THE ACCEPTANCE AND ADOPTION OF DATA ANALYTICS BY EXTERNAL AUDITORS

: A view from practice

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ABSTRACT:

Although the NBA, PCAOB and academic literature recognize that the use of data analytics can provide an increase in efficiency, effectivity and audit quality, only a small group of auditors is using data analytics as yet. This study tries to fill the academic gap between the potential of data analytics and actual implementation of data analytics during the audit. This study shows that there are 23 barriers that should be overcome in order to let successfully implement analytics during the audit. This paper presents the Data Analytics Auditors Acceptance Model (DAAAM) (figure 1), which consists of nine categories of barriers. These categories are: awareness, investment, acceptance by client, data extraction, implementation, collaboration, justification, regulatory environment and success story. These nine categories which cover the 23 barriers found can arise when audit companies want to implement data analytics within their audits.

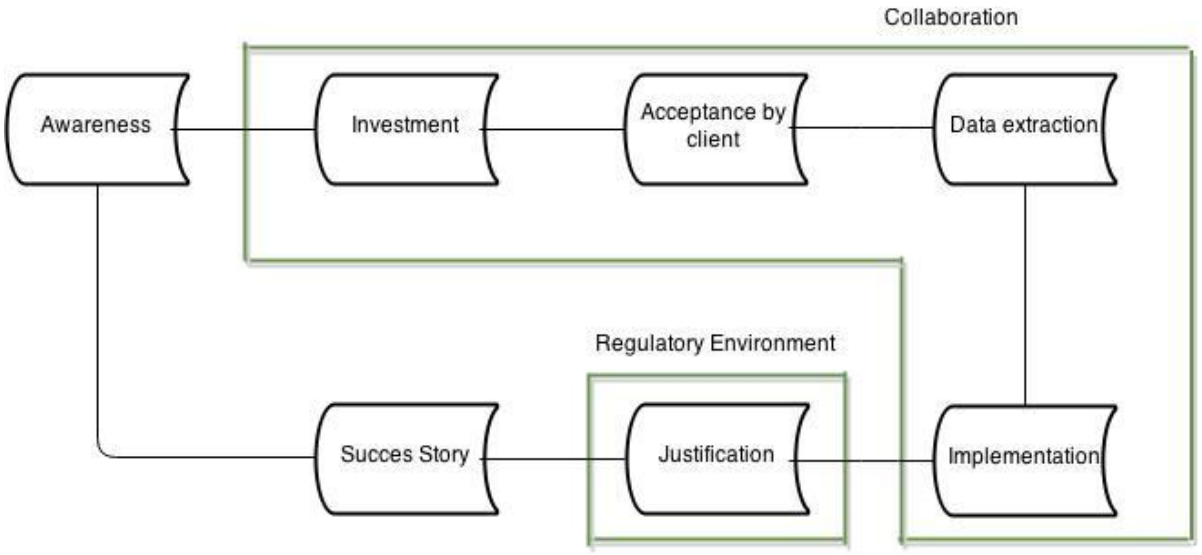

Figure 1: Data Analytics Auditors Acceptance Model (DAAAM)

1. INTRODUCTION

1.1 RESEARCH TOPIC

In a world in which auditors are surrounded by IT devices, applications and data of all kinds. Concepts like ''big data'' and ''continuous auditing'' are hot topics in the audit profession and academic literature. According to Vasarhelyi (2012a) all areas of accounting must deal with changes in the data processing environment. There is a need for accounting information systems (AIS) to accommodate business needs generated by rapid changes in technology (Vasarhelyi, 2012a). Although auditors embrace and make extensive use of IT, little has been done to consider how auditing might be transformed by it (Brynes et.al., 2014). Technologies like data analytics will greatly change the nature of the audit process, which traditionally has relied on hard copy documents (Bierstaker et.al., 2001).

An important way to improve the quality of the audit according to the report of the NBA is to invest in modern audit methods, such as data analytics (NBA, 2014). Data analytics is the science of examining raw data with the purpose of drawing conclusions about that information (Tech target, 2014). In addition to that, according to the AICPA the use of data analytics will contribute to the efficiency and effectiveness of the audit process (Brynes et.al., 2014). Although the NBA and the AICPA strongly recommend using modern audit methods like data analytics there is as yet a small group of auditors using data analytics. There is still a long way to go before data analytics reaches its full potential. (Verver, 2014).

Currently, many of the leading audit firms are investing heavily in projects concerning data analytics (Verver, 2014). They consider analytics to be a key area for the provision services to audit, risk and compliance functions (Verver, 2014). Slowly, the market is beginning to realize that failing to use technology effectively is professionally unacceptable and irresponsible.

In order to make data analytics part of the audit it will be important to have an overview of all the possible barriers and requirements to implement data analytics during the audit. A barrier is an obstacle that prevents movement or access (Oxford dictionary, 2014). The identification of all the barriers that the auditor will experience therefor is an important step towards implementing data analytics in the audit.

In short, the main purpose of this thesis is to construct a model that identifies barriers that should be overcome in order to implement data analytics during the audit.

1.2 RESEARCH QUESTION

The research question answered in this study is:

Which barriers can be identified for the successful implementation of data analytics during the audit?

1.3 RESEARCH OUTLINE

In order to answer the research question the following four sub questions will be discussed and answered:

1. *What is data analytics in the context of an audit procedure?*
   The answer to this question will consist of two parts. The first part will explain what data analytics is in the context of an audit procedure. Different definitions that can be identified in the literature will be discussed. The second part will explain what the possible applications and purposes of data analytics are during the audit. This will give a clear framework for the use of data analytics and where the possible barriers might be. To answer these question both academic and professional literature has been used. This sub question will be discussed in chapter three of this study.
2. *Which stakeholders can be identified for the use of data analytics during the audit?*
   The answer to this question will be based on academic and professional literature. An overview of all stakeholders that are involved in the possible implementation of data analytics during the audit will be provided. The review of academic and professional literature will give a framework for the data collection phase of this study. During the interviews conducted in this study the overview of all the stakeholders will be tested and revised if necessary. These two information sources will give a clear model of all the stakeholders at the end of this study.
   The answer to this sub question can be found in chapter three and four of this study. In chapter three the literature review concerning this sub question will be described. Chapter four will describe the vision of the interview panel on the possible stakeholders involved in the process of implementing data analytics in the audit.
3. *Which barriers are identified by different interest groups?*
   To answer this question this study will use interviews and memos. Different interest groups identified by the author of this study have been interviewed. An interest group is a group of people drawn or acting together in support of a common interest (Oxford dictionary, 2014). The results will be discussed in chapter four of this study.

4. *What barriers can be found in existing academic and professional literature regarding the use of data analytics during the audit?*
   The answer to this question will be deducted from prior academic research and professional literature on the topic of data analytics. Because of the lack of research about data analytics. This study will also examine research about other IT related audit topics to verify barriers found during the interviews (for example: IT auditing, continuous auditing, and big data). Chapter five will describe the last sub question.

1.4 RELEVANCE

Theoretical relevance

Prior research identifies applications and problems for the use of data analytics, but as yet there is no research available which gives a clear overview of the barriers regarding the use of data analytics in practice. In the existing academic literature the identification of barriers for the implementation of data analytics is mainly focused on practical problems concerning IT and technical barriers.

This study aims to increase knowledge and supply theory to the already existing academic literature, by adding a funded model about barriers that should be overcome in order to implement data analytics in the audit. According to Verver (2014) there is a gap between the academic literature and practice on the topic of data analytics. This study aims to reduce this knowledge gap.

Practical relevance

This study will provide a model that can be used as a guide to identify possible problems during the implementation of data analytics in the audit. Because of the qualitative character of this study, it provides barriers identified by people working in practice. It gives the industry insight in the barriers that can arise within their companies when they implement data analytics in the audit. The model provided in this study can be used to identify possible barriers that should be overcome for the successful implementation of data analytics.

1.5 THESIS OUTLINE

This study consists of seven chapters. Here the purpose of each chapter will be briefly discussed:

1. *Introduction*: In the introduction the research topic and the concept of data analytics will be described. The introduction will also show the research outline and thesis outline Moreover theoretical relevance and the relevance to practice will be discussed.
2. *Method*: In this chapter the empirical work will be discussed. This section will give an overview of the research method and the research design. The reasons for choosing grounded theory as research method and the research design of Pandit (1996) will also be explained.
3. *Literature review part one:* The purpose of the first part of the literature review is to provide a clear framework for the data collection phase. It will narrow the scope of this study. In order to identify all the barriers first the definition, possible uses and stakeholders of data analytics must be identified. In this part of the literature review the academic view on the first two sub questions will be described. The chapter will firstly provide an overview of possible definitions for data analytics in the context of an audit procedure. Secondly, the possible uses and purposes of data analytics during the audit will be explained. Lastly, chapter three provides an overview of all the possible stakeholders which are involved in the possible implementation of data analytics during the audit. The first part of the literature review will also guide in choosing the possible interest groups interviewed during the data collection phase of this study.
4. *Results:* In this chapter the results from the interviews are presented. Here the barriers identified during the data collection phase will be given. The identified barriers will be summarized in covering categories. These categories are the main building blocks of the model presented in chapter six. In this chapter the basis for the answer of sub question three will be described.
5. *Literature review part two*: In the second part of the literature review this study will look into the academic research in order to see if the identified barriers can be found in the academic research. This study has two sections of literature review because of the exploratory nature of my research method. The first part has the purpose to narrow the scope and provide a framework for the data collection phase of this

study. The second part will use constant comparative analysis to see if the barriers identified during the data collection phase can be found in the academic and professional literature.

6. *Model*: In chapter six the model will be presented. The model presented will give an overview of the possible barriers that can be identified when implementing data analytics in the audit. This model will be based on the categories formed in chapter four, together with the academic confirmation from chapter three and five.
7. *Conclusion*: In the conclusion, chapter four, five and six will be combined in order to answer the research question. Firstly, this study will present the answer to the sub questions stated in section 1.3. Secondly, the research question of this study will be answered. To conclude limitations and possibilities for future research will be described in respectively section 7.4 and 7.5.

2. METHODOLOGY

2.1 INTRODUCTION

This chapter elaborates on the research methodology used in this study. The research method that forms the basis for this study is grounded theory. The reason for choosing a qualitative research method is the lack of theory and quantitative data available. Together with the explorative character of my research question grounded theory is a logical choice.

The first section of this chapter will describe the purpose and goal of grounded theory. Next to that the first section will outline why grounded theory is appropriate for this study. The second section will describe the research design. This study follows as research design described by Pandit (1996). The second section of this chapter describes the reason for choosing this research design and will also explain the chosen research design step-by-step. The last section of this chapter will look into research quality of this study by looking at construct validity, reliability, internal validity and external validity.

2.2 RESEARCH METHOD

Grounded Theory (GT) according to Martin and Turner (1986) is a systematic methodology in the social sciences involving the construction of theory through the analysis of data. Grounded theory is an inductive research method in which the first step is data collection. The second step is looking into existing literature and academic research to verify barriers found during data collection (Allan, 2003). The structure of this study is in line with the inductive nature of grounded theory. The first step explained by Allan (2003) is described in chapter four and the second step can be found in chapter five.

The three basic elements of the grounded theory are concepts, categories and propositions (Pandit, 1996). A concept is a descriptive or explanatory idea, its meaning embedded in a word, label or symbol (Holloway, 2008). Categories are higher in level and more abstract than the concept they represent. Categories can be formed by multiple concepts (Corbin and Strauss, 1990). The third element of grounded theory is formed by propositions which indicate generalized relationships between concepts and categories (Glaser and Strauss, 1967).

According to Birks and Mills (2011) there are three conditions that have to be met in order to make the use of grounded theory appropriate. These are: (1) 'little is known about the area of study', (2) 'the generation of theory with explanatory power is a desired outcome' and (3)

'an inherent process is imbedded in the research situation that is likely to be explicated by grounded theory methods'.

All three conditions of Birks and Mills are met with in my research question and research design. There is a lack of knowledge about the implementation process of data analytics in the audit. As was mentioned in the introduction there is not much research done which gives a clear overview of the barriers that can be identified for external auditors to use data analytics.

In order to make sure that a modern audit technique like data analytics is used, more research with explanatory power is highly desired. As mentioned in the introduction according to the NBA and the AICPA the use of modern audit methods is an important step towards improving audit quality. Although there is research done on the purposes of data analytics, not much has changed in the audit profession in the last decades (Basu, 2008). This clearly shows that also the second condition of Birks and Mills is met with in my research.

The definition of an inherent process according to Corbin and Strauss (2008) is an ongoing interaction taken in response to situations or problems. Because little is known about the complete process of implementing data analytics in the audit, performing exploratory research using grounded theory can provide a framework by first collecting qualitative data via interviews and then confirm the findings with academic research. Concluding, the third condition of Birks and Mills is met because of the exploratory character and the inherent process that will be looked at during this study.

Summarizing, because the explorative and inductive character of my research together with the fact the at all the conditions described by Birks and Mills are met within my research, grounded theory is suitable for this study.

2.3 RESEARCH DESIGN

A research design is defined by Easterby- Smith et al. (1990) as, an overall configuration of research: what kind of evidence is gathered from where, and how such evidence is interpreted in order to provide good answers to the basic research questions. This shows that a structured research design is needed in order to provide a good answer to the research question.

This study will use the research design that described by Pandit (1996) in his article: "The creation of theory: a recent application of the grounded theory method''. This study will use

this research design to provide structure in identifying the barriers for the use of data analytics during the audit.

The research design of Pandit (1996) consists of five analytic phases namely: research design, data collection, data ordering, data analysis and literature comparison. Within these phases multiple procedures are identified. Table one provides an overview of the nine steps of the research design of Pandit together with the activity and the rationale linked to the various steps. Below table one will describe the practical implementation of the various steps for my research.

Research design Phase	Activity	Rationale	Reference
Step 1	Review of technical literature	- Definition of research question. - Definition of a priori constructs	Ch. 3
Step 2	Selecting casus	- Theoretical, not random, sampling of interest groups	Based on § 3.3
Data Collection Phase			
Step 3	Developing data collection protocol	- Create interview protocol - Interview selection	Appendix A (based on § 3.2)
Step 4	Entering the field	- Overlap data collection and analysis - Flexible and opportunistic data collection methods	
Data ordering phase			
Step 5	Data ordering	- Arraying events chronologically	Appendix B
Data analysis phase			
Step 6	Encoding the data	- Use open coding - Use axial coding - Use selective coding	Ch. 4 & Ch.6
Step 7	Theoretical sampling	- Literal and theoretical replication across cases (go to step 2 until theoretical saturation)	Ch. 5
Step 8	Reaching closure	- Theoretical saturation when possible	
Literature comparison phase			

Step 9	Validate emergent theory	- Member checking	

Table 1 (Pandit, 1996)

This study will now describe the research design step by step. For every step there will be described what the theoretical explanation and the practical implementation is for this study.

Step 1: Review of technical literature

The first logical step following the definition of Easterby-Smith (1990) is to define the basic research question(s). Because of the inductive nature of grounded theory the research questions should be narrow enough to focus, but at the same time broad enough to allow flexibility and serendipity (Pandit, 1996). A good way to orientate for a research question is the review of technical literature. Corbin and Straus (1990) define technical literature as 'reports of research studies and theoretical and philosophical papers characteristic of professional and disciplinary writing'.

This study reviewed academic literature about data analytics, but also papers about other IT developments in the audit profession. Professionals and academic literature speak highly about the possible increases of efficiency, effectiveness and quality that data analytics can bring (Verver, 2014). The fact that people are excited by the idea of using data analytics, but are not using data analytics, together with the lack of academic literature about barriers during the implementation of data analytics, were the main reasons for choosing the specific research question that can be found in the introduction of this study.

The review of technical literature can be found in chapter three and is the basis for the selection of cases and the interview protocol in step two and three of the research design. The purposes and stakeholders identified in chapter three will provide guidance for the interviews performed during this study.

Step 2: Selecting Casus

After the formalization of the research question the next aspect of the research design is to select appropriate cases. A case in this research is defined as a principal unit of data (Pandit, 1996). According to the founders of grounded theory, Glaser and Strauss (1967), the process of data collection for generating theory, whereby the analyst jointly collects, codes and analyses his data and decides what data to collect next and where to find them, in order to

develop his theory as it emerges. A casus should be chosen on theoretical base and in a non-random fashion (Pandit, 1996). The principal units of data in my research are the different interest groups involved in data analytics and academic/professional literature.

Until half November the author has been carefully selecting different interest groups (casus) that could add value in answering the research questions. The main group of interest is the auditors. The auditor is the end user that has to use data analytics and has to take the responsibility for the fact that data analytics is used during the audit.

The other identified interest groups in an audit company are:

- Policy makers
- IT specialists
- Marketers

These three groups are all involved in the implementation of data analytics during the audit in different ways. Policy makers are involved in creating a strategy involving data analytics. One of their tasks, is the support and guidance of the use of data analytics, within audit companies. IT specialists are the professionals that have to provide the software and IT solutions in order to make sure data analytics can be used by auditors. Marketers are involved in communicating possibilities of data analytics to auditors and clients.

There are also two groups from outside the audit company that were identified as interest groups:

- Researchers
- Clients

The clients are an important interest group because the data analytics is used to audit their company. The clients are identified as an interest group because from informal conversation during this study it became clear that the acceptance of clients could be an issue during the implementation of data analytics.

The researchers were added for two reasons. The first reason is that researchers have a theoretical point of view. The second reason is that they are able to be more objective about data analytics than other interest groups.

All groups identified are involved in some part of the process of implementing data analytics during the audit. In figure two, an overview of all casus used for this study is presented

All the cases in green are inside the audit firm. The red blocks are information sources from outside audit companies. The blue rectangles are the technical literature that was used during this study.

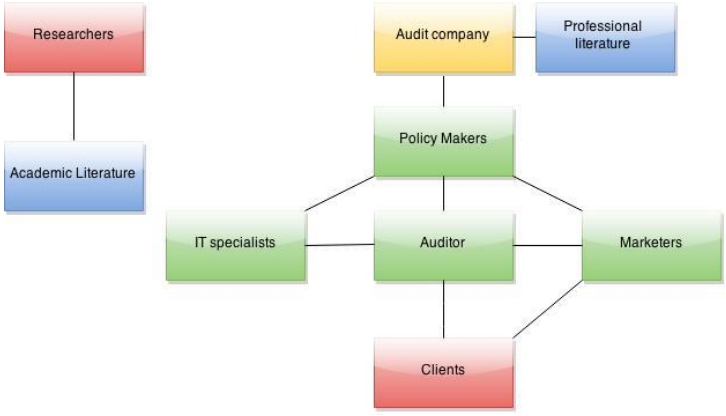

Figure 2: Overview casus

Step 3: Developing data collection protocol

The grounded theory approach advocates the use of different data sources, and terms these 'slices of data'. The third step is to develop a rigorous data collection protocol by employing multiple data sources (Pandit, 1996).

During this step the interview protocol was developed. The interviews were semi-structured interviews. This format allows a series of questions to be asked, but not in an fixed order. Additional questions may be asked, as the interviewer sees fit, to examine associated issues that arise in the course of the interview (Smith, 2011). The use of semi-structured interviews is in line with the explorative character of this study.

At the start of the interview a clear definition of data analytics in the context of this study was given in order to make sure that no miscommunication about different kinds of data analytics would arise. The definition used during the interviews is the definition of Titera (2013). The reasons for using the definition of Titera can be found in chapter three of this study.

The topics that were discussed during the interviews are:

- Software
- Data
- IT knowledge
- Client acceptance
- Auditor acceptance
- Regulations & audit standards

- Tone at the top
- Resources
- Company culture/structure

The topics are the result of the review of the technical literature and informal conversations with people from different interest groups during step one of the research design. The topics discussed during the interviews are also in the interview protocol which can be found in appendix A of this study.

Because of different angles of perspective of the interviewees some topics were not relevant during some interviews. For example, the discussion of strictly related audit topics during the interviews with the marketers.

Interview selection

The interview panel was selected by the author of this study. The goal of the interview selection was to create a balanced interview panel representing the interest groups. For an objective creation of theory the interview panel must consist of people who are enthusiastic and people that are somewhat skeptical about the use of data analytics. This objective was achieved by not only selecting auditors that are frontrunners of data analytics, together with adding a more objective group like the researchers to the interview panel.

During the first weeks of November people were contacted via email in order to see if they were willing to participate in this study. Auditors were asked to give a description of their past experience with data analytics, in order to select a balanced group of auditors consisting of skeptical as well as enthusiastic auditors.

This resulted in the following interview panel:

Date	Function	Organization	Interest group	Acronym
17-11-2014	Senior manager	Big four (Netherlands)	Auditor	ABS1
24-11-2014	Director	Big four (Netherlands)	Auditor	ABD1
27-11-2014	Manager	Big four (Netherlands)	Auditor	ABS2
01-12-2014	Senior manager	Big four (Netherlands)	Auditor	ABS3
09-12-2014	Senior manager	Big four (Netherlands)	Auditor	ABS4
10-12-2014	Partner	Big four (Netherlands)	Auditor	ABP1
16-12-2014	Manager	Big four (Netherlands)	Auditor	ABS5
24-11-2014	Partner	Big four (Netherlands)	Policy maker	PBP1

03-12-2014	Partner	Big four (Netherlands)	Policy maker	PBP2
16-12-2014	Senior manager	Big four (Netherlands)	Policy maker	PBS1
26-11-2014	Partner	Big four (Netherlands)	IT specialist	IBP1
01-12-2014	Consultant	Big four (Netherlands)	IT specialist	IBS1
02-12-2014	Manager	Big four (Netherlands)	IT specialist	IBS2
17-11-2014	Manager	Big four (Netherlands)	Marketer	MBS1
09-12-2014	Senior manager	Big four (Netherlands)	Marketer	MBS2
17-11-14	PhD researcher	University (Amsterdam)	Researcher	RUP1
11-12-14	Professor	University (Amsterdam)	Researcher	RUP2
26-11-14	CFO	Financial services industry (Netherlands)	Client	CFC1
24-12-14	Manager risk	Financial services industry (Netherlands)	Client	CFM1

Table 2: Interview panel

All interviews were face-to –face in a setting that was familiar with the interviewee. During the interviews of all the interviewees agreed to the interview being recorded. After the interview a summary with relevant citations was send to the interviewee within five working days. To give the interviewee the opportunity to suggest corrections if they were not properly quoted. The duration of the interviews was between the 35 and 70 minutes. Two ''big four'' firms were represented in the interview panel.

