# Implications to the Audit Process of Auditing that uses Data Analytics Tools and New Business Models

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# List of studies

There are three studies included in this dissertation and these are:

1. Mugwira, T., Stuart, I., Kulset, E., and Nipper, M. The use of process mining in assessing the risk of material misstatement during an audit: Experimental evidence Under review in the Auditing, A Journal of Practice and Theory (ABS 3).

2. Mugwira, T. The unintended consequences of visual output from Audit Data Analytics tools on junior auditors' professional judgments: Investigating the availability bias.

3. Mugwira, T., and Stuart, I. Fraud detection in the New Economy: Understanding digital fraud in Wirecard. Under review in the Accounting Auditing and Accountability Journal (ABS 3).

   Studies not included in the dissertation:

1. Mugwira, T. (2022) Internet Related Technologies in the auditing profession: A WOS bibliometric review of the past three decades and conceptual structure mapping. *Spanish Accounting Review, 25(2), 201 -216.* (ABS 1).

# Table of contents.

**Overview of the Dissertation: Implications to the Audit Process of Auditing that uses Data Analytics Tools and New Business Models**

# 1. Introduction

In this overview of the dissertation, I introduce the three papers in the dissertation and discuss the important International Standards on Auditing used in the dissertation. In addition, I discuss the theoretical framework that underpins the dissertation, the research design, the philosophical position and the analytical procedures used in the three papers. Finally, I summarize the three papers that constitute the dissertation studies.

## 1.1 Introduction to the three papers

New advances in information technology have created a wave of technological innovations which affect the audit firms. Audit firms are now investing large sums of money to acquire and adopt data analytics tools (Cangemi, 2014). Audit Data Analytics (hereafter, ADAs) are data analytic tools used in the audit process (ICAEW, 2016). Audit firms are adopting ADAs in anticipation of the potential benefits that these tools might bring to the audit process including the ability to test more data (Austin et al., 2021; Gepp et al., 2018; Tang et al., 2017) and visualize that information in different formats to identify anomalies and trends (Buchheit et al., 2020). ADAs are developed within the audit firms such as PACE from EY, Halo from PwC, KAAP from KPMG and Spotlight from Deloitte (Eilifsen et al., 2020), or they are outsourced tools originated by technological software companies. Whether the tools are outsourced or developed within audit firms, ADAs are adopted with the objective of assisting the auditors in gathering sufficient and appropriate audit evidence, either to make the audit process more efficient or more effective. Sufficiency is the measure of the quantity of the audit evidence while appropriateness is the measure of quality; that is, to determine how reliable and relevant the evidence is in support of audit decision making and rendering audit opinions (ISA 500).

One of the outsourced ADA tools adopted by audit firms for use in conducting the audit process is a process mining tool. Using transaction event logs, process mining tools provide unique audit evidence where the auditor can look at all the transactions from the beginning to the end of a given period including the various paths the transaction can take in a business process (Chiu & Jans, 2019; Werner et al., 2021). Prior research on the use of process mining tools suggests that these tools enable auditors to test more business transactions compared to manual procedures (Chiu & Jans, 2019; Werner & Gehrke, 2019; Werner et al., 2021). Merely testing more accounting transactions may add to the sufficiency (the quantity) of audit evidence, but it does not follow that increasing the

quantity of evidence that is tested necessarily adds to the appropriateness (relevance) of the audit evidence collected. In other words, what is not clear from prior research is whether the audit evidence from process mining tools provides relevant information.

A piece of evidence is to have relevant information if when viewing it a decision maker will alter his or her decision or behavior (Beaver, 1968; Biddle et al., 1995; DeFond et al., 2007). The issue of the relevance of information from process mining tools is investigated in the first paper.

