee's typology and processes also influence IT-audit support effectiveness.

Lastly, both the context of computational auditing and the context of the current risk-based auditing approach, are also well suited for additional research on IT-audit support objectives. More specifically, research into

[10] A classification of organizations based on the structure and nature of their value-cycle (Griffioen, Elsas, & van de Riet, 2000).

[11] See works by Elsas (Elsas, 1996, 2019; Elsas, van de Riet, & van Leeuwen, 1992) or Griffioen (Griffioen, Christiaanse, Wang, & Hulstijn, 2016; Griffioen et al., 2000).

IT-audit support effectiveness which explicitly considers the objectives accountants are setting for IT-audit support. Is IT-audit support effectiveness influenced by how the accountants formulate the IT-audit support objectives? Do the type of IT-audit support objectives influence IT-audit support effectiveness as well? Regardless of the answer to these questions, it is evident that the concepts in this thesis provide room for various interesting avenues of additional research.

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Appendix A

Interview framework

As described in section 1.2, section 3.3, and section 4.2 multiple interviews were conducted during which (signing) accountants, (lead) IT-auditors and independent quality controllers were interviewed. These interviews served as input for solutions to the various research questions and most notably for RQ1a, RQ1b and RQ2. This (translated[1]) framework was used as guidance during these semi-structured interviews and highlighted the topics to be addressed during the interviews. Due to the semi-structured and conversational nature of the interviews additional topics might also have been addressed. Furthermore, the various topics may have been discussed in differing levels of detail based on the topic's relevance to the interviewee's role, experience and knowledge. Concepts and terms, such as IT-audit support, were introduced and explained in accordance with the definitions presented in the thesis before the topics or questions containing these terms were addressed. Where logistically possible interviewees were selected such that audits could be addressed from various (disciplinary) perspectives. The topics and questions addressed in the semi-structured interviews were as follows:

General audit

1. How would you define the primary objective of an audit?
2. How and when does the audit start?
3. What does an audit look like for you? How are you involved?

[1]The interviews were conducted in Dutch as this is the official working language of the ADR.

4. When are you satisfied with an audit?
5. How would you define audit effectiveness, how do you measure it and what does an effective audit look like?
6. Who formally decides / determines whether an audit was effective?
7. How do you determine what processes and systems are relevant for the audit?
8. What sort of things do you worry about during an audit?
9. What do you see as the biggest risks to an audit's effectiveness?
10. Are there any audits conducted in the past years that you would consider examples of (in)effective audits? Why do you think these audits were exemplar of an (in)effective audit?

General IT-audit support

11. How important is IT-audit support to the overall audit?
12. When and how is the decision made (not) to incorporate IT-audit support in the audit
13. How should IT-audit support be used / incorporated in the audit?
14. How is IT-audit support scoped?
15. When are you satisfied with IT-audit support?
16. To what extent do you believe that the IT-audit support findings are applicable, relevant or useful for the overall audit?
17. How would you define quality IT-audit support, how do you measure it and what is high quality IT-audit support like?
18. How would you define IT-audit support, how do you measure it and what does effective IT-audit support look like?
19. What sort of things do you worry about with respect to IT-audit support?
20. What do you see as the biggest risks to IT-audit support completion or integrity?
21. What do you see as the biggest risks to IT-audit support applicability or usefulness?

22. What do you see as the biggest risks to IT-audit support effectiveness?

23. Are there any audits conducted in the past years during which IT-audit support was exceptionally (in)effective? Why do you think these audits were exemplar of (in)effective IT-audit support?

24. How do you think that the dependence on or usage of IT-audit support within the audit will develop in the (near) future?

Accountants and IT-auditors[2]

25. How do you perceive your own discipline and their role in the audit?

26. How do you perceive the other discipline and their role in the audit?

27. What is your knowledge / understanding of the other discipline?

28. What does the interaction between the two disciplines look like at the 'lead' level? At the 'operational' level?

29. How, if at all, is the interaction between the two disciplines documented or formalized?

30. Could you give a concrete example of the interaction between the two disciplines? E.g. when determining what is within scope of IT-audit support.

31. How do the disciplines interact with the auditee? With the client?

32. Are you aware of the other discipline's greatest worries / risks and what do you think they are?

33. How do you adjust your own work, if at all, to address these worries / risks?

34. How does your discipline's work impact or influence the other discipline? Does the other discipline understand these implications?