Step 4: Entering the field

During the fourth step data is collected and analyzed simultaneously to make sure that flexibility is maintained. Data were collected by means of interviews and literature.

Interviews

After an interview the tapes were listened to in order to get the relevant quotes from the interview. These quotes were send via email to the interviewee in order to check that the respondents were quoted properly.

The relevant quotes are the basis for the coding of the data during step five of this research design. During the interviews relevant quotes that could be linked to quotes of earlier interviews were also included in the summary. After nineteen interviews theoretical saturation was reached. The last interviews gave no new insights, only conformation of

arguments and views from earlier interviews. The relevant quotes can be found in appendix B of this study. The results of the interviews can be found in chapter four.

Literature

During this study academic and professional literature concerning data analytics and other IT developments was searched for. The review of the literature can be found in chapter three and chapter five.

During the period in which the interviews were conducted, this study used constant comparative analysis between the literature and the interviews. Constant comparative analysis is the constant comparison of different data sources and cases in order to see if theoretical saturation is reached (Birks and Mills, 2011).

Step 5: Data ordering

The aim of this fifth step is to make sure that the data is easy to code. The arraying of events into a chronology is the main goal of the data ordering phase (Pandit, 1996).

In this study the ordering of data consisted mainly of combining all the interview data on returning topics and combining the quotes of the different interest groups. The data ordering was mainly done during step four because the relevant quotes were already arranged chronologically.

During the combining of relevant quotes the first returning concepts and categories could be identified. For example:

- Resource
- Success stories
- Company culture
- Awareness of possibilities
- Budget pressure

The complete results of the data ordering can be bound in Appendix B.

Step 6: encoding the data

Once the data is ordered, the most important part of grounded theory is performed. Data analysis via coding is central to grounded research. For the study as a whole as mentioned

before data collection, data ordering and data analysis are constantly necessary because of the constant comparative analysis that is part of grounded theory (Pandit, 1996).

Coding

There are three different analytic types of coding types. This means that a researcher does not move from open through selective coding in a strict consecutive manner. The types of coding can be linked to the three basic elements of grounded theory described in section 2.2, namely concepts, categories and propositions. Figure 3 provides a visual representation of the process of coding.

The first type of coding is open coding. Open coding is the labeling and categorizing of phenomena as found in the data (Pandit, 1996). The data in this study are the relevant quotes gathered during the interviews. The data can found in appendix B. In this study the open coding is the labeling of the data and the linking of a concept to the data (figure 3). A concept as described in paragraph 2.2 is a descriptive or explanatory idea, its meaning embedded in a word, label or symbol. Open coding of interview was done twice during this study. The first time was right after the interviews were listened to and the relevant quotes were summarized. The second time was after all the interviews were conducted. The concepts (figure 3, green rectangles) are the results of the open coding and are based on the interview data (figure 3, blue rectangles). The concepts can be found in section 4.2 of this study.

The second part of coding is axial coding. During axial coding categories and subcategories are developed (Pandit, 1996). As described in section 2.2, categories are higher in level and more abstract than the concepts they represent. Categories can be formed by multiple concepts (Corbin and Strauss, 1990). This is done by summarizing the concepts from open coding into covering categories. This part of the coding process was done after all the interviews were conducted. The red rectangles in figure 3 are the results of axial coding. The categories formulated during this study can be found in section 4.3.

The last form of coding is selective coding. This involves the integration of the categories that have been developed into a model (Pandit, 1996). A model is an explanatory scheme comprising a set of concepts/categories related to each other through logical patterns of connectivity (Birks and Mills, 2011). Propositions are made in order to link the different categories. The selective coding is the last part of this study. When a model is built to

identify all the barriers that need to be overcome in order to implement data analytics in the audit. The yellow rectangle in figure 3 represents the model build during the selective coding. The model can be found in section 6.3.

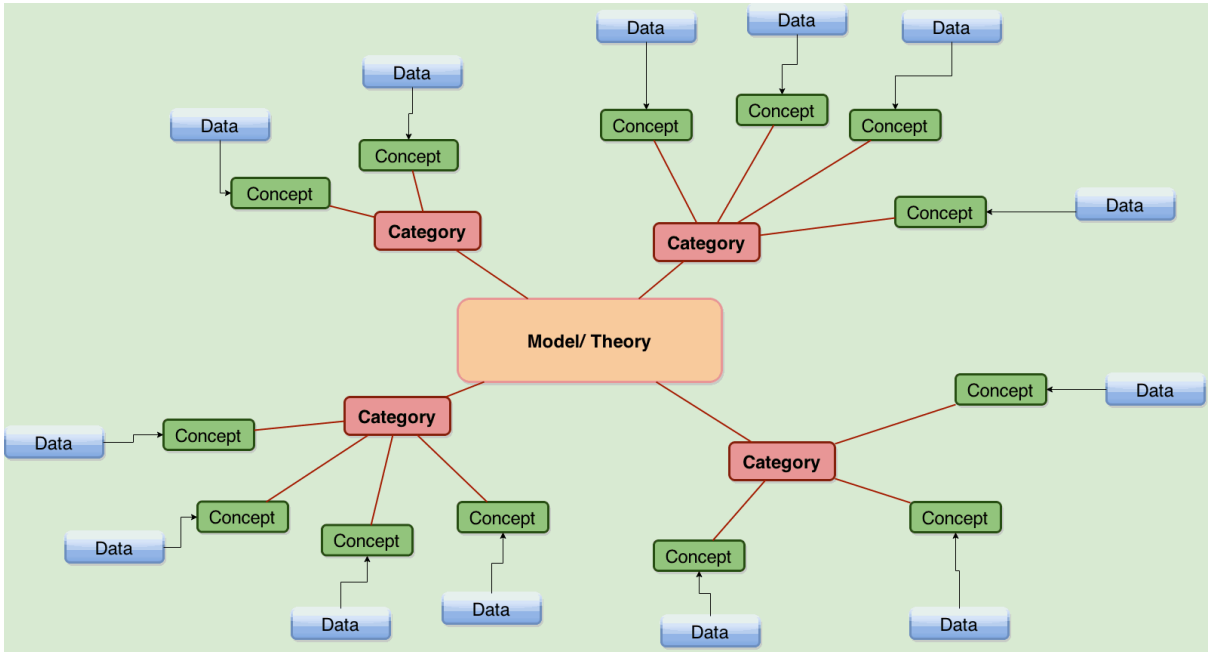

Figure 3: Coding

Memos

During the process of coding and building a theoretical model the writing of memos is an important activity according to Pandit (1996). According to Corbin and Strauss (1990) writing theoretical memos is an integral part of doing grounded theory. That is because it is impossible for a researcher to keep track of all the categories, properties and questions that evolve from the analytical process.

Three types of memos can be distinguished: code memos, theoretical memos and operational memos. Code memos are related to open coding and the initial coding process. Theoretical memos relate to axial and selective coding in the coding process. Finally, operational memos contain directions relating the evolving of the research (Pandit, 1996).

During this study code memos were used during the summarizing of the interviews in order to keep track of all mentioned barriers across different interviews. Operational memos were used during the complete duration of this research to keep track of the different angles and visions that came up.

Grounding specifications

The academic literature about grounding theory was reviewed for guidelines in declaring barriers grounded. Because such guidance are not described in the literature, the following grounding specifications which seem suitable for this study were applied. The validation technique is chosen in line with the exploratory nature of this study. Moreover the involvement of the interest groups during different parts of the complete process of implementing data analytics during the audit was taken into account.

The auditors should mention every concept in order to declare it grounded because as described in step two of the research design, they are the main interest group. Secondly, a concept must be validated with academic or professional literature. This is in line with the inductive nature of grounded theory as described in paragraph 2.2. Lastly, a concept should be mentioned by at least two other interest groups. Given that the interest groups are not involved during the whole process of implementing data analytics in the audit it is reasonable to assume that not all interest groups will identify all the barriers.

Summarizing, in order to ground a concept:

1. The concept should be mentioned by the auditors (Chapter 4 & Appendix B)
2. The concept must be validated with academic literature (Chapter 5)
3. A concept has to be mentioned by at least two other interest groups (Chapter 4 & Appendix B)

Step 7: Theoretical sampling

Theoretical sampling looks at the outcomes of the research during the research and reviews if it is necessary to gather more data (Pandit, 1996). As mentioned earlier the process of data collection for generating theory, the analyst jointly collects codes and analyzes his data and decides what data to collect next and where to find that data (Glaser and Strauss, 1967). In the research design of Pandit this means that a researcher performs step two to step seven repeatedly until theoretical saturation is realized.

During this step interviews are compared with each other to see if new insights are still coming up during later interviews. During the study this step is used to see if interest groups can still bring more insights in order to answer the research question. The interviews are moreover compared with the academic and professional literature. In determining when

the theoretical saturation was reached this study focused on new insights from interviews and literature in order to be sure that all relevant topics were covered in this study.

Step 8: Reaching closure

Theoretical saturation occurs when no new codes are identified pertaining to a particular category and when categories are clearly articulated with sharply defined and dimensionalized properties (Birks and Mills, 2011).

Because of theoretical saturation some topics as described above were not discussed during the latter interviews. During the latter interviews there was a focus on themes where theoretical saturation was not yet reached.

When theoretical saturation is reached the value of new data is marginal (Pandit, 1996). When the stage of theoretical saturation is reached you reach step eight of the research design. All the categories are clear at this point. It is possible that the propositions between categories can still change (Glaser and Strauss, 1967).

During this study theoretical saturation was reached after nineteen interviews. All interest groups that could add value to the process of answering the research question were identified at step two of the research design. Moreover, the database with relevant data after nineteen interviews was large enough for qualitative research. During the first weeks of January, reached the state of theoretical saturation was reached.

Step 9: Validate emergent theory

In the last step of the research design the emergent theory has to be validated. In order to validate the emergent theory member-checking was performed. According to Lincoln and Guba (1985) member-checking is a good technique to validate the quality of the theory created by qualitative research. Member-checking is when data, analytic categories, interpretation and conclusions are tested with members of those groups from whom the data were originally obtained (Lincoln and Guba, 1985).

Member-checking was done during this study in January after the model was created and validated with academic literature. The validation of the literature is step seven of the research design and can be found in chapter five of this study, The member-checking was done with two senior managers. The senior managers belong to different interest groups, namely one IT specialist and one auditor. The session brought some minor changes in the

model. In addition to that the verification of the important citations with the interviewees is a form of member checking (Lincoln and Guba, 1985).

2.4 RESEARCH QUALITY

This paragraph will describe the construct validity, reliability, internal reliability and external validity of this study.

Construct validity is the degree to which a test measures what it claims (Smith, 2011). Construct validity is enhanced by establishing clearly specified operational procedures (Pandit, 1996). In order to have good operational procedures the research design of Pandit was chosen for this study. Within the research design of Pandit (1996) in step three the creation of a good interview protocol was essential. Creating clear procedures for coding is highly important to make sure the research does not threaten construct validity. The procedures for coding the data can be found in step six of the research design as described in paragraph 2.3.

Reliability establishes the consistency of a research instrument in that the results it achieves should be similar in similar circumstances (Smith, 2011). Reliability requires demonstrating that the operations of a study can be repeated with the same results (Pandit, 1996). In order to ensure the reliability of this study the previous paragraph showed the circumstances for collecting data and searching for relevant literature. This way it is possible to repeat the study with guidance of the research design described.

External validity is the extent to which the results of the study can be generalized to other situations and to other people (Smith, 2011). External validity requires establishing clearly the domain to which the study's findings can be generalized (Pandit, 1996). The external validity is relatively low. In this study the interviews with practitioners from the Netherlands is compared with literature concerning other markets like the audit profession in the United States. This study only shows that barriers found during this study can be validated using the literature, but gives no conformation on the generalizability to other markets.

Internal validity is the extent to which a causal conclusion based on a study is warranted (Smith 2011). Internal validity is enhanced by establishing causal relationships whereby certain conditions are shown to lead to other conditions (Pandit, 1996). The internal validity

increases by a clear description of the theory/model created in this study. The internal validity is also increased with member- checking done in step nine of the research design.

3. LITERATURE REVIEW PART 1

3.1 INTRODUCTION

This chapter is the result of the first step of the research design described by Pandit. The first step of the research design of this study is to review technical literature in order to create a clear research question. Moreover the review of the technical literature gives the researcher a clear insight in what the important subjects are that need to be examined during the study (Pandit, 1996).

The purpose of this chapter is to create a clear framework for selecting the cases and developing the interview protocol. This chapter thus provides a clear foundation for step two and three of the research design as described in section 2.3.

This chapter consists of three sections. Section 3.2 gives an overview of possible definitions for data analytics in the context of an audit procedure. In order to give an overview the academic literature will be reviewed together with the professional literature. In section 3.3 the possible uses and purposes of data analytics during the audit in the context of an audit procedure will be explained. This section will be based on a review of academic and professional literature. Section 3.4 provides an overview of all the possible stakeholders which are involved in the possible implementation of data analytics during the audit.

3.2 DEFINITION DATA ANALYTICS

This section will give an overview of possible definitions for data analytics in the context of an audit procedure. At the end of each subsection a table with a summary of characteristics and definitions will be given. The definitions will provide guidance for the creation of the interview protocol. The creation of the interview protocol is part of step three in the research design as described in section 2.3.

3.2.1 COMMON DEFINITION

In this first subsection some definitions of data analytics will be stated without specifically looking at the definition in the context of an audit. This section will show three definitions from business dictionaries and three from the academic literature (not concerning audit or accounting topics). Moreover this subsection will compare the six given definitions and look for characteristics across the different definitions.

Data are facts and statistics collected together for reference of analysis (oxford dictionary, 2014). As mentioned in the introduction, according to Tech-target (2014) the general

definition of data analytics is: ''the science of examining raw data with the purpose of drawing conclusions about that information''.

The business dictionary techopedia (2014) has a definition that is stated to point out the advantage of data analytics. Its definition is: ''Data analytics refers to qualitative and quantitative techniques and processes used to enhance productivity and business gain''.

According to the business dictionary (2014) analytics often involves studying past historical data to research potential trends, to analyze the effect of certain decisions or events or to evaluate the performance of a given tool or scenario. This definition tells us what data analytics can do in a more precise manner in comparison with the other two definitions.

Data analysis researches methods to automatically extract valuable information from raw data by means of automatic analysis algorithms (Keim et.al., 2008). This academic definition shows the most similarity with the definition of Tech Target.

The term data analytics is the general process of exploration and analysis of data to discover new and meaningful patterns in data (Kohavi et.al., 2002). Another definition of data analytics described in an article written by Norris and colleagues (2009) is defined as: the processes of data assessment and analysis that enable us to measure, improve, and compare the performance of individuals, programs, departments, institutions or enterprises, groups of organizations, and/or entire industries. The definitions from the business dictionaries have a more practical view compared to the definitions used in the academic literature.

Concluding, the most common characteristics of data analytics according to academic literature are the use of data, drawing conclusions from that data and looking for patterns/trends (see table 3).

Characteristics data analytics	**Reference**
- Use of data	All six definitions
- Drawing conclusions from data	Tech target, business dictionary, Keim et.al., Kohavi et.al
- Improve productivity	Techopedia, Norris et.al
- Looking for patterns/trends	Business dictionary .Kohavi et.al., Norris et.al
- Evaluate/compare performance	Business dictionary, Norris et.al
- Quantitative and qualitative	Techopedia
- Analysis algorithms	Keim et.al.

Table 3: summary of the characteristics of data analytics

3.2.2 PROFESSIONAL LITERATURE

In this subsection different definitions used by Audit Companies will be described. The definition of the '' Big four'' will be looked at.

KPMG applies the following definition: ''data analytics is an analytical process by which insights are extracted from operational, financial, and other forms of electronic data internal or external to the organization'' (de Kroon and Karp, 2013). Ernst and Young (EY) uses the following definition: ''data analytics is an analytical and problem solving process to identify and interpret relationships amongst variables'' (Gupta, 2004). PwC defines data analytics as ''the discovery and communication of meaningful patterns in data'' (Talesara and Harrington, 2014). Deloitte defines data analytics as ''the practice of deriving insights from data to make better fact based decisions'' (Bowtell et.al., 2014) .

Summarized, each big four firm has his own definition with a slightly different focus. What can be seen is that KPMG and Deloitte have a more practical based view on data analytics, where EY and PwC use a definition that is closer to the academic definitions described in the previous subsection.

So there can be Concluded that the use of data and looking for patterns/trends are the common characteristics that can be found across the different definitions used by the ''big four'' (see table 4).

Characteristics data analytics	**Reference**
- Use of data	Big four
- Looking for patterns/trends	PwC, EY
- Drawing conclusions from data	KPMG
- Making better decisions	Deloitte
- Solving problems	EY

Table 4: summary of the characteristics of data analytics

3.2.3 ACADEMIC LITERATURE

In this subsection the definitions of data analytics used for audit purposes that can be found in the academic literature will be described.

According to de Kroon and Karp (2013) the most frequently used definition of data analytics in relation to the audit is: ''the process of inspecting, cleaning, transforming, and modeling data with the goal of highlighting useful information, suggesting conclusions, and supporting decision making''.

The AICPA uses the following definition: ''Audit data analytics is the science and art of discovering and analyzing patterns, identifying anomalies, and extract other useful information in data underlying or related to the subject matter of an audit through analysis, modeling and visualization for the purpose of planning or performing the audit (Brynes et.al, 2014).

A definition formulated by William Titera another definition specifically tailored to the audit. Data analytics is defined as ''the computer-assisted examination of information underlying financial statements or other subject matter being audited'' (Titera, 2013). Such an analysis will often be multidimensional and can start with the entire population of the element being examined.

Concluding, the characteristics that are most common among the used definitions of data analytics for the audit purpose are: use of data and looking for patterns/trends (see table 5).

Characteristics data analytics	**Reference**
- Use of data	De Kroon and Karp, Titera, AICPA
- Looking for patterns/trends	De Kroon and Karp, Titera, AICPA
- Using whole population	Titera
- Drawing conclusions from data	Titera
- Making better decisions	De Kroon and Karp
- Changing data	De Kroon and Karp
- Audit specification	Titera
- Identifying anomalies	AICPA

Table 5: summary of the characteristics of data analytics

3.2.4 CONCLUSION

The definition that will be used during the remainder of this study and the data collection phase is the definition described by William Titera. This definition is tailored to the audit. The definition by Titera has all the important characteristics found in the concluding paragraphs of the previous subsections. Namely, use of data looking for patterns/trends, drawing conclusion form the data. Moreover, as can be read in the next section, the article of Titera gives the most complete overview of the possible purposes and user possibilities that data analytics can provide in the audit. This, together with the definition that is tailored to data analytics, makes the article of Titera an interesting starting point for the interviews during the data collection phase of this study.

3.3 POSSIBLE USES OF DATA ANALYTICS

In this section the possible uses and purposes of data analytics during the audit will be explained. This section and section 3.2 form the basis for the interview protocol created during step three of the research design. The interview protocol can be found in Appendix B.

In the academic literature there are four types of audit procedures to be found (Arens et.al., 2014). An audit procedure is an audit technique in gathering auditing evidence to substantiate the reliability of accounting records (Arens et.al., 2014)

The four types of audit procedures are:

1. Test of controls
2. Substantive tests of transactions
3. Analytical procedures
4. Test of detailed balances

These four types of audit procedures lead to the auditor having sufficient and appropriate audit evidence (Arens et.al., 2014).

Data analytics can take multiple forms and yield superior evidence not attainable without the use of technology. Data analytics can create value for the audit particularly by providing audit evidence. Moreover, data analytics is a technique that can provide supporting information during different procedures of the audit (Titera, 2013).

Data analytics can be highly effective in finding anomalies, which is very important when testing the controls of a client (Titera, 2013). The ''test of controls'' is an audit procedure to test the effectiveness of controls in support of a reduced assessed control risk (Arens et.al., 2014). Data analytics can provide more effective planning and risk assessment during the planning and designing of the audit approach (Titera, 2013). The audit process should make reference to the client business process, data analytics can be used to get more understanding of a client's processes and potential risks and misstatements (Bierstaker et.al.,2001). Data analytics can therefore be a part of your test of control.

Substantive tests are designed to test for dollar misstatements that directly affect the correctness of financial balances (Arens et.al., 2014). Auditors rely on three types of substantive tests: (1) Substansive test of transactions, (2) substansive analytical procedures and (3) tests of detailed balances (Arens et.al., 2014).

''Substantive tests of transactions'' are used to determine whether all audit objectives for each class of transactions are satisfied. Looking into the data concerning individual transactions and looking for exceptions will become easier in the future because of modern audit techniques like data analytics (Vasarhelyi, 2013). Concluding, data analytics can be used for substantive test of transactions (Titera, 2013).