In addition to investigating whether process mining evidence provides relevant evidence, the first paper investigates at what stage of the audit this evidence is found to be the most useful. Prior research in the use of process mining tools suggests that these tools can be used in different phases of the audit process (Chiu et al., 2019; Werner, 2017). There are five basic audit stages: (1) pre-engagement activities, (2) planning stage, (3) evidence gathering stage, (4) evidence evaluation and reporting stage and (5) post reporting stage. Auditing standards provide guidance on the use of analytical procedures in three stages of the audit—the planning stage, the evidence gathering stage and the reporting stage of the audit. Analytical procedures described in ISA 315 are preliminary because the objective of auditors at this point of the audit is to form initial expectations of the risk of material misstatement in the financial statements. By contrast, analytical procedures described in ISA 520 are carried out when the auditor collects audit evidence and when the auditor completes the audit and issues the audit opinion. This dissertation investigates whether process mining evidence is considered by the auditor to be more valuable as planning stage analytical evidence or as substantive stage analytical evidence.

In addition to process mining ADA tools, ADA tools also have powerful visualization abilities which can transform data into visual output which are easier to understand than is textual evidence alone (Alles & Gray, 2016; Dilla & Raschke, 2015). These tools offer a possibility of providing more meaningful insights from a dataset (Borthick & Pennington, 2017; Murphy & Tysiac, 2015). Prior research has found that in an analytical procedure task, presenting audit evidence as visual evidence rather than as textual evidence improves auditor's judgment by providing a better cognitive fit (Backof et al., 2018), and such a presentation also frees up auditors cognitive resources which can then be used on other tasks (Anderson et al., 2020).

Even though visual audit evidence is associated with cognitive benefits, this evidence is vulnerable to auditors' subjective interpretations; hence biases in decision making can occur (Chang & Luo, 2019; Huerta & Jensen, 2017). This is true because whenever a subjective decision is carried out under conditions of uncertainty, that decision is susceptible to bias (Bazerman et al., 2002). To alleviate the effects of the biases, auditors must engage in deliberative reasoning and carefully assess all the available evidence before making decisions.

Prior research in auditing has documented that auditors do not always engage in deliberative reasoning and sometimes suffer from decision making biases (Bedard & Wright, 1994; Knapp & Knapp, 2012; Libby, 1985). However, our knowledge is limited as to whether auditors also suffer from these biases when using the new forms of audit evidence produced by ADA tools. Research calls from prior studies has suggested that these potential biases be investigated in an experimental setting (Chang & Luo, 2019; Huerta & Jensen, 2017). The second paper in this dissertation responds to these calls and investigates decision biases that might be relevant for auditors whenever they use both visual and text evidence to make a decision in the audit process. Specifically, the study investigates how visual audit evidence can potentially aggravate the availability bias during the decision-making process.

In addition to the new ADA tools that have been added to the audit process, there are new business models now used by audit clients, and these models require auditors to modify the audit process to accommodate their use. For instance, many businesses organizations are changing their business models and are moving toward cashless societies. The move toward cashless societies has led to the formation of new industries one of which is the financial technology industry.

Financial technology  refers to the use of technological software in the delivery of financial services (Arner et al., 2015).  Financial technology industry is highly innovative and is associated with complex business transactions (Haddad & Hornuf, 2019; Lee & Shin, 2018).  Complex business transactions render financial technology companies vulnerable to accounting manipulations such as fraud.

Fraud has always been a concern for regulators and auditors due to its effect on stakeholders' confidence and trust in the professional competency of the audit profession

(Healy & Palepu, 2003; Thomas, 2002). In this context, the International Standards on Auditing (hereafter, ISAs) requires the auditor to assess the risk of material misstatement due to fraud or error in the financial statements of the audit client (ISA 240). To do this, the auditor needs to use fraud risk factors given in the auditing standards to assess the opportunities in the audit client that might be capitalized by management to commit fraud. Auditors also assess the pressure which might influence management to commit fraud and how these leaders can rationalize the fraud. These fraud risk factors (also referred to as the fraud triangle), assist the auditors in detecting fraud during the audit process (Albrecht et al., 2018).

The recent emergence of financial technology organizations has complicated fraud detection for auditors during the audit process. Financial technology organizations adopt complicated revenue recognition models and often operate in high-risk online business transactions such gambling and money laundering. Fraud detection in online business transactions is difficult and has always been a concern for auditors. Accordingly, the recent fraud in Wirecard offers researchers a unique opportunity to understand the types of fraud that auditors are most likely to encounter in companies that have adopted technology-oriented business models, including companies in the financial technology industry. The third paper analyses the fraud case of Wirecard with the intention of learning from past failures and developing ways to conduct the audit process to avoid audit failures in the future.