[2]Due to their nature most of these questions were only asked to signing accountants and lead IT-auditors and not the independent quality controllers.

35. How does the other discipline's work impact or influence your own discipline? Does the other discipline understand these implications?
36. To what extent do you believe that cross-disciplinary knowledge (sharing) is important? How do you believe that it influences IT-audit support effectiveness?
37. How do you believe that tighter IT-auditor and accountant integration influences IT-audit support effectiveness?
38. How do you believe that 'cross-disciplinary opinions and relationships' influence IT-audit support effectiveness?

Appendix B

Survey

As described in chapter 5 a survey was created and sent to all employees involved in the end-of-year audit at the ADR. This chapter shows the various (translated[1]) questions that were part of the survey in section B.1. Additionally, in section B.2 multiple supporting tables for the survey analysis are provided. See chapter 5 for a description and analysis of the responses and results of the survey.

B.1 Survey questions

If a question directly addresses certain indicators (Table 3.2) or factors (Table 4.2) these are indicated by their key. Additionally, text marked in *italics* is used to describe any comments and automated flows based on (the respondent's answer to) the preceding question. Each subsection corresponds to a different page in the online survey tool. Lastly, a quick note on notation. Whenever an answer option is notated as 'A $\longrightarrow$ B' it represents an 11 point scale with A, as one extreme, at 0 and B, as the other extreme, at 10.

[1]The survey was conducted in Dutch as this is the official working language of the ADR.

Demographic information

Table B.1: *Survey questions on demographic information (RQ3).*

Q-1 Have you been involved in a financial end-of-year audit at least once since 2017?	yes | no
If "no" inform the respondent they are ineligible and end the survey.	
Q-2 Have you been involved in IT-audit support, from accountant or IT-auditor perspective, at least once since 2017?	yes | no
If "no" inform the respondent they are ineligible and end the survey.	
Q-3 What best describes your current role?	accountant | IT-auditor
Q-4 Are you part of a horizontal team or an account?	
F-14	horizontal | account
Only IT-auditors are asked this question.	

Auditor expertise

Table B.2: *Survey questions on auditor expertise (RQ3).*

Q-5 How many years of experience do you have as an IT-auditor?	
F-1	none | $\leq$2 | 3-5 | 6-10 | $\geq$11
Q-6 How many years of experience do you have as an accountant?	
F-2	none | $\leq$2 | 3-5 | 6-10 | $\geq$11
Q-7 Which of the following auditor titles do you have? Select all that apply.	
F-5	none | RA | RE

Continued on next page

Table B.2 – continued from previous page

Q-8 What degree of IT training have you received?	
F-3	none | basic | intermediate | extensive
Q-9 What degree of financial training have you received?	
F-4	none | basic | intermediate | extensive
Q-10 How would you rate the IT-auditors' accounting knowledge?	
F-6	very insufficient $\longrightarrow$ very sufficient
Respondents are asked to rate horizontal and account IT-auditors separately.	
Q-11 How would you rate the accountants' IT knowledge?	
F-7	very insufficient $\longrightarrow$ very sufficient
Q-12 How would you rate the IT-auditors' ability to speak the accountant's language?	
F-8	very insufficient $\longrightarrow$ very sufficient
Respondents are asked to rate horizontal and account IT-auditors separately.	
Q-13 How would you rate the accountants' ability to speak the IT-auditor's language?	
F-9	very insufficient $\longrightarrow$ very sufficient
Q-14 How would you rate the IT-auditors' ability to translate audit risks to IT-audit support activities?	
F-10	very insufficient $\longrightarrow$ very sufficient
Respondents are asked to rate horizontal and account IT-auditors separately.	
Q-15 How would you rate the accountants' ability to translate audit risks to IT-audit support activities?	
F-11	very insufficient $\longrightarrow$very sufficient
Q-16 How would you rate the IT-auditors' ability to translate IT-audit support findings to audit implications?	

Continued on next page

Table B.2 – continued from previous page

F-12	very insufficient ⟶ very sufficient

Respondents are asked to rate horizontal and account IT-auditors separately.

Q-17 How would you rate the accountants' ability to translate IT-audit support findings to audit implications?