Data analytics can be used as an analytical procedure (Bierstaker. Et.al., 2001; Titera, 2013). Analytical procedures are evaluations of financial information through analysis of plausible relationships among financial and nonfinancial data (Arens et.al., 2014). There are five types of analytical procedures (Arens et.al., 2014). All these types of analytical procedures are useful for identifying risks during the audit. Auditors can compare client data with:

1. Industry data
2. Similar prior-period data
3. Client-determined expected results
4. Auditor-determined expected results
5. Expected results using nonfinancial data

When comparing client data with industry data you create useful insights regarding your client by looking at the performance of the industry and comparing that to the performance of you client. This can provide extra insights that are going to be missed when you only look at the client data (Arens et.al., 2014). According to the definition by Norris et.al. (2009) data analytics can compare the performance of individuals, programs, departments, institutions or enterprises, groups of organizations, and/or entire industries. The definition of Norris tells that data analytics can provide evidence in comparing client data with industry data, client-determined expected results (e.g budget) and auditor-determined expected results. Data analytics can also look into historical data (business dictionary, 2014) which tells us that data analytics can also be used for comparing client data with similar prior period data. Using data analytics to create an expectation of results (eg. Sales) is possible. With data analytics you can create an expectation and test this expectation (Titera, 2013). With data analytics you can compare and recalculate populations of data (O'Reilly, 2006).

The ''test of detailed balances'' focuses on the ending general ledger balances for both balance sheet and income statements accounts. Data analytics enables an auditor to drill down into the underlying details of balances. Which gives the auditor the chance to perform his test of detailed balances with data analytics (Titera, 2013).

Across the different procedures data analytics will bring a great change because audit procedures like recalculation, aging and scanning for unusual transactions, can be performed on the entire population instead of testing a small part of the entire population (sample testing) (Titera, 2013). So according to Bierstaker et.al. (2001) there is no longer a test of details because you will be testing the entire population.

Titera states that the use of data analytics does fit into the existing audit model. Data analytics has most value if used during analytical procedure and the test of detailed balances (Titera, 2013). Data analytics has most value for analytical procedures because identifying risks becomes easier with data analytics. Moreover the fact that it is no longer necessary to select samples, but instead perform an audit on the total of a certain balance will provide much more assurance during the audits detailed testing (Titera, 2013).

Summarizing, data analytics is a technique that can provide evidence that cannot be attained without the use of technology (Titera, 2013). Data analytics can provide audit evidence within every procedure described by Arens et.al.(2014). During the remainder of this study the focus will be on analytical procedures and test of detailed balances because the positioning of Titera regarding data analytics states that data analytics has the most value in these two types of audit procedures. This means the focus will not be on the test of controls and substantive test of transactions during the remaining part of this study.

3.4 STAKEHOLDERS

This section will provide guidance for choosing different interest groups and the interview selection during step two of the research design as described in section 2.3.

The starting point of this section is the contemporary approach written by Shelly in 2002 in her book ''system analysis and design''. In this book Shelly identifies different stakeholders during the development of a new information system. As described in the previous section data analytics can bring new ways of collecting evidence. The introduction of data analytics can be seen as a new information system (IS). This is in line with the definition of Whitten et.al. (2001.) They define IS as an arrangement of people, data, process , information presentation and information technology that interact to support and improve day-to-day operations in a business as well as support the problem solving and decision making needs of management and users. Next to that, the first important task in getting new IT development to work is identifying the relevant stakeholders (Alles et.al., 2008)

The first group of stakeholders identified by Shelly (2002) are the internal users. The first group of internal users of data analytics are the employees, managers and the board (Freeman, 1984). Moreover, the owners/partners are internal users within an audit company (CAQ, 2011). In case of the implementation of data analytics during the audit the auditor is responsible for using data analytics and making sure the use is in line with law and regulations (Titera, 2013).

The second group are government/ outside stakeholders. Everything within an audit is done within certain boundaries. These boundaries are present because the audit is a regulated profession (Aalst et.al., 2010). In the case of the audit these boundaries are set by governments and regulatory authorities (e.g PCAOB AICPA, AFM, NBA) (Aalst et.al., 2010). In the report of the CAQ (Central for Audit Quality) (2011) this group is described as regulators/standards setter.

The third relevant group Shelly identifies is the IT department. Information system designers and also IT auditors can be mentioned here as part of the IT department (Vasarhely et.al. 2012). The involvement of IT personnel is also mentioned by Alles and colleagues (2008).

Last important group identified by Shelly are the clients/customers. The involvement of the client in the process of getting new working methods to function is very important. The new method must be accepted by your client to have a high chance of surviving (Nelson et.al. 2000). Next to that the trust between an auditor and the client is very important to make sure a new working method will succeed (Nelson et.al. 2000).

The report of the Center for Audit Quality (CAQ) identifies one more group and that is a group named Academia. According to the report they are stakeholders because they increase the scope of the auditor responsibilities.

Summarizing, five groups of stakeholders have been identified before starting the data collection phase of this study. During the data collection phase the completeness of the stakeholders will be tested.

4. RESULTS

4.1 INTRODUCTION

This chapter states the results of the interviews. In this chapter results of the open coding and axial coding as described in section 2.3 can be found. The coding of the data is step six of the research design that was described in section 2.3.

In section 4.2 the results of the open coding will be explained. Each concept will represent a barrier that will exist when implementing data analytics within the audit. The concepts are the result of the interviews. The complete interview data can be found in appendix B of this study. Section 4.3 shows the process of axial coding. In this section the concepts are summarized into covering categories. The results of the last type of coding, namely selective coding, will be shown in chapter six when the model is described and presented. Section 4.4 provides a visual summary of the formulated concepts and categories.

4.2 CONCEPTS

This section shows the process of open coding. In this study the open coding is the labeling of the data and the linking of a concept to the data. As visually shown in figure 3 (page 20). A concept is a descriptive or explanatory idea, its meaning embedded in a word, label or symbol (Hollaway, 2008). Each sub section first states the most relevant quotes. Secondly each subsection provides a description of the concept, this summary is based on all the quotes about a certain concept (appendix B). The formulated concepts in section 4.2 are based on the interview data that can be found in appendix B. This paragraph represents the first part of step six of the research design as described in section 2.3. Furthermore, some concluding remarks about the stakeholders and definition of data analytics will be made at the end of section 4.2.

4.2.1 BARRIERS

1. *Awareness of possibilities*

- *Auditors are not aware of the possibilities. There is not a clear overview of what data analytics can do and how it adds value to the audit (IBP1)*
- *The average auditor is not aware of all the possibilities that data analytics can provide (RUP2)*
- *There is not much marketing about the audit and data analytics. There is less focus on audit and data analytics (MBS2)*
- *There is a lack of knowledge about the applications and purposes of data analytics (ABS1)*
- *Auditors are not aware of the increase in efficiency that data analytics can bring (ABP1)*

In order to use data analytics more often auditors have to be aware of the possibilities and solutions that data analytics can provide. According to the interview panel data analytics makes the auditor a better collocutor, increases your efficiency and also the quality of an audit. Auditors are not aware of the possibilities that the use of data analytics can provide within their audit approach. There is no clear understanding of what data analytics can do and how it increases the value of the audit

2. *Upfront investment*

- *A barrier is cost. The understanding of all processes and data is expensive (ABS1)*
- *The first steps to use data analytics are the biggest investment (IBP2)*
- *The audit fees on my assignments are not high enough to use data analytics for most of my clients (ABS5)*
- *Making the tools and the software goes with a big upfront investment because of the cost of building the software and collaboration between auditors and IT specialists (MRA1)*
- *The use of data analytics is costly and therefore not appropriate for all clients at this moment (ABP1)*

The barrier that was most mentioned is the upfront investment that is needed to use data analytics. Developing tools and software goes with a upfront investment. The upfront investment is an investment in time and money. It is what stops auditor's from using data analytics when they have a client with less audit fee. Next to that the understanding of a new working method and understanding all the new processes make the upfront investment an even bigger barrier.

3. *Budget pressure auditors*

- *There is a challenge for auditors, because of budget pressure and lack of time, there might be no chance to innovate (ABD1)*
- *Data analytics is at this moment very time consuming and expensive (IBS2)*
- *It is difficult to reach auditors to increase their awareness because of a lack of time to educate auditors (MBS2)*
- *There must be the time to develop the software and solutions for data analytics. Budget and resource pressures could be a barrier in that process (IBS1)*

The budget pressure that auditors experience can be a barrier for using data analytics. When the budgets of an auditor are under pressure they will not choose to innovate because there is no time to innovate. Innovation takes time and planning and when time and money to

innovate is not available auditors will not use data analytics. The pressure on the auditors budgets makes it also hard to find time to educate auditors in data analytics.

4. Audit firm culture/strategy

- *Wrong implementation strategy for the use by audit firm (ABS1)*
- *The culture has to change in order to make sure auditors will use data analytics more often (MBS1)*
- *People have to see the complete process of implementing and using data analytics and that is not there (ABS5)*
- *The intern communication about the implementation/ development strategy must be good, because otherwise people will not act according to the strategy that was decided at the top of the company (ABS4)*
- *In order to make sure data analytics can increase the value of the audit, the focus has to be on the increased value of the audit and all stakeholders have to keep that in mind (ABS4)*

The company culture and strategy can block innovation. First, according to the interview panel there needs to be a good implementation strategy. Moreover, the culture has to support innovation in order to make data analytics work. Support from the top and the managers is also important. Without the support of the people who choose the audit procedures data analytics will never become part of the audit. Some of the interviewees mentioned that more guidelines on the use and justification of data analytics should be provided by the top of the audit company.

5. Audit firm structure

- *The company structure does not support data analytics because I have to pay another intern department (ABS5)*
- *People work for their own department and have their own interest. But bottom-line the IT specialist and the auditor work inside the same company (IBS1).*
- *The structure of an audit firm does not support the upfront investment you have to make when you use data analytics (IBS2)*
- *The cost allocation could be a problem, because we take all the cost in one year. The cost allocation does not fit the idea of data analytics (ABP1)*

There are two important things that can be a barrier concerning the company structure. First the interest of all people inside the company should be aligned. The company structure of big four companies does not support the use of data analytics because the auditor has to charge another department for building the software. All those departments have their own

interests and these interests should be aligned. Secondly the cost allocation of the upfront investment are all made in the first year, which is another barrier that auditors experience.

6. ***Willingness to innovate***

- *Auditors are risk averse. Doing something new is not our nature (ABS1)*
- *Thinking out of the box is important to see the possibilities of data analytics (PBS1)*
- *You have to be open to change in order to use data analytics (ABS4)*
- *Auditors are not open to change and are by nature sceptical (ABP1)*

According to the interview panel the lack of willingness to innovate is a barrier to use data analytics. Auditors are by nature sceptical and tend to take the safe route. Taking the safe route blocks innovation. A new mind set is needed to make sure that there is enough willingness to change and innovate. Next to that negative experiences with data analytics in the past, like for instance a pilot that went wrong, can create less willingness to innovate.

7. ***IT culture***

- *For some client another way of thinking is necessary to use data analytics (IBS2)*
- *Managing expectations to the client is important in order to make sure that the client provides data and support. This is important to take away barriers for data extraction (IBS2)*
- *The fact that we as internal audit department perform data analytics makes that the external auditor uses less data analytics because they rely on our data analysis (CFM1)*
- *Clients have another way of looking at IT applications because they are not aware of the possibilities and how data analytics is embedded in the working methods of auditors (PBS1)*
- *Some clients won't give access to the data because you did not use data analytics in the past (IBS2)*

IT culture in the context of this study is the description of the IT culture and vision of the client. Clients are not always willing to give all their data or are not eager enough to support the use of data analytics. In order to make data analytics work the client needs to support the use of data analytics. Reasons for not wanting to give their data is because of a lack of eagerness or experience, by which is meant that they do not see the necessity of using data analytics. In addition to that, the fact that an internal audit department uses data analytics can cause problems, because the client wants you to rely on their use of data analytics. For some clients it might be necessary to change their way of thinking to get their support for the use of data analytics during the audit. Data analytics might not be used because the client is not innovative enough and therefore not eager enough to give his support.

8. Data security/ Privacy

- *Clients want to know if their data are safe (RUP1)*
- *We only share data with our external auditor if it is relevant for their audit and if they have a contract with us concerning data security (CFM1)*
- *More clients ask in which way the data is secured (ABS2)*
- *You can have my data but only when you use a computer without wifi and only when you perform your data analytics on site. So the data can't leave our office building (ABP1)*
- *Data privacy is important and can cause serious problems like fines or even administrative liability (CFM1)*
- *The security of privacy-sensitive data will be an important issue in the future. New agreements about the way auditors use our data will be necessary (CFC1)*

Clients only share data with an auditor when it is relevant and they know for sure that the data are safely stored. Clients nowadays are concerned with the security of their data. As auditor and audit firm, securely getting and storing the data is important to make sure that data analytics can be used.

For auditors data privacy is an issue because it can lead to fines or even administrative liability. Furthermore, data should not be retraceable to specific employees of your client. Data privacy can be an issue with some types of databases, because in some databases it is not easy to make data not retraceable.

9. Data management

- *You can't go to the data supervisor at some clients, because they don't have one (ABS2)*
- *It takes time to get data and you have to know who can give you the data (ABS2)*
- *Data accessibility can be an issue. If you take the data to the audit firm and their servers. Which data do you get and do you want to have all data? (IPB1)*
- *Sometimes it is hard to use data analytics because the ownership of data is not clear in most companies (PBS1)*

Auditors face problems regarding data management during the implementation of data analytics. Not all companies have enough data management to find out what data you need and where you can get the data. The end responsibility of data is sometimes not clear inside a client's company, which makes it hard for the auditor to access the data. Some companies do not have someone who is responsible for the data which makes it harder to extract data from a client's database.

10. Data standardization

- *At this moment there is not enough standardization to use data analytics on a bigger scale (ABP1)*
- *Data extraction is a big challenge and there is no company who standardized the data enough to easily get the data out of databases (IBS1)*
- *Everybody has his own names for example an invoice, it must be possible to map this to your software to use data analytics (ABD1)*

A lack of data standardization is a barrier for using data analytics. Every client has other IT systems and even if they use the same hardware/software, even the difference in a column of an excel sheet concerning personnel numbers (e.g. difference between Personnel number and Personnel num), data standardization can be a problem. There are no companies that standardized the data in such a way that it is easy to get it out of their IT systems.

11. IT system client

- *The client must first fix some bugs in the new IT systems, before data is available for us (ABS3)*
- *Data extraction is under most circumstances not a problem, but with our new IT systems that could be a problem (CFM1)*
- *An organization can be so complex that it will take weeks to build applications or tools with data analytics that will help us (ABS2)*
- *The structure of IT systems and databases can cause that it is not possible to extract the data (IBS1)*
- *A problem of data extractions could be the way in which data is embedded in different IT systems (PBS1)*

The IT system of the client can be a barrier for using data analytics. The IT system of a client can make it impossible or too expensive to extract the data from the databases of the client. The problems with data extraction are duet to the fact that the IT system is to complex or just because the IT system is fairly new. The accessibility of data is often underestimated. Moreover, the fact that the needed data are stored within different IT system can be a problem for the data extraction.

12. Data reliability

- *The data must be trustworthy otherwise data analytics is useless (IBP1)*
- *You have to check if the data are reliable, because garbage in is garbage out (ABS4)*
- *There must be multidisciplinary collaboration to see if the data are reliable and is extracted in a proper way. You need an IT auditor to know if the data are reliable (ABS5)*
- *Data extraction from large IT systems are very difficult and moreover it is hard to know if the data are reliable (CFM1)*

The interview panel identified that an auditor must know whether the data are reliable and trustworthy in order to use data analytics. When the data used during data analytics are not reliable data analytics is useless. The complexity of the client IT systems can lead to data uncertainty about the reliability of the data. The help of an IT auditor is necessary if you want to use data analytics. Uncertainty about the reliability because of a lack of knowledge about data and IT can be a barrier that auditors will experience.

13. Software

- *You need software that helps with the purpose of your audit and that actually helps your audit (ABS4)*
- *We build standardized tools for the tasks that audit performs during every audit (IBP1)*
- *The use of the software needs to be changed for every client (PBP1)*
- *Every time data analytics is used it is client specific. And this increases the investment (ABD1)*

The software can be a barrier. Software needs to be adjusted to for every client. The fact that not much software is standardized is a problem clearly identified by the interview panel. Moreover, you want software that helps you with the purpose of your audit and answers audit questions. If the link between the software and the auditor's audit approach is not clear, then data analytics will not be used.

14. Resources

- *There are not enough people who have the knowledge about the IT and the audit (IBS2)*
- *In building client specific solutions there is a serious lack of people who can build the tools and software (IBS1)*
- *The workload is high and you are happy to finish the audit in time and the busy workload blocks innovation (ABS5)*
- *The biggest Barrier is people and a lack of skills. People must have the skills to work or start working with data (RUP1)*

- *You need good people with enough knowledge and skills to let data analytics work (PBS1)*

Resources are a barrier according to the interview panel. There are not enough IT auditors and IT specialists. In addition to that, as long as the budget pressure of the auditors is high, there is also a lack of resources within audit departments. The lack of resources can cause auditors not to choose for innovation and modern audit techniques. There are also too few people who know enough about both IT and the audit. Overall, a lack of people who can build the software and facilitate the use of data analytics during the audit can be an obstacle for using data analytics.

15. Expertise

- *In some audits you work with IT auditors and the question will be if a financial auditor has enough IT knowledge to check what the IT auditor is doing (ABS2)*
- *The IT auditor and financial auditor must broaden their knowledge. A financial auditor should have more knowledge about data and IT (CFM1)*
- *Auditors have not enough knowledge about data and IT to communicate clearly what they need in the software and the tools (IBS1)*
- *With the increasing importance of IT systems, auditors should broaden their knowledge base and understanding of IT systems (ABP1)*
- *You need someone who has a clear view on what the software can do and what is relevant for the audit and combine those fields of knowledge (ABS2)*

The lack of expertise is important in multiple ways. Auditors have a lack of knowledge about IT and data. Auditors must understand what happens when the data is extracted and what the software exactly does because they have to take the responsibility for the audit. A lack of expertise can cause auditors not to fully understand how the software works which is a barrier for using data analytics.

The IT specialists have a lack of knowledge regarding the audit. Most of the IT specialists don't know what audit procedures are. Auditors should broaden their knowledge in order to make sure that they understand the software they use and can take responsibility for the software used. Education and training are important to close the knowledge gap between auditors and IT specialists, according to the interview panel. The lack of expertise and knowledge regarding IT was mentioned during most of the interviews. The knowledge gap

between IT specialists and auditors should be narrowed.

16. Multidisciplinary collaboration

- *The collaboration between the people who build the software and the people who use the data is key in this process (ABS4)*
- *The IT specialist and the auditor have their own knowledge base. The first step is to get people talking with each other (RUP1)*
- *There needs to be understanding between the IT specialists and the auditors what we can do and expect from each other (IBS1)*
- *The collaboration between IT and the business is important to perform data analytics (CFM1)*

According to the interview panel the collaboration between the IT specialists and the auditors is essential during the process of implementing data analytics in the audit. In order to make data analytics work, stakeholders have to team up. IT specialists must work together to make sure the software increase the value of the audit and also to know which data must be subtracted. The IT specialist and the auditor have a different knowledge base and to make data analytics a success these groups have to work together and share their knowledge.

17. Communication

- *The auditor must have the skills to tell the IT specialist what he wants to see (IBP1)*
- *Auditors must ask the right questions and people must have some knowledge of what you can do for each other (RUP2)*
- *You have to understand each other's perspectives in order to make data analytics work. And auditors should have some IT knowledge and the IT specialists must have some knowledge of the audit (RUP2)*
- *The auditors and IT specialists should communicate to get a clear view on what auditors need and what the IT specialists can deliver (IBS1)*
- *After the data analysis was performed the data analyst has to explain to the auditor what he has done with the data and the IT (ABS4)*

A lack of communication could lead to software that does not match the needs of the auditor. The communication is important between the IT specialist and the auditor. There needs to be a clear view on what the auditors want from the software and what the IT specialists can deliver. You have to understand each other's perspective in order to make

data analytics work. Auditors must be able to communicate clearly what they need and therefore they need to explain the basics of an audit to the IT specialists.

18. End user ownership

- *The auditor must be leading and the approach should be integrated with the IT auditor and IT specialist and also there should be integrated budgets (ABS5)*
- *Audit is now leading in the process of building software and guiding the process of getting helpful tools for the audit (ABD1)*
- *Financial auditors should be leading when it comes to options about what data analytics should do (ABS5)*
- *Audit should take the lead in setting the requirements that we need in order to build good tools for audit (IBP1)*

The end user ownership is clearly a barrier that exists. According to the interview panel it is very important that the audit department of a company takes the lead in building the software by asking the right questions. They should ask the questions is order to make sure the relevant software is built. If IT specialists with a lack of knowledge about the audit take the lead it is possible that software will be developed that is not relevant to the auditor or his audit approach.

19. Audit standards

- *We don't know if data can be audit evidence according to the audit standards (ABD1)*
- *Auditors don't know if the use of data analytics is in line with ISA (RUP1)*
- *The audit standards kill the possibilities for innovation, because auditor's don't know if the innovation is conform the standards (ABS5)*
- *The interpretation of COS/regulations by the Big Four does not support the use of data analytics (ABS1)*

Auditors do not know if the use of data analytics is in line with the audit standards that they have to follow. According to the interview panel, the audit standards are outdated and should be revised otherwise they stand in the way of innovation. Another problem mentioned is the interpretation of the audit standards by the big audit companies. The interpretation of audit standards by the big audit companies does not support the use of data analytics.