## 2. Overview of International Standards on Auditing (ISAs) used in the dissertation

The dissertation is anchored on the auditing standards. These standards were used to discuss how auditors comply with the requirements of the standards as they conduct an audit. This section discusses the overview of the dominant ISAs used in the dissertation.

### 2.1. ISA 500: *Audit evidence*

ISA 500 outlines the auditor's responsibility pertaining to the collection of audit evidence. Audit evidence is used by the auditor to determine whether the financial statements have been prepared in accordance with the applicable financial reporting framework. To ensure this, the auditing standards states that it is the auditor's responsibility to design and perform audit procedures which will enable the auditor to obtain sufficient

appropriate audit evidence to form a reasonable audit opinion. Sufficiency pertains to the quantity of evidence while appropriateness is a measure of quality; that is, its fit to the specific purpose under consideration. There is some ambiguity here since the standards did not explicitly state what constitutes sufficient appropriate audit evidence but leaves this to the professional judgment of the auditor. ADA tools are known to bring additional evidence to the attention of the auditor since they can be used to test large datasets. Given this, however, it is not clear whether that increase in the quantity of evidence adds to the appropriateness of the evidence already collected by traditional procedures. This standard (ISA 500) was used in the process mining context to investigate whether evidence from process mining tools adds to the appropriateness of the evidence already collected by means of the traditional analytical procedures.

## 2.2. ISA 315: *Identifying and assessing the risk of material misstatement*

The auditing standards state that it is the auditor's responsibility to identify and assess the risk of material misstatement due to fraud or error. ISA 315 provides guidance on the risk assessment procedures the auditor can use to assess the risk of material misstatement in financial statements. These risk assessment procedures are carried out at the planning stage of the audit. The main concern at this stage is to help the auditor to have a better understanding of the client's risks and to reveal areas that might require extra attention from the auditor during the audit process (Clikeman & Diaz, 2014; Hirst & Koonce, 1996). The auditor should not be biased in his or her risk assessment procedures.

There are several risk assessment procedures which the auditor can use, including to perform analytical procedures, inquire from management perform observations and inspections of documents. Analytical procedures include review of both financial and non-financial information to identify inconsistencies or significant differences from expected values. Simple analytical procedures include trend and ratio analyses, comparisons of the clients' financial statements to similar companies in the same industry and size, comparison of the current financial statements to budgets, forecasts or interim statements. Analytical procedures can also include complex statistical analysis and information from computer audit software applicable in the audit process--commonly referred to as audit data analytics (Appelbaum et al., 2018).

### 2.3. ISA 520: *Analytical Procedures*

ISA 520 discusses the use of analytical procedures to obtain evidence during the substantive procedures and in the formation of an overall conclusion of the financial statements that takes place near the end of an audit to determine whether the financial statements have been prepared according to applicable financial reporting framework. When analytical procedures are used as substantive procedures, they will be used to respond to the risk of material misstatement at the assertion level. Analytical procedures are the least reliable source of evidence; hence the auditor will use professional judgement to determine whether analytical procedures can be used as the only audit procedure or in combination with tests of details.  Test of details may be the preferred option if the risk of material misstatement is high. If the risk of material misstatement is low, analytical procedures may provide sufficient evidence. At the end of the audit, the auditor will use analytical procedures to assess whether the financial statements are in conformity with his or her understanding of the entity. These procedures at the end of the audit are quite similar to the procedures performed at the planning stage. If there are deviations from the auditor's expectations, the auditor must gather additional evidence (for example, by asking management for explanations for the deviations and performing other necessary audit procedures to corroborate management's explanations).