F-13	very insufficient ⟶ very sufficient

Auditor interaction

Table B.3: *Survey questions on auditor interaction (RQ3).*

Q-18 How often do you have a formal* in-person† interaction with an IT-auditor?

F-15	≤1x/month | 2-3x/month | 1x/week | 2-4x/week | daily

Only accountants are asked this question. Respondents are asked to rate horizontal and account IT-auditors separately.

Q-19 How often do you have a formal* in-person† interaction with an accountant?

F-15	≤1x/month | 2-3x/month | 1x/week | 2-4x/week | daily

Only IT-auditors are asked this question.

Q-20 How often do you have an informal* in-person† interaction with an IT-auditor?

F-16	≤1x/month | 2-3x/month | 1x/week | 2-4x/week | daily

Only accountants are asked this question. Respondents are asked to rate horizontal and account IT-auditors separately.

Q-21 How often do you have an informal* in-person† interaction with an accountant?

F-16	≤1x/month | 2-3x/month | 1x/week | 2-4x/week | daily

Only IT-auditors are asked this question.

Continued on next page

Table B.3 – continued from previous page	
Q-22 How approachable do you find IT-auditors to be?	
F-17	very unapproachable ⟶ very approachable
Q-23 How approachable do you find accountants to be?	
F-18	very unapproachable ⟶ very approachable
Q-24 How well integrated into the audit team do you perceive yourself to be?	
F-19	very much not integrated ⟶ very much integrated

* Formal interactions refer to activities such as (planned) meetings, presentations or interviews. Informal interactions refer to activities such as conversations in the hallway, at the coffee machine or during lunch.

† Or what would have been an in-person interaction before the Covid-19 pandemic.

Audit execution

Table B.4: *Survey questions on audit execution (RQ3).*

Q-25 How involved are you in the planning process of IT-audit support?	
F-20	very uninvolved ⟶ very involved
Q-26 To what extent do you (dis)agree that IT-auditors and accountants are on the same page with regard to what should be in scope for IT-audit support?	
F-21	strongly disagree ⟶ strongly agree
Q-27 To what extent are the objectives of the IT-audit support activities to be executed clear?	
F-22	very unclear ⟶ very clear
Q-28 To what extent are the objectives of the IT-audit support activities to be executed documented?	
F-22	very insufficient ⟶ very sufficient

Continued on next page

Table B.4 – continued from previous page

Q-29 To what extent are the objectives of the IT-audit support activities to be executed specific?	
F-23	very vague ⟶ very specific
Q-30 What percentage of the IT-audit support objectives are generally met?	
I-1	0-9% | 10-19% | 20-29% | 30-39% | 40-49% | 50-50% | 60-69% | 70-79% | 80-89% | 90-100%
Q-31 To what extent are the deadlines of the IT-audit support activities to be executed clear?	
F-24	very unclear ⟶ very clear
Q-32 To what extent are the deadlines of the IT-audit support activities to be executed feasible?	
F-25	very infeasible ⟶ very feasible
Q-33 With respect to the established deadlines, when is IT-audit support completed?	
I-2	very much too late ⟶ on time
Q-34 To what extent does IT-audit support provide an added-value to the audit?	
I-3	greatly reduced value ⟶ greatly added value
Q-35 Are you satisfied with IT-audit support?	
I-4	very unsatisfied ⟶ very satisfied

B.2 Supplemental tables

Table B.5: *IT-audit support effectiveness score frequencies.*

Effectiveness Score Range*	No.	%
(40,50]	11	27.50%
(50,60]	11	27.50%
(30,40]	8	20.00%
(60,70]	5	12.50%
[10,20]	2	5.00%
(20,30]	2	5.00%
(70,80]	1	2.50%

* Computed using the effectiveness formula (Equation 3.1) on the indicators for each response.

Table B.6: *Auditor roles and experience.*

	Account IT-auditors		Horizontal IT-auditors		Accountants	
Years of Experience	IT	Financial	IT	Financial	IT	Financial
None	0	8	0	9	13	0
Less than 3 years	2	1	6	0	1	1
3 to 5 years	1	0	2	0	1	0
6 to 10 years	1	0	0	0	1	2
More than 10 years	7	2	2	1	2	15
Total	11	11	10	10	18	18