20. Information overload

- *The fact that you have so much results and unique processes identified when you use data analytics can be a barrier for some auditors (IPB1)*

- *Data analytics can give too much insight, but auditors have to think about how to process these insights according to their standards and regulations (IPB2)*
- *The possibility of more insight via data analytics can feel as a threat (ABS4)*
- *You have to change your way of thinking about what to do with the extra insights and errors in the whole population (ABS5)*

The use of data analytics brings new and more evidence in comparison with traditional audit techniques. Data analytics can bring more insights and auditors have to think how to process those new insights. Those new insights can be created because data analytics gives auditor's the opportunity to audit more evidence in an efficient way. The possibility of finding much more insights can feel as a threat according to the interview panel of this study. A new way of thinking about what to do with extra insights and errors found is necessary to make sure auditors use data analytics.

21. <u>Regulatory review</u>

- *Uncertainty about documentation in your files, how to justify the way you are working when you use data (ABS5)*
- *When people do not innovate because of for example a review by regulatory authorities then the supervisory role is not correct in the market (RUP2)*
- *Auditors are conservative in order to be sure to pass AFM reviews (ABS1)*
- *There is no clear overview of what to include in your audit file when you use data analytics (ABP1)*

Auditors are nervous about the review of the supervisor of the financial market. They have the feeling that the use of data analytics is an extra responsibility. The auditors know that they can get a positive review with their old working methods and they do not know what the review will be while using a modern audit techniques like data analytics. So there is uncertainty about the documentation in audit files in order to pass the review of the supervisor in the market. According to the interview panel, if this is the case, maybe the supervisory role is wrong because it blocks innovation.

22. <u>Guidance/ Support regulatory authorities</u>

- *Auditors look to the PCAOB and AFM for guidance and support on the use of modern control techniques (PBP1)*
- *It is important to make the AFM part of your developments which are not in line with the traditional audit (ABS4)*

- *There should be more guidelines to use data analytics if you use data analytics in line with guidelines (PBP2)*
- *More supervision and regulations make it harder to innovate. The supervisor should not block innovation (RUP2)*

Auditors look at regulatory authorities for their opinion. According to the interview panel support and guidance on the topic of data analytics would help auditors to innovate. There are at this moment no guidelines on how to justify the use of modern audit techniques like data analytics.

23. Complete success story

- *Not everybody wants to be a frontrunner of data analytics, they want to use it if there are success stories (ABD1)*
- *There is no dossier to my knowledge that was reviewed and approved by the AFM where data analytics were used (PBP2)*
- *First there has to be a best practice. A client case in which the whole team confirmed that the use of data analytics increased the efficiency/ the quality. I have not heard about a success story when it comes to data analytics and the audit (ABS2)*
- *Companies must share the success stories, and this is even more important because the business is regulated (RUP2)*

In order to make sure that auditors will use data analytics they need a complete success story. All auditors within the interview panel have not come upon a complete success story. A best practice is an audit with use of data analytics in combination with good explanation of what has been done, complete justification and positive review by the regulatory authorities and internal quality department of an audit company. Furthermore, the audit firm should share success stories with their auditors. Another problem is that there is a different interpretation of what a success story is among the different stakeholders. In order to make data analytics work policy makers and IT specialist have to understand that a success story includes a proper justification of the use of data analytics.

4.2.2 DEFINITION AND STAKEHOLDERS

The interview panel had no extra insight about different stakeholders or a completer definition for data analytics within the audit.

Some members of the interview panel argued that some parties like the regulatory authorities or the IT specialist are not stakeholders of data analytics. Only a few members of

the panel mentioned these parties not being stakeholders, the other members of the interview panel did support the IT specialists and the regulatory authorities as being a stakeholders.

The interview did give insight in how the stakeholders are connected and what the relationships between the different stakeholders are.

All the members of the interview panel agreed with the definition by William Titera. Although the positioning of William Titera within the current audit model was questioned. According to some members of the interview panel, there is no longer a test of detailed balances when using data analytics (see also section 3.3). The interview panel argues that because data analytics gives auditors an opportunity to test complete accounts.

There was not enough difference between the vision of the interview panel and the literature described in chapter three to reconsider the stakeholders or the definition of data analytics used during this study.

4.3 CATEGORIES

This section shows the process of axial coding. Axial coding is the process of summarizing the concepts from open coding into covering categories. The concepts can be found in the previous paragraph. The axial coding process is shown visually in figure 3 (page 20). Categories are higher in level and more abstract than the concept they represent. Categories can be formed by multiple concepts (Corbin and Strauss, 1990). This paragraph describes the second part of step six of the research design as described in section 2.3

1. ***Awareness***

The first category is Awareness. As mentioned the Auditors must know what the possibilities and changes are before they will use data analytics.

Concept covered:

- Awareness of possibilities

2. ***Investment***

The second category is investment. In order to use data analytics a large upfront investment is necessary. To make this investment auditors must be willing to innovate. The company culture, strategy and structure should not block innovation. Lastly, when there is budget pressure for auditors they will not innovate because there is a lack of time and money to do

so. It needs to be clear for auditors that the investment is worth it to increase the efficiency or the quality of their audit.

Concepts covered:

- Upfront investment
- Budget pressure
- Company culture/strategy
- Company structure
- Willingness to innovate

3. ***Acceptance by client***

The third category is acceptance by client. In order to use data analytics you need the support of your client. The barriers that make the acceptance by the client an issue are data security, data privacy and the IT culture. Mainly a lack of eagerness to let the auditors use data analytics was brought up as the main reason of client not accepting data analytics during the review session of the concepts.

Concepts covered:

- IT culture
- Data security/privacy

4. ***Data extraction***

The fourth category is data extraction. In order to let data analytics work the problems that auditors face with data extraction need to be overcome. The lack of data standardization and complex IT systems of clients are a big problem for the data extraction. Next to that, a lack of data management and problems with data reliability need to be attended to before an auditor can use data analytics.

Concepts covered:

- Data management
- Data standardization
- IT systems client

- Data reliability

5. ***Implementation***

The fifth category is implementation. All the possible problems during the actual implementing of data analytics in the audit are described in this category. In order to implement data analytics you need enough resources. A barrier during the implementation can be scarcity of resources of IT specialists, IT auditors and financial auditors. The lack of expertise about software, data and IT can be a barrier when trying to implement data analytics. Furthermore, the lack of expertise about the audit from the IT specialist can be a problem because software might be build that will not increase the value of the audit.

Concepts covered:

- Software
- Resources
- Expertise

6. ***Collaboration***

The sixth category is collaboration. According to the interview panel multidisciplinary collaboration is important. The communication between the IT specialists and the auditors is important in order to get the right solutions for the audit approach. Also, building the software application has to start with the right questions of the auditor. This makes the end user ownership essential according to the interview panel.

Concepts covered:

- Multidisciplinary collaboration
- Communication
- End user ownership

7. ***Justification***

The seventh category is justification. Auditors need to know how to justify their use of data analytics. Auditors need to understand how data analytics fits into their audit approach and their audit standards. Furthermore, new forms of information and higher volumes of evidence needs to be justified.

Concepts covered:

- Audit standards
- Information overload

8. ***Regulatory environment***

The eight category is regulatory environment. Because the audit profession is a regulated profession, auditors look to the regulatory authorities for their opinion. Auditors are nervous about their regulatory review because they do not how to justify their use of data analytics for their reviews. In addition to that, auditors are looking for guidance and support from the regulatory authorities.

Concepts covered:

- Regulatory review
- Guidance/support regulatory authorities

9. ***Success story***

The last category is success story. There is a lack of a complete success story. Moreover, not all the people involved in the implementation of data analytics have the same definition of what a complete success story is. The lack of a complete success story was mentioned in every interview with auditors and therefore success story is a separate category within the theory.

Concept covered:

- Complete success story

4.4 VISUAL SUMMARY

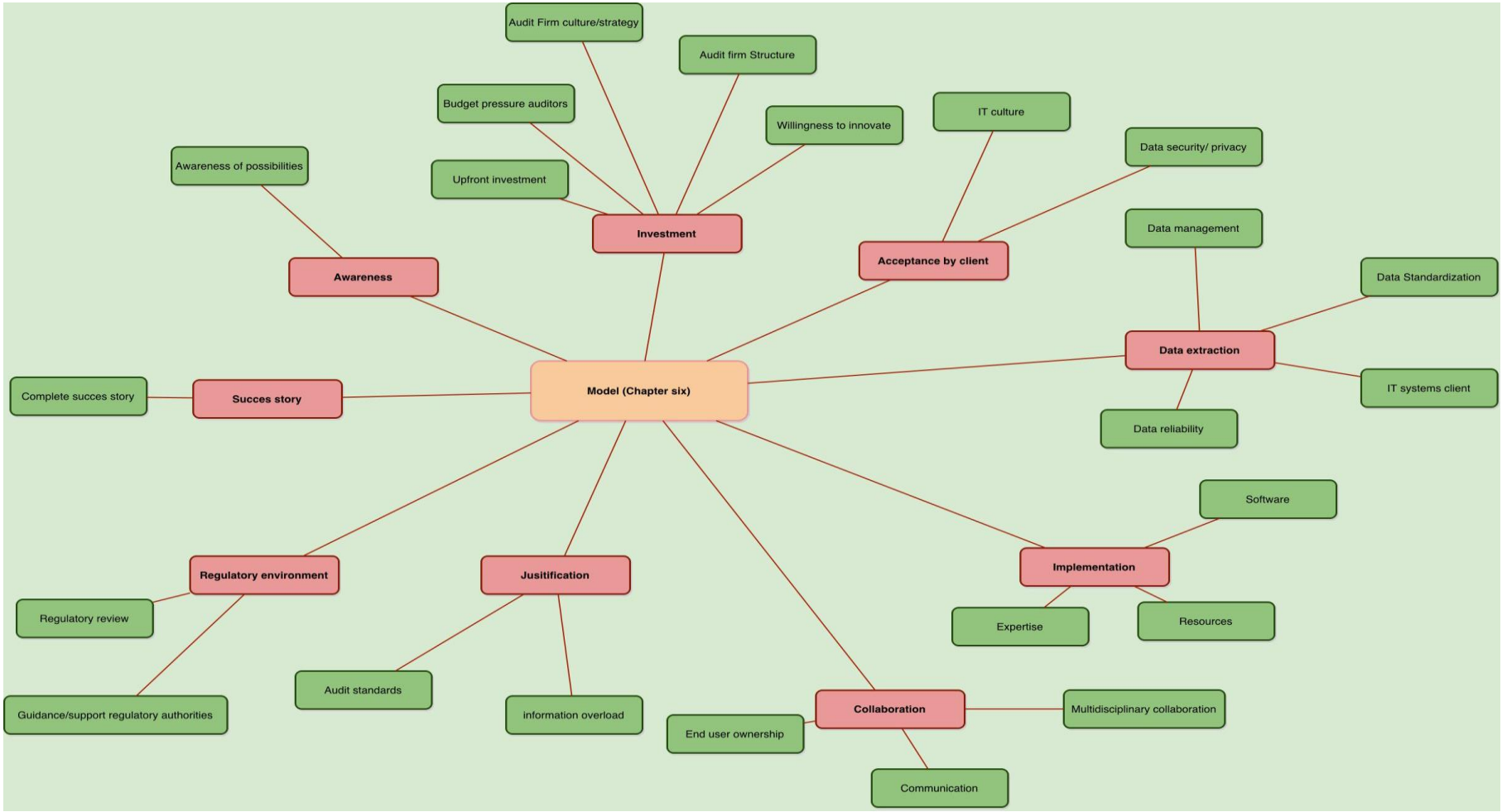

Figure 4: Summary of the open and axial coding of the data. The concepts (section 4.2) are in the green, the categories (section 4.3) are shown in red.

5. LITERATURE REVIEW PART TWO

5.1 INTRODUCTION

The purpose of the second part of the literature review is to validate the formulated barriers described in chapter four. During this study the results of the research are presented first in chapter four, where after the formulated concepts are validated with academic and professional literature. This approach is line with the basic idea of grounded theory as described in section 2.2.

The chapter consists of nine sections. The remaining sections will validate the created concepts (see figure 4) and categories (see figure) from chapter four by exploring the academic and professional literature. The chapter represents step seven of the research design as described in section 2.3.

5.2 AWARENESS

In order to make the best use of data analytics an organization first has to identify what the possibilities are for using data analytics within the audit (ACL, 2008). An auditor has to identify which audit assertions and procedures can benefit from the use of data analytics. Getting an overview of all the practical solutions and possibilities is essential (Vasarhelyi et.al., 2014). There should be a database with all the possible uses of a new audit technology (Alles et.al., 2004).

Within audit firms there is little guidance on what can be done with new audit methods and how to adopt those methods. Large audit firms have made significant investments in IT applications. However, only a modest amount of descriptive research documents is shared with the auditors to make sure they are aware of the possibilities (Janvrin et.al.,2008).

Modern audit techniques like data analytics can increase the quality and efficiency of the audit. Furthermore, they provide new forms of audit evidence (Moffitt and Vasarhelyi, 2013). Managers are not aware of the potential benefits resulting from investments in data analytics. When managers are not aware of the benefits, nor of the possibilities they will not use data analytics or any other modern audit technique (Banker et.al., 2002).

5.3 INVESTMENT

5.3.1 UPFRONT INVESTMENT

The payback of using data analytics can be considerable, but that requires an upfront investment (ACL, 2013). There is a big difference between the occasional use of an analytic tool and making analytics core part of the audit process. Analytic programs need to be owned and process changes need to be made, all of which takes time, effort and resources (ACL, 2013). According to a survey held by AuditNet (2012), the software implementation costs were the reason most frequently mentioned for not using data analytics software. Most managers in the survey mentioned that the implementation costs were too high. Next to that, the upfront investment is mentioned as the most important factor in the decision to use data analytics.

Automating manual audit programs requires significant startup costs. The fixed cost may become a significant hurdle in the process of audit automation (Alles et .al., 2008). An important reason for not choosing to innovate is often the perceived cost of implementing (Alles et.al., 2006). Among the studied characteristics that influence technology adoption, one of the most important is cost (Vasarhelyi et.al. 2009). Taylor and Murphy (2004) also suggested that high set-up costs and ongoing costs could be barriers to the implementation of technology.

5.3.2 BUDGET PRESSURE

In the article written by Blair Winsor (2012) the effects of time pressure on innovation is studied. The effective management of innovation is an important topic, because during the 21ste century rapid innovation became even more important. The analysis performed during this study suggests that managers working in a project-based environment should be extremely wary of the effect that time pressure has on innovation. The analysis revealed that time pressures eliminated innovation in time-pressured environments (Winsor, 2012).

Research shows that time budgets have the potential to create pressure which causes employees only to act as control mechanism, no longer thinking critically about working methods and audit quality (Liyanarachchi & McNamara, 2007). The increasing competition among audit firms, results in the fall of audit fees (Soobaroyen and Chengabroyan, 2006), indirectly leading to less innovation according to the research described by Winsor.

5.3.3 AUDIT FIRM CULTURE/STRATEGY

For innovation to be successful, management must transform the organization in such a way that the data and models actually yield to using the new working methods (Barton and Court, 2012). Management support is critical for successful implementation, especially for a project that requires a large budget and affects operational processes (Vasarhelyi et.al., 2009).

There needs to be a clear strategy on how to use data analytics to compete with other audit companies (Barton and Court, 2012). Furthermore, the deployment of the right technology architecture and capabilities should be clear (Barton and Court, 2012). The lack of buy-in by management is one of the biggest risk factors when implementing new innovations (Dekroon and Karp, 2013).

The culture of a company must support the use of new technologies in order to let data analytics increase the quality or the efficiency of the audit (Martens et.al. 2008). An audit support system is key to new technologies increasing the effectiveness and efficiency of the audits. The support from the top of the company and the managers is essential in making new technologies a success. Moreover, according to research, new technologies must be enforced within the audit in order to make auditors use the new technologies (Dowling and Leech, 2007). The acceptance by the staff of an audit firm can be reached by a clear strategy and a supporting culture. Furthermore, audit guidelines from the top of the company should be in place (O'reilly, 2006).

Research found that junior staff accepts audit automation more readily than senior staff. So there should be more focus on getting the senior staff to support innovations and new technologies (Manson et.al., 2000). In a survey study conducted, a significant part of the partners interviewed mentioned that there would have to be a change in mindset to make sure new audit technologies would work (Searcy et.al., 2003).

5.3.4 AUDIT FIRM STRUCTURE

Within audit companies there is generally a departmental focus. It is important for the board of an audit firm to make sure that the interest of the departments are aligned when implementing data analytics (Russom, 2011).

Analytic applications are departmental by nature. An analytic solution is focused on specific data domains and companies. It is important to make sure that everyone who can profit

from certain solutions is well acquainted with that solution. In addition to that, the danger of departments owning their own data analytics platform is a serious problem that should be considered (Russom, 2011). The aligning of interest is important to make sure that new audit methods will work (Russom, 2011). Next to that, the support of a new technology with organizational and technical infrastructure to support system usage is important (Janvrin et.al., 2008).

As mentioned before, the upfront investment is a significant barrier for using data analytics. The company structure does not support the use of data analytics because of the cost allocation possibilities (Banker et.al., 2002).. The upfront investment is fully allocated in the first year. The investment in hard- and software is the main part of the investment and if the cost could be allocated differently it would become easier to invest in new audit technologies like data analytics (Banker et.al., 2002).

5.3.5 WILLINGNESS TO INNOVATE

After the scandals such as Enron, the auditing standards and guidelines have placed a greater emphasis on auditors being sceptical (Elliot and Elliot, 2011). Auditors are by nature not willing to change and innovate. In order to let data analytics work there must be the willingness to innovate (Vasarhelyi and Alles, 2006). Managers within audit companies are by nature risk averse and the majority is content to leave a current level of investment in new technologies unchanged (Hunton et.al., 2006). Moreover, 15% of the managers said that their unwillingness to innovate is the biggest reason for not investing in data analytics (Auditnet, 2012).

The partners are sometimes not willing to invest because they are not familiar with new technologies. The resistance comes in most cases from the older generation of partners. As mentioned before, the younger staff is more familiar with computers in comparison with the older staff. This causes the junior staff to know more about the new working methods than the older staff which may cause some resistance to implement new working methods (Manson et.al., 2000).

The disability to create the willingness to innovate can cause threats. Innovative behavior depends on organizational resources and their deployment and their deployment via managerial action (Horsthuis et.al.,2012).

Auditor's acceptance and willingness to invest are often driven by firm resources and individual user perceptions. The willingness to invest is linked to the acceptance of a technique. According to the unified technology acceptance and use of technology theory (UTAUT), there are four factors that influence users acceptance: (1) the expectation users hold regarding how the system will improve their performance, (2) the degree of effort users believe will be needed to use the new systems, (3) the extent to which users perceive that individuals important to them encourage system usage, and (4) the expectation users hold regarding the existence of an organizational and technical infrastructure to support system usage (Janvrin et.al., 2008). This model shows the importance of the acceptance of auditors in order use data analytics and have the willingness to innovate.

5.4 ACCEPTANCE BY CLIENT

5.4.1 IT CULTURE

New information technologies or systems represent innovations used for a certain group or client group. The perception about the usability of innovation has a significant influence on user's acceptance (Agarwal & Prasad. 1997). There are three critical factors of project success: (1) clear mission, (2) top management support and (3) client acceptance. It was found that client acceptance was an explanatory success factor during the planning and the execution stages of a project. It shows the importance of getting the client to accept your new working methods, otherwise the implementation of data analytics might not work as good as expected (Pinto and Prescott, 1988). In a survey study performed in 2003, 22 percent of the partners indicated that changing the mindset of the client is the most important challenge when it comes to new working methods (Searcy et.al., 2003).

As mentioned before, the inability to create the willingness to innovate can cause threats to innovation in construction. Innovative behavior depends on organizational resources and their deployment and their deployment via managerial action. A lack of willingness to innovate within the client company can cause a lack of eagerness which leads to acceptance problems (Horsthuis et.al.,2012).

According to innovation theory the early majority is risk averse and not willing to try new working methods. In addition to that, only a small group of companies can be identified as early adopters of innovation. This means that the majority of the companies are not technically focused which would cause a lack of eagerness to try new working methods

(Kuo et.al., 2013).

5.4.2 DATA SECURITY AND PRIVACY

Giving auditors access to the databases of the client makes the database automatically more insecure. Data integrity and security is maintained by getting data out of IT systems without human intervention (Vasarhelyi et.al., 2012). Ensuring the security of sensitive data is yet another question that deserves future research and investigation (Liu and Vasarhelyi, 2014). When data accessibility increases the concerns such as data security and privacy attract progressively more attention.

During the transfer to the audit company data should not be open to possible modification, in order to maintain data security. The IT environment must be secure in order to make clients accept the use of data analytics. The security of working methods and systems is highly important in the acceptance of the client for the use of data analytics (Nelson et.al., 2000). After the crisis with Enron and Worldcom, not only the accuracy of the financial statements were questioned, but also concerns have risen about the privacy and security of information technology systems. When the systems are not safe the security and privacy of the data are in serious doubt (Alles et.al., 2006).

In the last years theft of computerized records has increased with an alarming rate. Despite all the attention around the security of data, the risk of breaches is likely to get worse. According to a study on 538 US companies conducted by the Ponemon institute, 28% of the digital security breaches occurred remotely among mobile workforces. Which makes the concern about data security for audit firms and their clients even higher because audit firms mainly work with mobile workforces. The data security and data privacy policies and procedures are in place, but audit companies did not adequately prepare themselves for new types of attacks (PwC, 2012).