### 2.4. ISA 240: *The auditor's responsibilities relating to fraud in an audit of financial statements*

ISA 240 outlines the auditor's responsibility for assessing the risk of material misstatement due to fraud or error in the client's financial statement. Fraud involves a deliberate act; therefore, the risk of failing to detect a misstatement due to fraud is higher than the risk of failing to detect an error. Fraud detection is even harder if there was collusion both from outside and inside the client and when it was perpetrated by senior management. The standards encourage the auditors to exhibit high level of professional skepticism when auditing the financial statements and to engage in team discussions on how and where financial statements might be susceptible to fraud. In assessing the fraud, the auditor may identify fraud risk factors; that is, conditions that can provide an opportunity to commit fraud, exert pressure to commit fraud and how they might justify their actions. This is commonly known as the fraud triangle. The standard also provides possible audit procedures which an auditor might use to address the assessed risk of material misstatements due to fraud. If an auditor identifies or suspects the existence of

fraud in the financial statements, he or she must report that to the appropriate level which is usually one level above where the fraud has been committed or suspected to have been committed. This ISA was predominantly used in the third paper to analyze the Wirecard fraud.

# 3. Applicable theoretical frameworks

Several theoretical frameworks were used in this dissertation. The first paper relied primarily on relevant prior research in auditing and psychology to predict the hypothesis and discuss the results. The second paper used the dual process theory of thinking and reasoning to provide theoretical underpinnings. The requirements of ISA 240 and the fraud triangle were used as the theoretical framework for the third paper.

## 3.1. The Dual Process Theory of thinking and reasoning

The dual process theory is built on the premise that human beings have two cognitive processing systems: system 1 and system 2 (Evans, 2003; Evans & Stanovich, 2013; Tversky & Kahneman, 1974). System 1 is intuitive, automatic and fast. It is often useful on routine tasks such as when shopping in a grocery store. System 2 is slow, but it engages analytical thinking (Evans, 2003). Decision making in auditing is carried out under conditions of uncertainty. This means auditors must use professional judgment to evaluate the available evidence and decide on the course of action to take. Given this, auditors are expected to use system 2 in their professional decisions. Even though system 2 is deliberative and often results in better professional decisions, it is not easy to put aside the suggestions that might have emerged from system 1. In a professional setting, suggestions from system 1 often result in judgment errors known as biases.

There are several biases which are applicable in auditing, but the dissertation only investigates the availability bias. Availability bias can be defined as the tendency to use the piece of information that can be easily brought to the cognitive mind (Tversky & Kahneman, 1974). Prior research in information visualization suggests that visual audit evidence can aggravate the availability bias by creating vivid images in the auditor's cognitive mind and thereby improving the retrievability of that information when they are making a decision (Chang & Luo, 2019; Ho & Beyan, 2020).

### 3.2. The fraud triangle

The dissertation used the fraud triangle to understand the fraud in Wirecard. The fraud triangle is primarily built on the premise that fraud is most likely to occur when three elements are present: opportunity, pressure, and rationalization (Albrecht et al., 2018). Opportunity emanates from the conduciveness of the circumstances in and outside the organization that can create a perfect chance to engage in fraudulent activities (Huang et al., 2017; Wilks & Zimbelman, 2004). Perceived pressure can come from outside or inside the company. For instance, many organizations have performance goals which can put pressure on employees and management to engage in fraudulent reporting. Pressure can also come from outside the organization, for example, from pressure to meet analysts' financial assessments and predictions. Lastly fraud perpetrators rationalize their actions; that is, they provide justification to why they engage in particular fraudulent activities. Whenever these three factors come together, they increase the inherent risk for fraudulent activities. Auditors and fraud investigators can use the fraud triangle to analyze whether fraud can occur. When the fraud has already occurred, the fraud triangle can be used to analyze why it occurred (Albrecht et al., 2008). Wolfe and Hermanson (2004) proposed another element to the fraud triangle: capability. They argued that an individual's personal traits and ability influence one to engage in fraudulent activities when the other three elements are present. After the addition of this fourth element, the combination of factors can be referred to it as the "fraud diamond". Even with regard to this proposed addition of a fourth factor, the fraud triangle is still a useful tool in analyzing frauds in different settings (Albrecht et al., 2018; Homer, 2019; Roden et al., 2016).

## 4. Research design

This section outlines the research philosophy that guides the study as well as the analytical procedures adopted by the researcher. A PhD dissertation is a scientific enquiry that follows an orderly and methodological process as guided by philosophical underpinnings. These philosophical beliefs and values include how the researcher understands reality (ontology) (Peile & McCouat, 1997) and how scholars access that reality and pass it on to others (epistemology) (Saunders et al., 2012). These philosophical beliefs have an impact on the choice of the research design. In the following section, I discuss the philosophical beliefs that I adopted in for this PhD dissertation.

## 4.1. Philosophical position

There are several schools of thoughts in scientific research about the philosophy of science. Saunders et al. (2012) argued that the most important philosophical stances are positivism, realism, interpretivism and pragmatism.

Positivism is similar to scientific research in natural science where research is viewed as a way to discover the truth (Peile & McCouat, 1997). Ontologically, positivist belief is that there is the truth out there which is observable and can be measured reliably (Yin, 2009). Positivists typically propose formal hypotheses and test them quantitatively. Experimental research falls under this category where researchers manipulate variables and test the cause-and-effect relationship under controlled environments. In social studies, positivism is the dominant philosophical position (Piekkari et al., 2009). Even though findings in this philosophical stance do not take into consideration research context, these findings are objective and considered generalizable.

Interpretivists offer a direct contrast of positivism (Bell et al., 2022). Researchers in this philosophical stance believe in subjective meanings which are construed by people and are influenced by specific situations and contexts (Peile & McCouat, 1997). Researchers using this approach are less concerned with objective facts, but they are more concerned with how actors construct knowledge. Interpretivists focus on qualitative research methods where they engage in in-depth exploration of a specific phenomenon. In contrast to positivism, findings from this philosophical stance are considered to be less objective and often they cannot be generalizable to other contexts.

There are several forms of realism but in the most simple fashion, realism lies in the middle of positivism and interpretivism (Peile & McCouat, 1997). One of the realistic perspectives is critical realism. Critical realists acknowledge that the objective truth exists, but they believe that research only endeavours to reveal that truth. As a result, researchers in this philosophical stance use triangulation to get a better understanding of the phenomena.

Pragmatists believe that both objective and subjective inquiries can produce acceptable knowledge (Saunders et al., 2012). Pragmatists do not usually take a particular philosophical position on what constitutes good scientific research, and they can use both quantitative and qualitative research methods. They put great emphasis on the research question and believe that the method of inquiry is driven by the particular research question

to be answered (Saunders et al., 2012). Researchers with this philosophical stance can do research in various ways, adopting methods which seem the best, according to the distinctive research objectives they pursue (Tashakkori et al., 1998).

This dissertation uses both quantitative (experimental research) and qualitative (discourse analysis) to acquire knowledge about auditing in the digital era. In effect, it adopts the pragmatic philosophical stance.

## 4.2. Context and data sources

The studies in this dissertation use different data sources. The first and second paper used primary data collected from experienced auditors. Online experiments were used due to the lack of direct access to auditors as a result of the COVID 19 pandemic. The data collection was done using Qualtrics, a data collection software (Holt & Loraas, 2019). The first paper which investigates the use of process mining tools used 82 auditors from Norway and Germany. Even though Norway is not part of the European Union, it is part of the European Economic Area and enjoys close and good relations with European Union member states. Considering these conditions, the auditing environment in Norway is indistinguishable from European Union member states (Sormunen et al., 2013). The second paper used 91 auditors from Norway. The third study used secondary data sources from publicly available documents including government reports, two reputable financial newspapers (*The Wall Street Journal and the Financial Times*) and peer-reviewed articles. The *Financial Times* was used because its investigative journalists led by Daniel McCrum played a pivotal role in exposing the financial fraud in Wirecard (McCrum, 2022). In addition, these two financial newspapers publish reliable information, and they have been previously used as data sources for research published in high ranking accounting journals (Stice, 1991; Thompson et al., 1987).