5.5 DATA EXTRACTION

5.5.1 DATA MANAGEMENT

A lack of data management causes the ownership of data not always to be clear. Clarifying data ownership would improve access to data resources. The issue of data ownership is a problem within many companies (Evans, 2011; Loshin, 2001).

In an environment with proper data management the environment provides security services such as authentication of users and control over who is allowed to access the data. When proper data management is absent this could give problems accessing the data. The two basic requirements within data management are: (1) efficient data access, and (2) transfer of data. These requirements are both crucial for using data analytics (Allock et.al., 2002). When using new technologies there is an increasing interest in advanced data management systems (Schmidt et.al., 2002).

5.5.2 DATA STANDARDIZATION

The process of data access is one of the most important challenges in order to get auditors to use data analytics more often. Therefore the AICPA has published the Audit Data Standards (ADS). These standards are intended to provide a common data model and standard format, enabling an easier process of getting access to the data (Titera, 2013).

Solving the problem of implementing data analytics is one of the most important practical issues that needs to be resolved. A standard format for the files and fields typically needed to support audits of a given financial business process area is important to get data analytics to work (Verver, 2014).

According to Elliot (2002) introducing standardization into accounting data will make data much more accessible and consumable to decision makers. External auditors keep having a difficult time in obtaining digital data from businesses (Alles, et.al., 2012). Many companies are not thinking about adopting data standardization solutions like XBRL because of the high implementation cost and the lack of knowledge about data standardization (Grabski, et.al., 2011).

Data acquisition difficulties have stopped the application of advanced audit technology. Auditors face a challenge in accessing data because there are no standard requirements in place for data availability. Auditors do not have access to their client's databases, even when there are almost no hard copies left within a company (Zhang et.al.,2012). Guidance is needed to facilitate data acquisition in a standardized fashion (Vasarhelyi et.al., 2011). Once standardized audit data is available, an endless number of applications can be used to analyze data (Zhang et.al.,2012).

5.5.3 IT SYSTEM CLIENT

The use of data analytics relies heavily on the IT system of the clients. The data extraction must go smoothly in order to use modern audit techniques like data analytics. The challenge is to get data within a given timeframe, which depends on the tasks complexity and IT system complexity (Vasarhelyi et.al.,2009). It is important to understand that we have to deal with increasing IT complexity in the coming years (Cong and Romero, 2013)

Many auditors experience that clients possess poorly designed IT systems resulting in lost data, failed conversions and delayed identification of processing bugs. Most clients are likely to be terrified by the idea of surrendering control to the auditor when it comes to their IT systems (Kuhn & Sutton, 2010).

According to Zhao et.al. (2004) the use of modern data techniques comes with significant technical hurdles. The system of the client should be available and often this is difficult because of complex IT systems.

Inadequate and disparate client systems are the biggest problem when trying to get digitized data from the client from the standpoint of the auditor. There needs to be effective software to make sure that data can be easily extracted. There is a lack of tools that can easily extract data from the system of the client. Usually there are multiple systems within one company that make it difficult to extract the data swiftly from their systems (Searcy .et.al., 2003). Acquiring accounting data has always been a significant challenge, largely due to separate systems and reliance on ad hoc methods of extracting and validating data (Zhang et.al.,2012).

5.5.4 DATA RELIABILITY

The need to ensure reliability of data in information systems has been recognized for years already (Krishan et.al, 2005). The information to be audited must be generated from reliable systems, to ensure the reliability of data (Zhao et.al., 2004). Because of complex and poor IT systems as described in the last sub section the data reliability can be a problem. The most important question regarding the data is whether it is trustworthy (Zhang et.al.,2012). Within an experiment most auditors thought the data they received looked good and useful, but the study actually indicated that they had no way of knowing whether the data was accurate (Nelson et.al.,2000).

Increased complexity of IT systems can cause the estimations of the reliability of data to be a difficulty. Surveys done in 2005 indicated that 85% of the companies mentioned they should

increase the reliability of their IT systems. Moreover, data reliability should be improved. According to the literature, there are two problems with data quality. The first flaw is caused by the IS design and the second problem arises from operational flaws (Krishan et.al, 2005).

According to Wang and Strong (1996) many databases are not error-free and some even contain a large number of errors. Furthermore, according to this study 60 percent of the companies have problems with data quality. This shows that data quality and reliability are both important subjects and a problem for auditors.

5.6 IMPLEMENTATION

5.6.1 SOFTWARE

When you want auditors to use software for data analytics it should be easy to use. The software should be linked to the audit approach. It is important that the software is linked to audit questions and is capable of answering those questions (Searcy et.al., 2003). Only when the link between the software and the audit procedures is strong enough auditors will consider using the software. The software should be better in monitoring financial data and needs to be more robust. Furthermore, the software should also be flexible enough to be used at multiple clients (Searcy et.al., 2003).

A problem with most Computer Assisted Audit Tools (CAAT) is that they are not interchangeable. The lack of standardization leads to less use of such tools. This is also important for data analytics. All software tools for new modern audit techniques should have audit tool requirements which ensure the link to the audit software (Zhao et.al., 2004). The necessity to link the software to the audit approach is highly dependent on the end user ownership described in section 5.7.3.

According to Russom (2011) software is the missing link and one of the main barriers for using analytics. Software that is not linked to the questions by the end user is not usable (Gehrke and Wolf, 2010). In an article of Bell et.al., (2002) the success of software is not only dependent on the link with the audit process, but also on the link with working papers. Working papers lead the audit process and therefore the link between the software and the working papers is important (Alles et.al., 2004). The link between the audit and the software is the most important criteria for the choice to buy or use software (Sayana, 2003).

5.6.2 RESOURCES

Most businesses have too many projects but not enough resources to handle them properly. This can be because the management does not provide the necessary resources to achieve the goal or the management approves too many projects. Often there are not enough people or not enough competent people to complete projects. If you want to improve your product or service, the problem of scarce resources must be dealt with. In many projects there is not enough money or not enough people to complete a project. Another facet in cross functional teams includes genuine commitment of resources to the team by management (Cooper, 1999). This is a serious problem with the implementation of data analytics because the multidisciplinary collaboration is essential as mentioned in subsection 5.8.1. So the problem of having and allocating resources is even greater in cross functional teams.

The right use of resources is one of the most important dimensions of innovation (Senge, 1999). A report published by Oracle (2008) mentioned that scarce resources can be a serious problem, because they tend to block innovation. The report also mentioned that when only limited resources are available the resources should be focused on the high-risk areas and the most innovative projects (Oracle, 2008).

There are not enough auditors with knowledge about IT (Alles et.al., 2008). In addition to that, there are also not enough people who understand the audit practice and have knowledge about IT and data (Searcy et.al., 2003). Furthermore, the IT audit function of some companies is still in the initial state and only have a few resources and capabilities (Vasarhelyi et.al.,2012).

The investment in data analytics should be targeted to results and this is only possible when you allocate enough resources and this can be a problem (Alles et.al., 2008). The problems with resources are linked to the budget pressure problems mentioned in section 5.3.2. Budget pressure will arise when there is a scarcity of resources (Liyanatachchi and McNamara, 2007). But the lack of resources is a wider problem in comparison with the budget pressure of auditors described in section 5.3.2.

5.6.3 EXPERTISE

The ongoing development and implementation of automations like data analytics will likely lead to major transformations within audit companies. The transformation will involve the skill set of the external auditor and a change in knowledge base (Alles et.al., 2008). The

results of two experiments with IT development suggest that auditors have a lack of knowledge concerning IT applications (Rose et.al., 2012). The adoption of a new invention might be slow if the success depends on the costly acquisition of new and complex knowledge (Hall and Khan, 2003). The increasing importance of understanding IT implications by auditors, and of the development of IT skills to effectively measure information is a growing demand within the audit market (Hunton et.al., 2004).

In order to use new technology in the best way, auditors must have the skills to use IT and have the knowledge about data and IT (Vasarhelyi and Alles, 2006). An auditor should know about the technical details of the platform which he uses to perform his audit. The auditor needs to understand what data he needs and where these data can be found (Sayana, 2003). The auditors need to broaden their knowledge and have to be educated and trained to increase their knowledge about IT (Alles et.al., 2009; Kuhn and Sutton, 2010). Because most auditors today do not possess the skill set necessary to implement new audit techniques like data analytics this will be a serious barrier (Jans et.al., 2013).

According to partners of the big four, the audit team member's lack of skills/training causes problems when implementing innovative working techniques (Searcy et.al., 2003). Furthermore, the survey held by Auditnet endorses this fact. The lack of skills and knowledge about IT was mentioned by over 30 percent of the respondents as an obstacle.

In order for IT specialists to build software that increases the value of a specific audit, they should have knowledge about two dimensions of the audit engagement: (1) unique features of the client and its industry and (2) the basis of the audit approach (Bell et.al., 2002). You need enough competent people to make data analytics a part of the audit (Alles et.al.,2006) .

5.7 COLLABORATION

5.7.1 MULTIDISCIPLINARY COLLABORATION

Audits with any degree of complexity usually require the participation of specialists in tax, information technology, valuations or other fields. In the future an audit will not only be performed by financial auditors (Brynes et. al.,2014). Teamwork is critical in a public accounting firm as audit engagements are performed by a team composed of professionals at different ranks. With the use of technology the collaboration and communication within teams is even more important (Banker et.al., 2002). Moreover, the implementation of new IT solutions within a company is a complex and challenging task and the multidisciplinary

collaboration between the professional and the IT specialist is very important (Grabski et.al., 2011). IT specialists are individuals within an audit firm who have detailed knowledge in computer auditing (Janvrin et.al., 2008). The use of IT specialists in the process is more important if the IT that should be implemented becomes more complex. Therefore auditors should work together closely with IT specialists and other professionals during their audit when computer-related audit procedures are used (Janvrin et.al., 2009).

When financial auditors work together with IT specialists and IT auditors the audit team can focus on the financial audit, while the IT specialists and IT auditors focus on their specialist fields. This kind of collaboration is essential when we want to use new audit methodologies (Vasarhelyi et.al.2012). The degree of cooperation between financial audit and IT audit and collaboration between other compliance departments is also highly emphasized during the use of new techniques during the audit (Vasarhelyi et.al.,2009).

5.7.2 COMMUNICATION

According to Danos et.al (1989) the communication of specialized knowledge with people outside the audit profession is a problem. But the communication with all stakeholders involved is essential for the succeeding of data analytics. The knowledge gap between the IT specialist and the auditor is large and therefore proper communication between those groups is crucial (Barton and Court, 2012).

The communication of auditors with the IT specialist is essential because the IT specialist has no in depth knowledge about the financial audit like the financial auditor (Carmichael, 2004). There is a lack of communication between IT specialists and financial auditors (Janvrin et.al.,2008). This is the reason for using high powered teams with multiple stakeholders. The communication between the end user and the IT specialist who builds the software is essential (Alles et.al., 2008)

5.7.3 END USER OWNERSHIP

The start of an innovation are audit requirements (Teeter and Brennan, 2008). Pre- existing audit procedures can be used as a starting point to determine which audit procedures can be done with data analytics (Chan and Vasarhelyi, 2011). Auditors need to have a clear view on what you want to accomplish with automation (Alles et.al., 2008). Through a whole process of innovation the feedback from managers, the auditors and researchers is important. In

using feedback provided by auditors the IT specialists can provide better software solutions (Teeter and Brennan, 2008).

Describing how data analytics fits into the audit model including when, where and how it might be used is one of the most important steps that needs to be taken. This shows that the building of software should start and end with the auditors. Auditors should be responsible for the requirements set for data analytics software (Tirtera, 2013).

According to the UTAUT model that was described earlier, one of the factors that leads to auditors accepting a new technology is that a system improves their performance. In order to make sure data analytics increases the performance auditors must be leading in the process of building/ choosing software (Janvrin et.al.,2008).

The most common challenge at the start of using data analytics is to get auditors to think along and getting them to set the requirements (ACL,2013). The auditor should generally be involved in designing the systems to ensure that the application includes his or her criteria (Zhao et.al., 2004).

5.8 JUSTIFICATION

5.8.1 AUDIT STANDARDS

In the USA, the use of modern audit techniques is recommended by the PCAOB. The audit standards advice auditors to examine the extent of IT in the year-end financial reporting (Janvrin, 2009). According to the SAS No.94, assessing the control risks at maximum and relying only on substantive testing may not be effective enough to give an opinion (AIPCA, 2001). So auditors need to innovate and look for new methods to support the audit (AIPCA, 2001).

The restructuring and conceptualizing of accounting and auditing drives the efforts of standard setting in the future information environment. Consequently, much of the effort by standard setters is focused on clarification of the original rules. Therefore a drastic change toward the formalization is needed (Moffitt and Vasarhelyi, 2013). The nature of audit evidence changes. An entire new generation of measurement possibilities has arisen. Vasarhelyi and Alles (2006) propose technologically based standards aimed at taking advantage of new IT developments.

According to Zhang and colleagues (2012) the audit standards are regulatory driven and do not promote evolution of the audit practice. Without open access to data and more progressive standards the modern audit techniques could become disconnected from the rest of the audit process. The changes that should be made to the standards for the purpose of data analytics should make the standards scalable, dynamic and usable by all parties interested in data analytics. Auditing tools must be linked to the audit standards, otherwise they provide little value to the audit process (Zhang, et.al., 2012).

In order to increase the value of the audit through data analytics, audit standards should be revised. Until the auditing standards are updated, there is little incentive for an auditor to use data analytics. Revising standards should also include removing standards that are no longer applicable. Ideal would be to have a global set of standards concerning data analytics (Titera, 2013). Until now no IT standards have been developed specifically with the financial audit in mind (Alles et.al.,2012). Reporting standards have failed to keep pace with users increasing sophistication or the power of technology (Vasarhelyi and Alles, 2006).

5.8.2 INFORMATION OVERLOAD

According to Keim et. al. (2008) the information overload problem is the danger of getting lost in the data. There are three types of information overload: (1) irrelevant to the current task at hand, (2) processed in an inappropriate way or (3) presented in an inappropriate way.

The information overload causes time and money waste and is an important topic to consider when using new ways of analysis (Keim et.al., 2008). A method or model that cannot turn data into reliable and provable knowledge cannot overcome the information overload problem. The information overload problems create an ''alarm flood'' of data which can cause problems in processing this data (Kuhn & Sutton, 2010). Data analytics can drill down into details of the whole population, creating new insights and evidence (Titera, 2013).

Corporate use of data has evolved dramatically towards much larger data sets. The theory and the standard setters must recognize the change in nature of the data captured, the volume of data, and the different types of data (Moffitt and Vasarhelyi, 2013).

5.9 REGULATORY ENVIRONMENT

5.9.1 REGULATORY REVIEW

Each audit can be reviewed by the authority that supervises the audit profession. In the AFM report issued September 2014, the use of data analytics was mentioned. Data analytics was used to check the fairness and completeness of the revenue of a pension fund. With the use of data analytics more audit evidence was created. Although data analytics was used, the conclusion was that the auditor had not performed an audit that was sufficient enough to pass the inspection, because there was a lack of research on the extra audit evidence that was created (AFM, 2014).

A new technology rich environment can significantly influence how auditors meet their objectives. When new audit techniques are introduced it is not uncommon that auditors struggle with the justification of these methods (Pathak and Lind, 2007).

The Sarbanes- Oxley act (2002) emphasized the need for more frequent reporting and restoring public faith in financial statements. The importance of quality documentation and files is greatly emphasized since. Auditors think that it is easier to have a high quality of documentation with traditional audit techniques. The regulatory authorities should not block innovation and give room for techniques that support continuous assurance (Alles et.al., 2004).

In 2004 there was a lack of tertiary monitoring (in other words: the audit of the audit). In order to restore the lakc of tertiary monitoring the regulatory authorities, like the PCAOB and the AFM, started to perform more and stricter tertiary monitoring which lead to the supervisor sometimes blocking innovation (Alles et.al., 2004).

5.9.2 GUIDANCE/ SUPPORT REGULATORY AUTHORITIES

Data analytics increases the opportunities for automatically auditing corporate accounting information through data centralization and direct access to transaction details. The AICPA has encouraged the use of modern techniques like data analytics. The support of the AICPA gave incentive to use more modern audit techniques (Grabski et.al.,2011). During 2014 the AICPA published a white paper with opportunities of data analytics together with the justification from the audit standards. This gives auditors a clue on how to justify their use of data analytics (Byrnes et.al., 2014).

A lack of guidance in the past made it impossible for auditors to know where new techniques fit into their procedures. A lack of guidance on the documentation caused auditors not to use modern audit techniques. The guidance and support provided by the AICPA filled a gap that was there in the past (Pathak and Lind, 2007).

SAS No.94 alerts auditors that assessing control risks at maximum and relying only on substantive testing might not be enough. Auditors are advised to consider using computer-related audit procedures during the planning of the audit and the audit by the AICPA (Janvrin et.al., 2009).

An absence of guidance and support by regulatory authorities can cause auditors not to use modern techniques like data analytics. There should be worked for a more in-depth analysis on the justification of data analytics. Creating a guide that would promote the use of data analysis as an efficient and effective audit technique (Titera, 2013).

5.10 SUCCESS STORY

Although in the business world the use of IT has grown exponentially, the extent to which auditors have adopted IT remains an empirical question according to Janvrin and colleagues (2008). Best practices in which computer assisted auditing techniques were used during the audit and reviewed positively by regulators and standards setters are not available (Janvrin et.al. 2008). Skeptics always ask for evidence that shows that a new working method will increase their business performance (McAfee and Brunjolfsson, 2012).

In order to make people use data analytics they have to have a positive expectation of the use of data analytics. They must expect that their performance will improve when they use data analytics. The lack of success stories makes it difficult to create positive performance expectancy (Janvrin et.al. 2008).

According to Chiu and colleagues (2014) the implementation experiences of other auditors are important to auditors. The sharing of best practices and successful implementation is key in getting auditors to use new techniques (Chiu et.al., 2014). Even very experienced auditors differ about how procedures must be carried out in practice. Which points to a different interpretation of practices which support the need of a common definition of success stories (Alles et.al., 2009).

6. MODEL

6.1 INTRODUCTION

This chapter consists of two sections. The first section describes the result of the constant comparative analysis, combining the interview results and the literature review. Concepts will be grounded, based on the criteria described in chapter two of this study.

In section 6.3 the model and the process of selective coding are presented. The model was based on the propositions deduced from the interviews and the literature. The propositions described in section 6.3 are part of step six of the research method as described in section 2.3. Furthermore the relationships between the categories were the main subject of discussion during the review session describe in section 2.3 step nine.

6.2 CONSTANT COMPARATIVE ANALYSIS

In this paragraph the concepts are tested based on the grounding specifications as described in paragraph 2.3 in order to see if concepts will be grounded. This paragraph is part of step six of the research design.

As described in section 2.3 step six of the research design, in order to declare a concept grounded: (1) It has to be mentioned during the interviews with auditors, (2) validated in the literature review, and (3) by at least two other interest groups.

All the concepts have been declared grounded based on the interviews and literature. All concepts were mentioned by the auditors and validated with technical literature. This is shown in table six.

The concepts data reliability, willingness to innovate, awareness of possibilities, upfront investment, multidisciplinary collaboration, expertise and company culture/strategy were mentioned by all the interest groups and also validated by the technical literature. This is shown in table six. Therefore these concepts are declared grounded.

All other concepts except data standardization were mentioned by at least two other interest groups (table six). Not all interest groups are involved in the complete process of implementing data analytics during the audit, therefore it is not surprising that not all concepts were mentioned by all interest groups.

The concept of data standardization was only mentioned by the auditors and the IT specialists which is not enough to be declared grounded. However, data standardization is a

highly recognized topic in the academic literature and the main barrier that is recognized by the AICPA. Moreover the IT specialists and the auditors are both closely involved in the extraction of the data and are therefore the two interest groups that experience the problems related to data standardization.The other interest groups did not mention data standardization because they are not involved in software implementation of data analytics in the audit. Therefore data standardization will be declared grounded, because the barrier was mentioned by the interest groups that are most likely to experience the barrier of data standardization and also because the AICPA recognizes this barrier as one of the more important barriers.

Concepts/ Interest groups	Auditors	Policy makers	IT specialists	Marketers	Researchers	Clients	Literature	Grounded
Awareness of possibilities	X	X	X	X	X	X	X	√
Upfront investment	X	X	X	X	X	X	X	√
Budget pressure auditors	X	X	X	X	X		X	√
Company culture/ strategy	X	X	X	X	X	X	X	√
Company structure	X	X	X		X		X	√
Willingness to innovate	X	X	X	X	X	X	X	√
IT Culture	X	X	X	X	X	X	X	√
Data security/ privacy	X	X			X	X	X	√
Data management	X	X	X				X	√
Data standardization	X		X				X	√
IT system client	X	X	X		X	X	X	√
Data reliability	X	X	X	X	X	X	X	√
Software	X	X	X			X	X	√
Resources	X	X	X		X	X	X	√
Expertise	X	X	X	X	X	X	X	√
Multidisciplinary collaboration	X	X	X	X	X	X	X	√
Communication	X	X	X		X	X	X	√
End user ownership	X	X	X		X	X	X	√

Audit standards	X	X	X		X		X	√
Information overload	X	X	X				X	√
Regulatory overview	X	X	X	X	X		X	√
Guidance/ support regulatory authorities	X	X	X		X		X	√
Complete success story	X	X	X	X	X		X	√

Table 6: Constant comparative analysis

6.3 MODEL

This section shows the process of selective coding. Selective coding is the integration of the categories that have been developed into a model (Pandit, 1996). Propositions are made in order to link the different categories. The categories formulated during this study can be found in paragraph 4.3. The selective coding is visually displayed in figure 3 (page 20). This paragraph describes the last part of step six of the research design as described in paragraph 2.3.

In chapter four, 23 concepts were described and summarized into nine covering categories which were the results of the nineteen interviews performed. In chapter five all the concepts underlying the categories were validated and all concepts have been declared grounded.

The model presented has been named the Data Analytics Auditors Acceptance Model (DAAAM).The model, shown in figure five, describes the categories of barriers that need to be attended before data analytics can be successfully implemented by auditors. The categories are connected with lines. The lines were chosen to show the propositions between all barriers. Although, all barriers are connected and should be solved, the processes underlying the barriers are performed simultaneously. Although an audit company could first create awareness and solve the barriers one by one, it is more likely that problems regarding awareness are connected to a lack of a complete success story. This is just one example of how the categories are connected. The visualization was reviewed with two senior managers who were part of the interview panel.

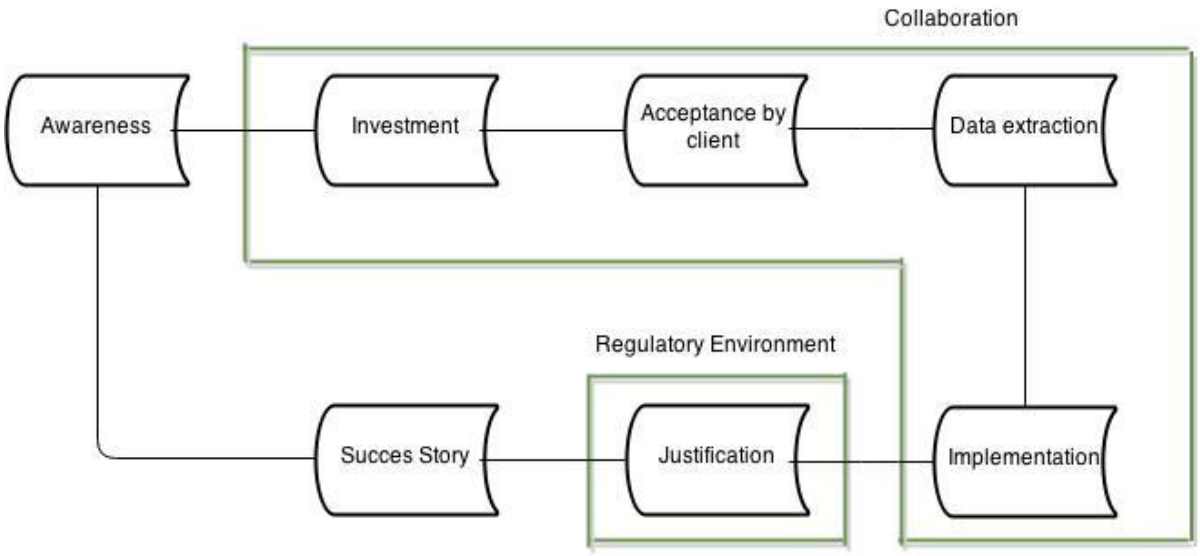

Figure 5: Data Analytics Auditors Acceptance Model (DAAAM)

The different parts of the model are shortly described below:

- Awareness

As can be seen in figure five the first barrier that should be solved is the barrier that describes the awareness of the possibilities and chances that data analytics can provide. All the practical possibilities that data analytics can provide should be known by an auditor before he/she will use data analytics.

- Investment

When auditors are aware of the possibilities they must be willing to invest. In order to make sure that auditors will invest in the use of data analytics a supporting company culture/strategy and structure is needed. In addition to the company characteristics, auditors also feel that the budget pressure and the upfront investment are barriers that should be overcome. Lastly, auditors must be willing to innovate. If these barriers are taken away the investment will no longer be a barrier.

- Acceptance by client

When auditors are aware of the possibilities and can invest in the use of data analytics the acceptance of the client is the next challenge to implement data analytics successfully. The client must accept the use of data analytics, otherwise it will be difficult for an auditor to use

data analytics. Data security and privacy together with the innovation and IT culture of the client can be reasons for the client not to fully accept the use of data analytics.

- Data extraction

Data extraction is not per definition a barrier that auditors will experience, but the effect of problems regarding data extraction are a barrier that the auditor will experience. A lack of data management at the client makes it difficult to extract data from the client database. The IT systems of the clients can be an obstacle because client can have complex IT systems which makes it difficult to extract data within a given time frame. Furthermore, the lack of data standardization and difficulties in confirming the reliability of data can be serious barriers.

- Implementation

During the implementation of data analytics in the audit there are different barriers that a auditor will have to face. The software might not answer audit question. Resources are scarce and auditors lack expertise about IT and data by auditors. The IT specialists lack expertise regarding the audit.

- Collaboration

The lack of collaboration is a barrier that is named by all the interest groups and the academic literature. Lack of communication and multidisciplinary collaboration leads to the failure of the implementation of data analytics. Moreover, the auditor should leading the process of developing the software in order to get software that supports the audit and answers audit questions. The collaboration is important to make sure that auditors will invest and that the client will accept the use of data analytics. Next to that when the data is extracted from the client and the software is implemented within an audit firm the collaboration is important.

- Justification

Auditors have a difficult time justifying their use of data analytics. They do not know how the use of data analytics fits into the audit standards that they have to follow and they are also unsure what to do with new and more audit evidence that data analytics will provide. The justification is part of the regulatory environment of the auditors. This environment also causes some barriers. This is described in the next paragraph.

- Regulatory environment

The audit profession is a regulated profession and auditors find it easier to pass their regulatory review without the use of data analytics. This holds back innovation and the use of data analytics. In addition to that, a lack of guidance and support by the regulatory authorities leads to auditors not trying new audit methods like data analytics.

- Success story

There is not a complete success story or at least auditors do not know any complete success stories. According to the interview panel and the literature review auditors need a complete success story to start using data analytics. Furthermore, all stakeholders involved in the process of implementing data analytics should have an equal understanding of what a complete success story is.

7. CONCLUSION

7.1 INTRODUCTION

In this last chapter the sub questions of this study will be answered in section 7.2. In section 7.3 the research question of this study will be answered. Section 7.4 provides limitations of this research. Lastly, section 7.5 the possibilities for future research are addressed.

7.2 SUB QUESTIONS

1. *What is data analytics in the context of an audit procedure?*

The answer to this question has been described in chapter three. Data analytics is defined as the computer-assisted examination of information underlying financial statements or other subject matter being audited. It can be used during all four types of procedures during the audit. Data analytics is a technique that can provide evidence that cannot be attained without the use of technology.

2. *Which stakeholders can be identified for the use of data analytics during the audit?*

This question has been answered with the contemporary approach of Shelly in chapter three. The stakeholders identified were employees, managers and the board within the audit firm. In addition to that the partners are identified as stakeholders. Moreover, the government/ regulatory authorities are also identified as stakeholder. The IT department is specifically named as stakeholder. The client is in this process of the implementation of a new audit technique also identified as stakeholder. The last group identified was based on a report of the CAQ and this group consist of the academia.

3. *Which barriers are identified by different interest groups?*

During this study the barriers found were explained in chapter four. The different interest groups named different barriers which were often related to their positioning within the process of implementing data analytics in the audit. Below table provides an overview ofall the barriers that were found. The barriers are described and clustered into covering categories in chapter four. The categories are the main building blocks for the model presented within this study.

Overview concepts:	-	--
Awareness of possibilities	Data Management	Communication
Upfront investment	Data Standardization	End user ownership
Budget pressure auditors	IT system client	Audit standards
Company culture/strategy	Data reliability	Information overload
Company Structure	Software	Regulatory review
Willingness to innovate	Resources	Guidance/ Support regulatory authorities
IT culture	Expertise	Complete success story
Data security/privacy	Multidisciplinary collaboration	

Table 7: Overview barriers

4. *What barriers can be found in existing academic and professional literature on the use of data analytics during the audit?*

All the barriers found in the interviews are validated with academic and professional literature. The barriers that were validated with academic literature about data analytics, were audit standards and data standardization. The validation of the other concepts was done with other academic and professional literature mostly concerning other IT related audit initiatives. The qualitative and exploratory character of this study made it necessary to validate most of the concepts with literature not directly issuing problems relating to data analytics.

7.3 RESEARCH QUESTION

The research question of this study was:

Which barriers can be identified for the successful implementation of data analytics during the audit?

In order to make sure auditors use data analytics, auditors should be aware of the possibilities of data analytics and should be willing to make the investment that is needed to implement data analytics. Furthermore, the client must accept the use of data analytics and it must be possible to extract the data from the system of the client. During the implementation the software must answer the right questions and there must be enough resources and expertise to make sure data analytics can be used. Collaboration between different stakeholders is very important in order to make sure the investment is done, the client will accept the use of data analytics, the data is extracted properly and the implementation is done well. The justification is a barrier that should be solved before auditors will use data analytics. Auditors must know how to document the use of data analytics and whether data analytics is in line with their audit standards. Lastly, auditors need a complete success story which consist of successful use of data analytics and the right justification.

7.4 LIMITATIONS

The first limitation of this study is the lack of specific academic literature about data analytics. Because of a lack of academic literature, lots of academic studies regarding other IT related audit subjects were used. Although the use of literature regarding other subjects is in line with the exploratory character of this study it is still a limitation that should be kept in mind while reading this study.

A second limitation is that all the members of the interview panel are practitioners in the Netherlands. Because of that this study might only be applicable in the Netherlands. Many of the barriers were validated with international literature, but the whole model might not have high external validity. The findings cannot be extended to wider populations with the same degree of certainty as quantitative research could do.

The third limitation is that this study only proofs evidence that barriers exist, but not how often those barriers are a problem in practice. Future research is necessary to quantify the barriers that were presented in this study.

7.5 FUTURE RESEARCH

There is a serious lack of quantitative research. The barriers found should be quantified and researched with quantitative research. The most important barriers that could be subject to future research are the barriers identified by all the interest groups. Furthermore future research can also research possible solutions for the identified barriers.

Furthermore, there should be quantitative research performed to provide evidence of the statements made in many articles, that the use of data analytics and other new audit techniques will improve the quality or the efficiency of the audit.

The justification is also a possible topic for future research. There should be research that provides auditors with more guidance on how data analytics fit within audit standards. This would guide auditors to change their documentation and use data analytics more often.

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APPENDIX A: INTERVIEW PROTOCOL

Interview protocol

During the interview it will be important to speak about all the possible angles of data analytics. The interview will be semi-structured. Below I will present questions that could be asked. Also the possible angles and subjects within data analytics in the audit will be displayed. It will be important however to allow new ideas to be brought up during the interview. This is important because of the exploratory nature of my research.

The following topics could be discussed during the interview: software, data, IT knowledge, Client acceptance, Auditor acceptance, Client size, Regulations & audit standards, Incentives, tone at the top (implementation strategy, guidance), Responsibility, resources, efficiency vs quality.

I will interview different stakeholders who will all have a different position in the process of implementing data analytics in the audit. Therefore the formulation of questions will be different when interviewing different stakeholders. The questions as provided below are intended for the interviews with auditors.

Introduction of the interview:

Definition: Audit Data Analytics is defined as the computer-assisted examination of information underlying financial statements or other subject matter being audited.

According to the academic literature data analytics in the audit is a technique that can support the audit, particularly through providing audit evidence. According to William Titera it can be positioned between analytical review procedures and test of details.

Analytical review: Analytical procedures are evaluations of financial information through analysis of plausible relationships among financial and nonfinancial data.

Test of details: focuses on the ending general ledger balances for both balance sheet and income statements accounts.

Question 1. Do you agree with the definition and the positioning of William Titera (technique or procedure)?

Question 2. Tell me about your experience with data analytics?

Question 3. Who are the stakeholders in the process of implementing data analytics during the substantive testing (primary and secondary stakeholders)?

Question 4. Have you used data analytics during the audit? If yes, why and when have you used it for the first time? If no. Why not.

Question 5. Which considerations are important when we talk about the client and the use of data analytics?

Question 6. Is the use of data analytics initiated by the client or the auditor?

Question 7. Have you ever spoken to a client about using data analytics during the audit?

Question 8. Could data analytics be appropriate for every client?

Question 9. Do you think the stakeholders are aware of all the possibilities that data analytics can provide?

Question 10. Do auditors have enough knowledge about data/ IT knowledge to use data analytics during the audit?

Question 11. Would you feel comfortable using data analytics during substantive testing?

Question 12. Does the use of data analytics during the audit feel like an extra responsibly?

Question 13. Is the use of data analytics during the audit in line with audit standards/guidelines?

Question 14. Is the software for data analytics in line with your expectations and wishes?

Question 15. Is all the data needed to use data analytics accessible for auditors?

Question 16. What are the barriers for the use of data analytics during the audit?

Question 17. Have you ever spoken with an IT specialist about the use of data analytics?

Question 18. Does anyone in your company recommend/support the use data analytics?

Question 19. Is there enough guidance from upper management to support the use of data analytics (guidelines, instructions)?

Question 20. When did you first hear of the possibility to use data analytics and in what way did you receive that information?

Question 21. Should accounting firms develop their own data analytics applications?

Question 22. Do you actively consider data analytics in every audit?

Question 23. Statement: Before auditors are going to use data analytics the use must increase the efficiency of the audit. Do you agree with this statement?

Question 24. Is there anything else you would like to say about barriers that might prevent auditors from using data analytics?

APPENDIX B: INTERVIEW DATA

Interview summary	Citation	Barrier
ABS1	Most Clients don't know that it is possible to use data analytics for audit purposes	IT culture
ABS1	There are frontrunners and followers when it comes to data analytics. And followers first want to see success stories before implementing data analytics in their audit.	Complete success story
ABS1	Not everybody knows for what purposes data analytics can be used	Expertise
ABS1	There is no uniform definition of data analytics and nobody is aware of the possibilities There should come a new way of looking at the audit.	Company culture/strategy
ABS1	Auditors have Lack data- and IT knowledge to make good use of data analytics.	Expertise
ABS1	The interpretation of COS/regulations by the Big four does not support the use of data analytics	Audit standards
ABS1	It is hard to describe and justify the use of data analytics in you audit files	Regulatory review
ABS1	No frames for a data analytics application (regulation/government)	Guidance regulatory authorities
ABS1	Auditors are risk averse. Doing something new is not our nature.	Willingness to innovate
ABS1	Auditors lack IT knowledge to justify their use of data analytics	Expertise
ABS1	Wrong implementation strategy for the use by audit firm (push strategy)	Company culture/strategy
ABS1	Accessibility of data is something that should be worked for. An auditor must have knowledge about data in order to know which data should be used.	Expertise
ABS1	The big question is: is the data trustworthy?	Data reliability
ABS1	You must understand what happens because an auditor has to take the responsibility for the use of data analytics.	Expertise
ABS1	Lack of IT auditors, not enough people in order to satisfy the need	Resources
ABS1	You must change the software for every client and use	Software
ABS1	Data reliability is an important topic	Data reliability
ABS1	A barrier is cost. The understanding of all processes and data is expensive.	upfront investment

ABS1	There is a big investment without the assurance of being a success	Complete success story
ABS1	Lack of efficiency to use it for more clients	upfront investment
ABS1	There could be a problem with the tone at the top at other audit firms. Not enough support from partners and directors. Support this with example of winning customers when presenting data analytics as a part of the audit	Willingness to innovate
ABS1	Misunderstanding of the use of different forms of analytics. Because of wrong implementation strategy.	Awareness of possibilities
ABS1	Auditors are conservative in order to be sure to overcome AFM reviews	Regulatory review
ABS1	Lack of knowledge about the applications and purposes of data analytics	Awareness of possibilities
ABS1	Enough time and people must be available within an audit firm	Resources
ABS1	Multidisciplinary collaboration is important in order to let data analytics	Multidisciplinary collaboration
MBS1	Strange that data analytics is not a part of your academic study	Expertise
MBS1	There must be awareness of the chances that data analytics can provide	Awareness of possibilities
MBS1	Not everybody blindly believes the positive effect of data analytics	Complete success story
MBS1	No uniform use of data analytics, which makes that something that adds value for one party, does not add value to other parties	Awareness of possibilities
MBS1	Not everybody knows that we can get an extra advantage with data analytics	Complete success story
MBS1	Auditors do not actively consider data analytics	Awareness of possibilities
MBS1	Auditors are introvert and have another look in comparison with consultants	Willingness to innovate
MBS1	The culture has to change in order to make sure auditors will use data analytics more often	Company culture/strategy
MBS1	People must be willing to use data analytics	Willingness to innovate
RUP1	There is a lack of quantitative research when it comes to data analytics	Complete success story

RUP1	A gap between academic research and practice in the understanding of data analytics	Expertise
RUP1	There is a lack of education about data analytics	Expertise
RUP1	Biggest Barrier is people and a lack of skills. People must have the skills to work or start working with data analytics and this starts with the education of new auditors	Resources/ Expertise
RUP1	People don't know what tools can do and how they can use those tools	Awareness of possibilities
RUP1	Auditors don't know if the use of data analytics is in line with ISA	Audit standards
RUP1	Clients want to know if there data is safe	Data security
RUP1	Accessibility of data should not be underestimated	IT system client
RUP1	Audit profession has too much of an internal view	Willingness to innovate
RUP1	A lack of knowledge in how to use data analytics and when to use data analytics	Awareness of possibilities
RUP1	Not knowing where data analytics can fit into the regulations and guidelines	Regulatory review/ audit standards
RUP1	A barrier could be time, because it takes time to innovate.	Budget pressure auditors
RUP1	Also the culture has to change to make sure that people will use data analytics in the future.	Company culture/strategy
ABD1	The use of data analytics was not widely known	Awareness of possibilities
ABD1	You have to think carefully about how to use data analytics, in such a way that it helps your audit. It starts with thinking about what risks you want to check	End user ownership
ABD1	You have to think about data and how can we use the data and how can we use data analytics. There was a lack of thinking from a data standpoint in the past.	Expertise
ABD1	Audit was not linked to the technology and IT specialist were building tools that were not helpful for auditors. There was a disconnection between these two groups	Multidisciplinary collaboration
ABD1	Audit is now leading in the process of building software and guiding the process of getting helpful tools for the audit. This is something that was absent in the past.	End user ownership
ABD1	You have to understand something of IT applications	Expertise
ABD1	Auditors have to understand that data analytics is not more than a bigger analysis that was in the past performed in excel	Company culture/strategy

ABD1	There is a challenge for auditors, because of budget pressure and lack of time, there might be no chance to innovate	Budget pressure auditors
ABD1	It can cost up to 25% of you budget and it a big investment. This is a barrier for some people	Budget pressure auditors
ABD1	Not everybody wants to be a frontrunner of data analytics, they want to use it if there are success stories	Complete success story
ABD1	Auditors need results/ success stories in order to get auditors to use the data analytics during the audit.	Complete success story
ABD1	The software did not add value to the audit in the past	Software
ABD1	And the investment is a barrier	upfront investment
ABD1	When people were in a failed pilot they will be skeptical	Willingness to innovate
ABD1	Everybody has his own names for example an invoice, it must be possible to map this to your software to use data analytics	Data standardization
ABD1	There is a lack of standardized solutions for work that we have to perform in every audit.	Software
ABD1	The implementation strategy is always important	Companny culture/strategy
ABD1	People might not be willing to use it at this moment because they are passive for change	Willingness to innovate
ABD1	Data analytics makes you a better interlocutor	Awareness of possibilities
ABD1	Multidisciplinary collaboration is the biggest step forward and this was absent in the past	Multidisciplinary collaboration
ABD1	As an audit firm you cannot close your eyes for new technological applications, there is no choice we have to change. We have to see the possibility data analytics and other IT related innovations.	Awareness of possibilities
ABD1	The implementation cost are too high to use data analytics in your whole client portfolio	upfront investment
ABD1	There is much work what we do every audit. So that needs to be standardized.	Software
ABD1	We have to transform the data of the client to our own data model and that can be hard	Data standardization
ABD1	You need IT auditors in order to perform the audit, to check the safety of databases	Resources
ABD1	Auditors need to know how to extract data	Expertise

ABD1	We have to make sure that the data we ask for is complete. Also getting data securely from the client is very important	Data security
ABD1	Every time data analytics is used it is client specific. And this increases the investment	Software
ABD1	Resources is always a problem. So we have to choose carefully in what audits we use data analytics.	Resources
ABD1	The audit standards are outdated, they should be changed with all the current IT developments	Audit standards
ABD1	We don't know if data can be audit evidence according to the audit standards	Audit standards
ABD1	Auditors have to know that the data is trustworthy	Data reliability
ABD1	Auditors have to widen their focus to see the chances of data analytics	Willingness to innovate
ABD1	We have to make sure that we can explain why our audit with the use of data analytics is reliable.	Regulatory review
ABD1	There will be new forms of evidence and we have to think about how are we going to process the new forms of evidence	Guidance regulatory authorities
ABD1	COS guidelines must be changed to cover some important topics related to data analytics.	Audit standards
ABD1	The use of data analytics is an extra responsibility for some people, because they don't know how to justify the use	Regulatory review
PBP1	Companies could look at the risks that other similar companies reported using data analytics (addition to definition of Titera)	Awareness of possibilities
PBP1	The people who deliver the software are not stakeholders	End user ownership
PBP1	It is weird that audit does not deliver the audit analytics themselves	Multidisciplinary collaboration
PBP1	When you delegate certain tasks. There should be much attention to guiding the department that is going to perform that tasks for you	Communication
PBP1	Using analytics during the audit is such a big change, that it should not be underestimated	Company culture/strategy
PBP1	It is hard to delegate something that changes your work as much as data analytics does	End user ownership
PBP1	With the change that we are making. You should recruit other people with other skills and knowledge	Expertise
PBP1	The use of data analytics during the audit is an extra responsibility for auditors	regulatory review
PBP1	Audit firms look at the AFM to see what they think	Guidance regulatory authorities
PBP1	The use of the software needs to be changed for every client	Software
PBP1	The lack of standardization is a problem with investments	upfront investment

PBP1	Is the understanding there to see when data analytics adds value and when it does not add value there	Complete success story
PBP1	When there is a pull strategy, the people should be willing to innovate, otherwise a pull strategy will bring you nothing	Willingness to innovate
PBP1	There should be a global vision to data analytics	Company culture/strategy
PBP1	Auditors look for the PCAOB and AFM for guidance and support on the use of modern control techniques	Guidance regulatory authorities
PBP1	Are there guidelines for the use of data analytics by the NBA and the AFM	Support regulatory authorities
PBP1	Corporate governance and the use of data is very interesting. Are clients willing to give insight in there data?	IT culture
PBP1	If I use data analytics is there support from the AFM or is it a problem for my reviews	Regulatory review
CFC1	It is impossible to check my business without looking at the IT systems.	Company culture/strategy
CFC1	Checking a single invoice only helps you to understand the company. But it is not enough to know if all the entries are correct and give a true and fair view of what really happens here.	Awareness of possibilities
CFC1	If we talk about the topic of data governance there will be some big changes per 1 January 2015. There will be stricter rules that deal with data security and data privacy.	Data privacy
CFC1	The security of privacy- sensitive data will be an important issue in the future. New agreements about the way auditors use our data will be necessary	Data privacy
CFC1	In the first few years of the audit we learned several things about our own systems and work out new control mechanism with the help of those findings	Multidisciplinary collaboration
CFC1	When there are new auditors in the team, we always have to answer the same questions	Expertise
CFC1	The understanding of the IT/ data must be there otherwise, you cannot audit our business	Expertise
CFC1	The financial auditors and IT auditors must communicate, in order to have a good understanding of how we work and how our business works	Communication
CFC1	IT and finance must be combined in order to understand IT and perform a good audit	Multidisciplinary collaboration
ABS2	I have not approved an annual report were the use of data analytics gave us an assurance advantage	Complete success story
ABS2	We analyze a whole population with data analytics, but we also still have to do our sample testing	Awareness of possibilities

ABS2	First there has to be a best practice. A client case in which the whole team confirmed that the use of data analytics increased the efficiency/ the quality. I have not heard about a success story when it comes to data analytics and the audit	Complete success story
ABS2	I am afraid of the fact that the use of data analytics will not increase the efficiency or that you build tooling that does not work. Than the investment was worthless	Complete success story
ABS2	You can use a IT application multiple years, if the people with the knowledge about the software are not leaving during those years	Expertise
ABS2	A organization can be so complex that it will take weeks to build applications or tools with data analytics that will help us	IT system client
ABS2	Building a formula for the price in some calculation of revenue can be so difficult that it will take much time to formulate the formula and build the software.	Software
ABS2	When an audit firm's gets access to some databases of the client the databases itself might become less secure.	Data management
ABS2	The IT specialist should be closer to the auditors to build relevant software	Multidisciplinary collaboration
ABS2	Our firm should have a small team to talk to the client about data analytics.	Multidisciplinary collaboration/ Communication
ABS2	You can't go to the data supervisor at some clients, because they don't have one	Data management
ABS2	It takes time to get data and you have to know who can give you the data	Data management
ABS2	A controller can question: whether you really need the data?	IT culture
ABS2	It is not so easy to explain to the client why you need the data and why it is relevant for your audit. In order to explain this you need data analytics specialist and the auditor	Multidisciplinary collaboration
ABS2	you need someone who has a clear view on what the software can do and what is relevant for the audit and combine does field of knowledge	Expertise/ Multidisciplinary collaboration
ABS2	Auditors must get more IT knowledge to get closer to the data analytics	Expertise
ABS2	It is hard for a financial auditors to tell the IT specialist what kind of data they need	Expertise
ABS2	We need IT specialist that start thinking from an audit perspective	End user ownership
ABS2	More client ask in which way the data is secured	Data security
ABS2	Data analytics is not much embedded in the COS	Audit standards
ABS2	How we explain some regulations and standards needs to be changed	Audit standards

ABS2	It is easier to pass your AFM reviews not using data analytics	Support regulatory authorities
ABS2	If you use data analytics it is very easy to make mistakes because the use of data analytics is new. If you don't use data analytics in a correct way you might not pass your AFM reviews. This can make people nervous.	Regulatory review
ABS2	Inside an audit company it is important to create a culture that supports data analytics	Company culture/strategy
ABS2	We need a network with people who can exchange knowledge	Multidisciplinary collaboration
ABS2	More (formal) guidelines when people want to use/ use data analytics from inside the company.	Company culture/strategy
ABS2	The education on the topic of IT and data must be better or completer. IT is not enough embedded in our study and that should change.	Expertise
ABS2	Auditors should know more about IT. Auditors have to know more about the way an organization can be IT dependent.	Expertise
ABS2	In some audits you work with IT auditors and the question will be if a financial auditor has enough IT knowledge to check what the IT auditor is doing.	Expertise
ABS2	Maybe you should try one year in which audit does not have to allocate the cost of data analytics to their audit budget.	Company structure
IBP1	In the past we build tools and gave them to audit without really communicating with audit about the purpose and the utility of our tools	Communication
IBP1	Audit should take the lead in setting the requirements that we need in order to build good tools for audit	End user ownership
IBP1	We build standardized tools for the tasks that audit performs during every audit	Software
IBP1	A manager can find our department now, but that was different in the past	Awareness of possibilities
IBP1	In the way we use data analytics in some of our audits you need a completely different way of thinking	Company culture/strategy
IBP1	The IT system of the client has to be ready in order to use data analytics	IT system client
IBP1	When you have an audit with a budget of 25.000 euro, you should ask yourself if its profitable to use data analytics because of the upfront investment	upfront investment
IBP1	In the first year we spend too much on building the tooling and the software	upfront investment
IBP1	There is an interesting question in how you should allocate the cost of the initial investment for the software and the tooling	Company structure

IBP1	The audit profession is seriously going to change with the upcoming IT solutions that companies can provide	Company culture/strategy
IBP1	Performing an audit with a sample of 25 when there are 2 million transaction is strange	Awareness of possibilities
IBP1	Auditors think that data analytics can't be used in there audit. But after talking one hour with an IT specialist they see that the whole audit can be done with data analytics. But the auditor does not see that.	Awareness of possibilities
IBP1	Data analytics does not increase the efficiency during some audits	upfront investment
IBP1	Auditors do not have the knowledge to understand the possibilities of data analytics	Expertise
IBP1	You have to use the right methods otherwise you will have a problem with the AFM	Regulatory review
IBP1	With SOX the use of data analytics might be problematic, because you have to explain all the things you find during your audit	Audit standards
IBP1	The fact that you have so much results and unique processes identified when you use data analytics can be a barrier for some auditors	Information overload
IBP1	Do we want to know everything, because we maybe we find something that might cause us to doubt the correctness of the annual report of last year	Information overload
IBP1	The added value for the client is enormous.	Awareness of possibilities
IBP1	Manager don't know the success stories or at least not enough auditors know the success stories	Complete success story
IBP1	The culture have to change, because you have to pay the people who build the software and the tools	Company culture/strategy
IBP1	The revenue of some partners changes because they have to allocate cost to the IT specialist department. Partners get reviewed on their revenue so they might not be willing to allocate cost to another department to build software and tools for data analytics	Company structure
IBP1	Resources can be an issue because we don't have enough IT specialist	Resources
IBP1	Data extraction can take up much time and this must be standardized.	Data standardization
IBP1	In building client specific solutions there is a serious lack of people who can build the tools and software	Resources
IBP1	It is difficult for IT specialist and auditors to communicate what the software must do and analyze.	Communication/ Multidisciplinary collaboration
IBP1	Audit has to tell what the software has to do and what the software must show.	Multidisciplinary collaboration

IBP1	Auditors have to understand something about the audit, IT and data analytics	Expertise
IBP1	You must have a broader knowledge base to perform an audit	Expertise
IBP1	Data accessibility can be an issue. If you take the data to the audit firm and there servers. Which data do you get and do you want to have all data.	Data management
IBP1	The auditor does not know what data they need from an organization.	Expertise
IBP1	The auditor must have the skills to tell the IT specialist what he wants to see.	Communication
IBP1	There needs to be understanding between the IT specialist and the auditors what we can do and expect from each other	Multidisciplinary collaboration
IBP1	You will be a better collocutor when you use data analytics, because you can now more of the company when you analyzed while using data analytics	Awareness of possibilities
IBP1	Sometimes a company is to complex and the investment will be to big	upfront investment
IBP1	The client stops the auditor from using data analytics	IT culture
IBP1	Some auditors don't see the added value of data analytics	Complete success story
IBP1	People had some negative experiences with data analytics. This is the cause of their skepticism.	Willingness to innovate
IBP1	Data extraction must be possible and this is sometimes a big challenge	IT system client
IBP1	The data must be trustworthy otherwise data analytics is useless	Data reliability
IBP1	The cost of external licenses cost	upfront investment
IBP1	There is not yet an overview of where data analytics has added value for the audit	Complete success story
IBP1	Acceptance of data analytics can be absent because of a lack of results of data analytics	Complete success story
IBS1	People work for their own department and have their own interest. But bottom-line the IT specialist and the auditor work inside the same company.	Company structure
IBS1	The allocation of the cost is a discussion	Company structure
IBS1	The biggest barrier is people. There are not enough resources for the development of audit analytics	Resources
IBS1	There is always budget pressures and there are different interest in different departments	Budget pressure auditors
IBS1	When clients don't want to give their data. You can't use data analytics	IT culture
IBS1	People are nervous about AFM reviews and if the use of data analytics is in line with their audit standards	Regulatory review

IBS1	Work papers with the use of data analytics should be reviewed by the AFM/ audit	Support regulatory authorities
IBS1	The COS, IFRS and US GAAP. There is an enormous difference between IFRS and US GAAP. Auditors should have a clear view of how we can use data analytics according to the different standards	Audit standards
IBS1	There should be guidance from inside the company about the use of data analytics during the audit	Guidance regulatory authorities
IBS1	Regulation is a barrier for auditors, because they don't know if the use of data analytics is approved	Audit standards
IBS1	The support of regulation and regulatory authorities should be there via guidance from inside the company	Guidance regulatory authorities
IBS1	A danger of data analytics is that it works to good. And you are busy afterwards to document why you don't test everything you have found	Information overload
IBS1	The AFM should change the way of thinking because checking everything when you use data analytics is not possible	Regulatory review
IBS1	The software can work so good that you are not happy with the outcome	Information overload
IBS1	You can't document everything you find with data analytics, because you can find everything what is going wrong. Data analytics can changes te way we think about an audit	Company culture/strategy
IBS1	The AFM does not have guidelines for the use of data analytics	Guidance regulatory authorities
IBS1	Auditors are not aware of the possibilities. There is not a clear overview of what data analytics can do and how it adds value to the audit	Awareness of possibilities
IBS1	education to create awareness is important and should be there	Expertise
IBS1	Guidelines for procedures are not there, this is necessary in order to make good use of data analytics	Company culture/strategy
IBS1	Auditors have not enough knowledge about data and IT to communicate clearly what they need in the software and the tools	Expertise
IBS1	It is hard for auditors to identify the elements of an ERP system that is needed to perform certain analysis.	Communication
IBS1	There is a way of upfront thinking necessary in order to understand what data out of a system or company you need.	Expertise
IBS1	Most of the IT specialist don't know what audit procedures are	Expertise
IBS1	The auditors and IT specialist should communicate to get a clear view on what auditors need and what the IT specialist can deliver	Communication
IBS1	Software was build that had no added value, because a lack of communication between the users and the providers of the software	Multidisciplinary collaboration

IBS1	Audit analytics is not always easy and that was not clear when it was introduced for the first time	Company culture/strategy
IBS1	The IT systems of the client can give a big challenge	IT systems client
IBS1	The structure of IT systems and databases can cause that it is not possible to extract the data	IT systems client
IBS1	The upfront investment is not that high if you can allocate the cost over several years	upfront investment
IBS1	The use of data analytics can feel as an extra responsibility, because you have to explain everything you find.	Regulatory review
IBS1	When you can standardize the software, you should do it	Software
IBS1	The investment of time to develop standardized solutions is huge.	upfront investment
IBS1	You have to collaborate with all the stakeholders in order to get the right solutions	Multidisciplinary collaboration
IBS1	There must be the time to develop the software and solutions for data analytics. Budget and resources pressures could be a barrier in that process.	Budget pressure auditors
IBS1	A lack of resources can be a serious issue	Resources
IBS1	It a manager wants to use data analytics the most common reason for IT specialist not to accept assignment is complex IT systems	IT systems Client
IBS1	Data extraction is a big challenge and there is no company who standardized the data enough to easily get the data out of databases	Data standardization
IBS1	The smaller clients don't know anything about data or IT	IT culture
IBS1	The client does not care about the use of data analytics	IT culture
IBS1	Data analytics should increase the efficiency otherwise auditors will not use data analytics during the audit.	Complete success story
ABS3	The client was enthusiastic about the use of data analytics, because the previous accountant did not use data analytics	IT culture
ABS3	There was nog enough data to use data analytics	IT system client
ABS3	The specific data that was necessary for our use of data analytics could not be extracted from there IT systems	IT system client
ABS3	We could not subtract the data because the data was not standardized	Data standardization
ABS3	The client must first fix some bugs in the new IT systems, before data is available for us	IT system client
ABS3	Some clients are too small to use data analytics	upfront investment
ABS3	The software has many features that are good for the client, but do not add value to the audit	Software

ABS3	The added value is not that obvious at this moment.	Complete success story
ABS3	There is not a continuous process in which auditors get informed about data analytics	Company culture/strategy
ABS3	I have not hear any success stories	Complete success story
ABS3	Auditors lack the knowledge to tell IT specialist what kind of data they need	Expertise
ABS3	Auditors are by nature skeptical	Company culture/strategy
ABS3	Auditors don't know what kind of data they need and what tools and software are available	Expertise/ Awareness of possibilities
ABS3	Not everybody is aware of the possibilities, because of a lack of success stories.	Awareness of possibilities
ABS3	You have to describe what you do during your audit, to work conform regulations and law.	Regulatory review
ABS3	With a push strategy in combination with a good product, data analytics should work	Company culture/strategy
ABS3	When there is no time to be inefficient, data analytics shall not be used until it increases the efficiency	Resources
ABS3	Lack of resources could be a reason not to try data analytics, because there is no room for trial and error	Resources
IBS2	It is rare that a auditor can tell me what kind of data we need for the use of data analytics	Communication
IBS2	Sometimes it can be difficult for auditors to explain precisely what they want to see as a result of certain analysis	Communication
IBS2	They find it difficult because they don't see the possibilities of data analytics in a specific client case	Awareness of possibilities
IBS2	Auditors have it difficult time thinking out of the box	Willingness to innovate
IBS2	Innovation is not a big topic in the accounting profession and this holds back the possibilities and solutions that data analytics can bring	Awareness of possibilities
IBS2	In order to implement data analytics you need knowledge about auditing, data analytics, company processes and company systems	Expertise
IBS2	There are not enough people who have the knowledge about the IT and the audit.	Resources
IBS2	Auditors lack the knowledge of IT and Data and IT specialist the knowledge about IT, data and data analytics	Expertise

IBS2	You need multidisciplinary collaboration is order to make data analytics part of your audit	Multidisciplinary collaboration
IBS2	There is more initiative since there were more success stories and examples	Complete success story
IBS2	The software needs to be changed for every client	Software
IBS2	The first steps to use data analytics are the biggest investment.	upfront investment
IBS2	For smaller companies with less budget, the investment to make data analytics part of the audit might not be appropriate	upfront investment
IBS2	There was a class in summer school about data analytics and raise the awareness of possibilities	Awareness of possibilities
IBS2	It is hard for auditors to have a clear view on the possibilities that data analytics can provide	Awareness of possibilities
IBS2	It is in the nature of the auditor to follow procedures and data analytics is not in the procedures, so people won't consider it	Company culture/strategy
IBS2	Without multidisciplinary collaboration an auditor can't know what the possibilities are in the audit	Multidisciplinary collaboration
IBS2	There is no complete overview of all the possibilities of data analytics	Awareness of possibilities
IBS2	There are some processes in which data analytics are not embedded and this are always manager and partners that had no contact with the IT specialist	Communication
IBS2	Some auditors might have had a negative experience in the past and are therefore skeptical	Willingness to innovate
IBS2	Different forms of analysis are not appropriate for every client	Awareness of possibilities
IBS2	The structure of an audit firm does not support the upfront investment you have to make when you use data analytics	Company structure
IBS2	The allocation of the implementation cost are completely in year one and this might be a problem when you get assessed per fiscal year	Company structure
IBS2	When there is budget pressure it is harder to make an investment for data analytics	Budget pressure auditors
IBS2	You need the time and the investment in order to make data analytics work	Budget pressure auditors

IBS2	The IT structure of the client must be good enough to get the data out of the system	IT system client
IBS2	Data extraction can be a serious problem and can take up a lot of time	IT system client
IBS2	Everything in your audit file needs to be explained	Regulatory review
IBS2	Data analytics can give too much insight, but auditors have to think about how to process these insights according to their standards and regulations	Information overload
IBS2	The audit procedures should be good enough to use data analytics and follow up the finds you find	Information overload
IBS2	Not following up the findings that you find with data analytics can be caused by a lack of knowledge about data/ data analytics	Regulatory review
IBS2	Because data analytics is not embedded in audit procedures and a lack of experience there is a risks of not following up the findings in a correct way	Company culture/strategy
IBS2	You need enough resources to make sure that there is time to innovate	Resources
IBS2	Data analytics is at this moment very time consuming and expensive	Budget Pressure auditors
IBS2	Stakeholders have to team up (auditors, IT specialist and IT Auditors)	Multidisciplinary collaboration
IBS2	For little clients with a smaller budget you need to standardize the tools of data analytics as much as possible	Software
IBS2	For some client another way of thinking is necessary to use data analytics	IT culture
IBS2	The calculation of the price in the revenue can be complex, this could happen with insurance companies	Data reliability
IBS2	A combination of complex IT systems and complex company processes can be a barrier	IT systems Client
IBS2	Some clients won't give access to the data because you did not use data analytics in the past	IT culture
IBS2	The use of data analytics in combination with a lack of knowledge about the business with the data analytics specialist can cause problems with data accessibility	Expertise
IBS2	Data extraction can be difficult for the client, because they don't know which data the auditor/ IT specialist needs	Expertise
IBS2	Resources is always an issue and then you have to give priority to the biggest clients	Resources
IBS2	Managing expectations to the client is important in order to make sure that the client provide data and support. This is important to take away barriers for data extraction	IT culture
ABP1	In the past software was built for the audit profession, but auditors did not know where to use the software for and what the added value was	Awareness of possibilities
ABP1	The use of data analytics is costly and therefore not appropriate for all client at this moment	upfront investment
ABP1	The missing link was that audit was not involved to set the requirements for data analytics	End user ownership

ABP1	The communication between IT specialist and auditors was not good enough to make sure that the IT specialist understood what the auditors need precisely	Communication/ Multidisciplinary collaboration
ABP1	At this moment there is not enough standardization to use data analytics on a bigger scale	Data standardization
ABP1	The first time you use data analytics the cost are larger than the benefits	upfront investment
ABP1	Investment for data analytics should be seen as R&D	Company structure
ABP1	The investment upfront is high and then data analytics can only be used if the budget is big enough	Budget pressure auditors
ABP1	Data analytics must replace other activities in order to make data analytics accessible to more people	Complete success story
ABP1	Auditors are not aware of the increase in efficiency that data analytics can bring	Awareness of possibilities
ABP1	In practice people are skeptical because the investment you have to make to use data analytics takes a lot of time and money	Resources
ABP1	Data extraction is in some cases a big problem, which take up much time and therefore budget	IT system client
ABP1	In order to get easy data extraction the standardization of data inside companies is very important	Data standardization
ABP1	Audit was not enough involved in the process of building the software and the tools	Multidisciplinary collaboration
ABP1	Auditors need a broader knowledge base	Expertise
ABP1	Auditors are not open to change and are by nature skeptical	Willingness to innovate
ABP1	Training and education will be necessary in order to let the auditors know what the possibilities are	Awareness of possibilities
ABP1	When you use data analytics you need to understand more about the IT systems and IT environment.	Expertise
ABP1	With the increasing importance of IT systems auditors should broader there knowledge base and understanding of IT systems	Expertise
ABP1	Because of budget pressure, automation is inevitable	Budget pressure auditors
ABP1	The AFM should think different about the audit because data analytics can provide so much insight. More insight is better and should not give more work for the auditor, because the audit quality is higher with data analytics	Information overload
ABP1	There is not enough support from regulatory authorities	Support regulatory authorities

ABP1	There is no clear overview of what to include in your audit file when you use data analytics	Regulatory review
ABP1	The audit can feel as an extra responsibility because of the inexperience and lack of knowledge	Regulatory review
ABP1	It should be clear that data analytics can be a replacement for traditional work	Complete success story
ABP1	Auditors should broader there knowledge about data and data extraction	Expertise
ABP1	The implementation cost are too high because of a lack of standardization	Software
ABP1	The cost allocation could be a problem, because we take all the cost in one year. The cost allocation does not fit the idea of data analytics	Company structure
ABP1	The auditors should know the possibilities and the success stories. So making sure people know the possibilities and stories is a challenge	Awareness of possibilities/ Complete success story
ABP1	You can have my data but only when you use a computer without wifi and only when you perform your data analytics on site. So the data can't leave our office building	Data security
ABP1	Data analytics should be brought to the attention of auditor using a push strategy	Company culture/strategy
ABP1	The implementation cost are relatively high and this stops many people from using data analytics.	upfront investment
ABP1	There are client with certain IT systems that make it a very expensive and time consuming tasks to extract the data.	IT system client
ABP1	Data privacy can be an issue to take up some types of data in a database.	Data privacy.
ABS4	The use of data analytics does not yet increase the efficiency, moreover in some cases the use of data analytics even decreases the efficiency.	Complete success story
ABS4	The IT specialist made tools without the involvement of auditors in the process of building the tools	Multidisciplinary collaboration
ABS4	In practice the data was not trustworthy or the data extraction was a major issue	IT system client/ Data reliability
ABS4	There is no time to experiment with data analytics for three months.	Regulatory review
ABS4	You need software that helps with the purpose of your audit and that actually helps your audit	Software
ABS4	A data analysis can analyze data and an auditor can perform an audit. So auditors have to explain to IT specialist what they want to see as a result of an analysis.	Communication
ABS4	After the data analysis was performed the data analyst has to explain to the auditor what he has done with the data and the IT	Communication

ABS4	The most significant barrier is to make sure that the IT specialist and the auditor are working together and can explain what they can do and what they want.	Multidisciplinary collaboration
ABS4	In order to make data analytics a success the software has to answer questions asked by the accountant	Software
ABS4	The cost allocation is an issue and you must be willing to make the upfront investment	Company structure
ABS4	The collaboration between the people who builds the software and the people who use the data in key in this process	Multidisciplinary collaboration
ABS4	In order to let the IT specialist work, the auditor must be able to specify the basics of an audit and tell the data analysts what actually he wants	Communication
ABS4	Also the output of the software should be more aligned to the needs of in this case the auditor	Software
ABS4	An auditor has to understand what happens and has to take the responsibility	Expertise
ABS4	Does the software what it should do and in what way is there guidance from regulations/ law. This is about quality control of the software.	Software/ regulatory authorities
ABS4	IT specialist must be able to get the data out of an organization	IT system client
ABS4	Data extraction is difficult because of different IT systems and databases from clients	Data standardization
ABS4	Accountant don't have the knowledge to understand what the data specialist do.	Expertise
ABS4	Making the tools and the software goes with a big upfront investment because of the cost of building the software and collaboration between auditors and IT specialist	upfront investment
ABS4	The data has to be reliable and easier to extract from the databases of the client and then data analytics can become a bigger part of the audit	Data reliability
ABS4	In order to make sure data analytics can add value for the audit, the focus has to be on the added value for the audit and all stakeholders have to keep that in mind	Company culture/strategy
ABS4	The resources to experiment with data analytics on individual audit are not available in some cases	Resources
ABS4	You need budget and people in order to let this work. Because there is a lack of resources and budget pressure if you don't do that.	Resources/ budget pressure
ABS4	Multidisciplinary collaboration is essential to make data analytics an important part of regular audits	Multidisciplinary collaboration
ABS4	Auditors are not aware of the possibilities and the implementation strategy	Awareness of possibilities
ABS4	The intern communication about the implementation/ development strategy must be good, because otherwise people will not act according to the strategy that was decided at the top of the company	Company culture/strategy
ABS4	People must work together across the whole company to get the most out of data analytics	Company structure

ABS4	There is not enough standardization in the way companies store their data	Data standardization
ABS4	Data extraction and the IT system of the client can be a serious problem, but it can be fixed with enough resources	IT system client
ABS4	It is important to see if the use of data analytics is in line with the COS and the AFM can give their opinion in order to see if the audit is in line with regulations	Audit standards
ABS4	It is important to make the AFM part of your developments which are not in line with the traditional audit.	Support regulatory authorities
ABS4	The possibility of more insight via data analytics can feel as a threat	Information overload
ABS4	The fear to find things that were relevant last year can be a barrier to invest in data analytics for some auditors	Willingness to innovate
ABS4	You have to check if the data is reliable, because garbage in is garbage out	Data reliability
ABS4	You have to be open to change in order to use data analytics	Willingness to innovate
ABS4	It is probably more save for your AFM review when you use traditional methods for your audit	Support regulatory authorities
ABS4	You need people that want to innovate that want to be frontrunner or promoter of data analytics	Resources
ABS4	The software must be linked to certain COS standards and you need people that can make that link between the software and the audit standards	Audit standards
ABS4	It would help if the AFM and the NBA would support the use of data analytics	Guidance regulatory authorities
ABS4	The most important barrier is data extraction, because difficulty with data extraction also make the upfront investment to big	upfront investment
MBS2	The purpose of my job is to communicate the awareness and possibilities of data analytics external, but also internal. Because people have to know what the possibilities are and where they can get the information about for instance data analytics.	Awareness of possibilities
MBS2	Our job is to create awareness and demand in the market for the use of data analytics.	Awareness of possibilities
MBS2	The people who are busy with innovation are constantly looking for new challenges, but it would be way more profitable to implement there solutions to more clients.	Company culture/strategy
MBS2	The fact that the audit is a regulated business does not help the marketer	Regulatory review
MBS2	The quality is very important, but the audit fees are under enormous pressure. So that gives less room to innovate, because you must ask for more fee or the use of data analytics should increase your efficiency.	Budget pressure auditors
MBS2	People underestimate the upfront investment of data analytics. But I think it's a barrier	upfront investment

MBS2	When the data is clean than it is not that difficult to extract the data from IT systems, but from what I understand that can be a big problem.	Data reliability
MBS2	There is not much marketing about the audit and data analytics. There is less focus on audit and data analytics	Awareness of possibilities
MBS2	The auditor should be able to explain to the customer that data analytics adds value for the audit	Expertise
MBS2	The people who decided which auditors gets the audit are the audit committee or the supervisory board and that are on average older people that could be less open for innovation	IT culture
MBS2	The marketing external and internal should be aligned.	Company culture/strategy
MBS2	If an audit company is good in data analytics a company might not choose for that company as their auditor because than the audit company is not allowed to give advice.	Awareness of possibilities
MBS2	People must be in contact with each other that is the core of what we want to accomplish. The more we work together, the more we can help our client.	Multidisciplinary collaboration
MBS2	It is difficult to reach auditors to increase their awareness because of a lack of time to educate auditors	Budget pressure auditors
MBS2	The multidisciplinary collaboration between marketing, IT specialist and practice in the process of creating awareness for data analytics	Multidisciplinary collaboration
PBP2	The result of the use of data analytics during the audit was limited in the past	Willingness to innovate
PBP2	The data of the client is often not reliable or we can't extract it from there databases	Data reliability
PBP2	There is a lack of a concrete plan for the use of data analytics	Company culture/strategy
PBP2	Data analytics should be more embedded in the audit	End user ownership
PBP2	We don't know when the software is applicable in the audit	Awareness of possibilities
PBP2	Data analytics and the audit standards should be aligned in our audit approach	Audit standards
PBP2	Data analytics must be part of your audit approach otherwise it is just an add on.	Regulatory review
PBP2	Resources can be a problem, you must have enough IT specialist to make sure that you can use data analytics in more audits	Resources
PBP2	You can only use data analytics when audit teams understand how to extract data and how the software works	Expertise
PBP2	The knowledge base must be broader in order to use data analytics	Expertise

PBP2	The management of audit teams must see the necessity to use data analytics	Willingness to innovate
PBP2	In the audit teams people should have more IT knowledge and how data analytics fits in the audit approach	Expertise
PBP2	We must know how data analytics is compliant with the COS standards	Audit standards
PBP2	Auditors should eventually have more knowledge about IT and data	Expertise
PBP2	Not everybody knows of the existence and the awareness of possibilities	Awareness of possibilities
PBP2	There must be a success story with a good profession based description. I don't know a complete success story	Complete success story
PBP2	The people who can provide and build the software are limited, this is a problem with resources	Resources
PBP2	From the top of the company I don't hear much about data analytics	Company culture/strategy
PBP2	The market conditions may cause the priorities to change	Willingness to innovate
PBP2	The implementation strategy is important, and it is weeks ago that I heard something about data analytics	Company culture/strategy
PBP2	Auditors tend to take the safe route and that is never innovation	Willingness to innovate
PBP2	The upfront investment is time in too much and there is a lack of qualified employees	upfront investment
PBP2	When the people are not available to assist the audit teams, the teams will not use it.	Multidisciplinary collaboration
PBP2	What are you going to do with the extra insights that data analytics provides	Information overload
PBP2	There should be more guidelines to use data analytics and if you use data analytics in line with guidelines.	Guidance regulatory authorities
PBP2	There is no dossier to my knowledge that was reviewed and approved by the AFM where data analytics were used	Complete success story
PBP2	Maybe audit standards should be changed in order to show what the possibilities of data analytics	Audit standards
PBP2	Data analytics shifts the focus even more to exceptions and people are not aware of these chances	Awareness of possibilities
PBP2	Primary auditors don't have the knowledge of IT and data knowledge to understand what happens themselves, but multidisciplinary collaboration is important because IT specialist must explain what they did to me in order to take the responsibility for the audit.	Multidisciplinary collaboration

PBP2	The reliability of the data is very important. Because the data must be trustworthy.	Data reliability
PBP2	IT specialist must be part of our audit teams. So the IT specialist must be closer to the audit teams.	multidisciplinary collaboration
PBP2	Auditors must ask the questions that will lead to the software applications	Communication
PBP2	There must be collaboration between client's, IT specialist and auditor's	multidisciplinary collaboration
PBP2	The client is afraid to give their data because of data security.	Data security
PBP2	You must start at the audit standards and you your audit guidelines. So the auditor's should lead in building the software.	Audit standards/ End user ownership
PBP2	The communication from the top of the company is limited and people don't know how data analytics add value.	Company culture/strategy
PBP2	The added value for the auditor is not always clear, so the focus on the added value starts at the audit teams asking the right questions	Awareness of possibilities/ end user ownership
PBP2	There must be more success stories in order to make sure that people will use it more	Complete success story
RUP2	You could look across different companies within an industries with data analytics to identify possible risks	Awareness of possibilities
RUP2	The IT specialist and the auditor have their own knowledge base. The first step is to get people talking with each other	Multidisciplinary collaboration
RUP2	Auditors must ask the right questions and people must have some knowledge of what you can do for each other	Communication/ End user ownership
RUP2	You have to understand each other's perspectives in order to make data analytics work. And auditors should have some IT knowledge and the IT specialist must have some knowledge of the audit	Communication
RUP2	Auditor must lead in that process and ask the questions, so the software is in line with the audit approach	Guidance regulatory authorities
RUP2	Auditors must have enough knowledge about data in order to take the responsibility for what an IT specialist does	Expertise
RUP2	When in the future auditing becomes more principle based. You will need other skills and those skills are more suitable for using data analytics.	Expertise
RUP2	When an audit is rules based there is less room for innovation and the use of data analytics because of the culture at the regulatory authorities	Regulatory review
RUP2	Client is maybe not willing to give all there data to the auditor	IT culture

RUP2	There could be practical problems like for instance time constraints and getting the right data.	Budget pressure auditors
RUP2	Maybe the fact the data analytics can give extra insights in comparison with last year, could be a reason for not using data analytics	Company structure
RUP2	Is the data available and is the data reliable	Data reliability
RUP2	When there are older partners may have an incentive not to invest in data analytics because they won't see the return of their investment in their own bonus/revenue	Company structure/ Upfront investment
RUP2	There must be no personal incentive to make no investment, maybe via self-regulation you can take away those incentives	Company structure
RUP2	The cost allocation could be done different with for instance the capitalization of cost for development	Company structure
RUP2	The culture must change is order to innovate and make changes. You can get more insight and then you may need another way to work	Willingness to innovate
RUP2	You need people that work in an innovative way and if they can work more efficient and deliver better quality the market will follow	Willingness to innovate
RUP2	You must recruit the right people and then you just have to invest in order to make sure it is used more often	Expertise
RUP2	Companies must share the success stories, and this is even more important because the business is regulated.	Complete success story
RUP2	The culture of the supervisor must change so they not only blindly check rules	Regulatory review
RUP2	When people don't innovate because of for instance a review by regulatory authorities than the supervisory role is not correct in the market	Regulatory review
RUP2	More supervision and regulations make it harder to innovate. The supervisor should not block innovation	Guidance regulatory authorities
RUP2	Another role for the AFM is to support the use of modern audit techniques	Support regulatory authorities
RUP2	Also the regulatory authorities could bring out success stories	Complete success story
RUP2	The tone and culture of the supervisor can influence how the business works in the future	Support Regulatory authorities
RUP2	The average auditor is not aware of all the possibilities that data analytics can provide	Awareness of possibilities
RUP2	You need an different mindset to look at data and see the possibilities	Willingness to innovate

RUP2	You need to look critically at the data in order to check the reliability	Data reliability
ABS5	the first time I used data analytics was because it was the best way and most efficient way to perform the audit. It was in this case the only way to perform a good audit on the online transactions	Willingness to innovate
ABS5	The audit fee on my assignments are not high enough to use data analytics for most of my clients	upfront investment
ABS5	Data analytics does not replace other tests or activities directly	Complete success story
ABS5	Data extraction can be a serious problem when it comes to specific data dumps from non-financial systems in the client it systems	IT system client
ABS5	Financial auditors should be leading when it comes to options about what data analytics should do.	End user ownership
ABS5	There should be education to understand that the culture must change	Expertise
ABS5	A new way of thinking is important in which continuous monitoring and data analytics has a central role	Company culture/strategy
ABS5	The multidisciplinary collaboration is very important and it is important to integrate activities of IT specialist and auditors	Multidisciplinary collaboration
ABS5	The communication between IT specialist and auditor must be good and this is a point of attention	Communication
ABS5	The audit must have the knowledge about data and IT to ask the right questions, so the IT specialist can build the software that an auditor needs	Expertise
ABS5	The audit standards are restrictive for innovation	Audit standards
ABS5	The audit standards kill the possibilities for innovation, because auditor's don't know if the innovation is conform the standards	Audit standards
ABS5	The use of data analytics can feel like an extra responsibility	Regulatory review
ABS5	The reviews of the AFM is a barrier to integrate new ways of auditing because there is uncertainty about how you should write down your new way methods	Regulatory review
ABS5	The possibilities of data analytics can be a barrier, because people don't know how to follow up new insights	Information overload
ABS5	Uncertainty about documentation in your files how to justify the way you are working when you use data analytics	Regulatory review
ABS5	You have to change your way of thinking about what to do with the extra insights and errors in the whole population	Information overload
ABS5	The AFM could support data analytics and tell us how to justify the use	Support regulatory authorities
ABS5	The sharing of knowledge about the use of data analytics is important	Communication
ABS5	The NBA could also think about how they can support the use of data analytics	Support regulatory authorities

ABS5	Auditors need success stories and examples from practice	Complete success story
ABS5	A best practice is a file with use of data analytics in combination with good explanation of what has been done and positive review by the regulatory authorities and intern quality department. Such an example is not there at the moment	Complete success story
ABS5	Agendas are full and people are looking for how to use data analytics and don't have the answers	Resources
ABS5	The workload is high and you are happy to finish the audit in time and the busy workload blocks innovation	Resources
ABS5	It is a bad idea that we intern bill each other for a client solution	Company structure
ABS5	The company structure does not support data analytics because I have to pay another intern department	Company structure
ABS5	The internal communication should be more intensive in in order to deliver a service with visual software	Communication
ABS5	Data extraction and data reliability is an extra barrier if you know the data is trustworthy by performing you traditional audit	Data reliability
ABS5	There is not enough support for the use of data analytics, there is not a concrete plan for the use of implementation of data analytics	Company culture/strategy
ABS5	People have to see the complete process of implementing and using data analytics and that is not there yet	Company culture/strategy
ABS5	I don't want to pay for software, but I want to pay for a solution that helps my audit	Software
ABS5	Data extraction can be impossible because of the volume of the data that needs to be extracted	Data management
ABS5	There must be multidisciplinary collaboration to see if the data is reliable and is extracted in a proper way. You need an IT auditor in te know if the data is reliable.	Data reliability
ABS5	There must be education in order to make people understand that they should consider data analytics earlier	Expertise
ABS5	The auditor must be in the lead and the approach should be integrated with the IT auditor and IT specialist and also there should be integrated budgets	End user ownership
ABS5	The story about data analytics should be communicated in another way	Awareness of possibilities
ABS5	Clients have a complete other vision on IT applications	IT culture
ABS5	There should be an implementation strategy, because only selling software does not work. There should be a complete story about the implementation and use of data analytics.	Company culture/strategy
ABS5	There is not enough constant attention for data analytics, the intern marketing and education should be more constant during the year	Company culture/strategy

PBS1	I am involved in stimulating collaboration between different groups of people on the topic of data analytics	Multidisciplinary collaboration
PBS1	Data can give so much insight that asking the right questions is essential	End user ownership
PBS1	Often IT specialist make reports without talking to the professionals, so there will be a gap between what IT specialist show and what professionals want to see.	Communication
PBS1	When auditors look at data analytics I think the starting point is the audit standards and guidelines	Audit standards
PBS1	Auditors must have the ability to communicate clearly what data analytics should do for them	Communication
PBS1	Thinking out of the box is important to see the possibilities of data analytics	Willingness to innovate
PBS1	People must be aware of the possibilities otherwise they will not use data analytics	Awareness of possibilities
PBS1	The availability of data is important and you should look at the availability before starting with data analytics. Some client do not provide some forms of data.	IT culture
PBS1	A problem of data extractions could be the way in which data in embedded in different IT systems	IT systems client
PBS1	The people are the most important barrier of getting data from clients.	Resources
PBS1	Sometimes it is hard to use data analytics because the ownership of data is not clear in most companies	Data management
PBS1	You must link the thinking of data analyst and the professionals and this will be essential. The collaboration is essential	Multidisciplinary collaboration
PBS1	If there is a lack of time innovations will not be used, because innovation takes time.	Budget pressure auditors
PBS1	The upfront investment of time and money can be a barrier	upfront investment
PBS1	With data analytics auditors can look for exceptions and I think that can help auditors	Awareness of possibilities
PBS1	Regulations can block innovation. Trial and error is not really an option because auditing is a regulated business	Regulatory review
PBS1	Regulations are a barrier to innovate because regulatory authorities must approve the way you work	Regulatory review
PBS1	The different way of thinking between a business analyst and a professional gives extra tension between these two different groups	Communication
PBS1	Auditors are from my point of view not aware of the possibilities	Awareness of possibilities
PBS1	Auditors may need another knowledge base because the working methods will be changing in the future	Expertise

PBS1	Clients have another way of looking at IT applications because they are not aware of the possibilities and how data analytics is embedded in the working methods of auditors	IT culture
PBS1	You need good people with enough knowledge and Skills to let data analytics work	Resources
PBS1	Auditors should broaden their knowledge regarding IT and data	Expertise
CFM1	We first look carefully at the data and the processes, before we perform some form of substantive testing with data analytics	End user ownership
CFM1	The users of data analytics are programming the queries themselves	End user ownership
CFM1	Data extraction is under most circumstances not a problem, but with our new IT systems that could be a problem	IT system client
CFM1	A new IT systems makes multidisciplinary collaboration necessary in order to make sure our internal auditors can perform the data extraction themselves	IT systems client
CFM1	To audit our business data analytics is important to understand the business	Willingness to innovate
CFM1	The auditor relies on the work that we perform as internal audit department	IT culture
CFM1	The fact that we as internal audit department perform data analytics makes that the external auditor uses less data analytics because they rely on our data analysis	IT culture
CFM1	There should be more client specific approach to make good use of data analytics	Software
CFM1	The collaboration between IT and the business is important to perform data analytics	Multidisciplinary collaboration
CFM1	You combine the knowledge of the processes and the IT in order to be in control of the money flow inside the organization	Multidisciplinary collaboration
CFM1	With a new IT system and performing data analytics there is a high upfront investment to make sure the data analytics results are reliable	upfront investment/ Data reliability
CFM1	When you don't query with the data yourself, you automatically have less knowledge about the data	Expertise/ end user ownership
CFM1	The biggest investment of data analytics is the upfront investment in the first year	upfront investment
CFM1	Time constraints can make that we use less data analytics.	Resources
CFM1	Sample testing is in the culture and I would rather use more substantive testing/ data analytics	Company culture/strategy
CFM1	The upfront investment is mostly in time. Data analytics and the development of data analytics takes up a lot of time	upfront investment
CFM1	Data privacy is important and can cause serious problems like fines or even administrative liability	Data privacy

CFM1	We only share data with our external auditor if it is relevant for their audit and have a contract with us concerning data security	Data security
CFM1	If we perform more substantive testing than it is possible for an auditor to perform an audit on our controls and have less work because of that	IT culture
CFM1	The IT auditor and financial auditor must broaden their knowledge. An financial auditor should have more knowledge about data and IT	Expertise
CFM1	The financial auditor should be more involved with data analytics and they need more knowledge about data.	Expertise
CFM1	IT auditor and financial auditors should work together and learn from each other	Multidisciplinary collaboration
CFM1	Data extraction from large IT systems are very difficult and moreover it is hard to know if the data is reliable	Data reliability
CFM1	Walking through data analytics tools and performing some analytics work yourself makes that people ask more in depth questions	End user ownership
CFM1	When using data analytics or looking at data you must have a clear vision on what your goal is	End user ownership