## 4.3. Analytical procedures

The first two papers were experimental studies followed a quantitative approach. The first paper used a mixed randomized repeated design (Tabachnick & Fidell, 2007) where we had one with-in subjects variable and two between subjects variables. For data analyses, the paper primarily used a mixed model ANOVA (Field & Hole, 2002). In addition to this, a simple ANOVA and multiple regression analysis were used as additional checks on the robustness of the reported results. The second paper used simple mean

difference analysis which includes one sample and two sample tests of proportion. Regression analysis was used for further analysis.

The third study used a qualitative approach of discourse analysis (Hannam & Knox, 2005). The discourse analysis was carried out by reviewing a wide range of documents mentioned earlier with the aim of discovering their meanings and to determine how those meanings can be used to reconstruct realities in the Wirecard fraud (Phillips & Hardy, 2002). Discourse analysis does not only strive to discover the meanings written in the documents, but it also tries to infer those meanings when these are not explicitly written in the various sources of documents (Hannam & Knox, 2005). Discourse analysis was relevant to study the Wirecard fraud because the sources of information for this case are scattered and no final analysis has yet been written on the fraud

## 5. Summary of studies and conclusion

This dissertation is comprised of three papers on auditing in the digital era. The first paper is under review at the journal, *Auditing: A Journal of Practice and Theory,* third paper is under review at the *Accounting, Auditing and Accountability Journal*, while the second paper has been submitted to international conferences for presentation and discussion.

The first paper, **"The Use of Process Mining in Assessing the Risk of Material Misstatement during an Audit: Experimental evidence,"** investigates the use of process mining tools in the audit process. Audit firms now invest in process mining tools as the firms anticipate the benefits these tools can bring to the audit profession. The relevance of the process mining evidence generated by these tools depends on several factors, including how auditors perceive the evidence contained in process mining outputs, the timing of the evidence presented to the auditors and the presentation format used when the evidence is addressed by the auditors. In this paper, we investigate three issues of importance when auditors use process mining evidence in conducting the audit: (1) whether process mining evidence is perceived as relevant by auditors in assessing the risk of material misstatement; (2) whether the stage of the audit when the evidence is available makes a difference in planning or testing; and (3) whether the presentation format of the process mining evidence (graph or written documentation) affects the auditor's risk assessment decision. To test our hypotheses, we designed a research instrument that uses financial data obtained from an international software consulting company operating in Europe. The financial data was

analyzed using Celonis, a process mining tool applicable in the auditing context. Eighty-two auditors completed the research instrument. We find that auditors perceive evidence from a process mining tool to express information that is relevant for both the planning and substantive stages of an audit. We also find that the auditors' risk assessment was higher in the substantive stage as compared to the planning stage. This suggests that auditors evaluate the same evidence presented at the substantive stage as containing more relevant information than identical evidence presented during the planning stage. This is because the auditing standards require the auditor to make an initial assessment of risk during the planning process and these expectations may be further refined during the substantive stage as the audit progresses. By contrast, as we considered the presentation formats, we find that there is no difference in the auditors' assessment of the relevance of the information presented in graph format or in written text as both are considered equally relevant in the planning and the substantive stages. This suggests that the presentation format does not really matter when the evidence presented in the text format is the same as the information presented in a graph.

We note, however, when questioning participants about the facts of the case at the end of the study, that participants who received the information in the form of a graph remembered the information more accurately than those participants who received the information in text format. This demonstrates that although there is no difference between the respondents' decisions of risk assessment based on the format of the information (graphs or text) that was presented to them, there is a difference in how accurately they remember the information after their decisions had been made.

The second paper, **"The Unintended Consequences of Visual Audit Evidence on Junior Auditor's Professional Judgment: Investigating the Availability bias",** investigates how outputs from visualization tools can unintentionally affect auditors in making their audit judgments and the consequences of such effects on the audit process. This paper acknowledges that evidence from ADA tools can facilitate auditors in making audit decisions by freeing up their cognitive resources (which then can be used in other tasks). Yet merely assisting in decision making does not necessarily mean that these decisions are immune to judgment biases. Indeed, subjective decisions made under conditions of uncertainty are always susceptible to biases (Bazerman et al., 2002). The dual process theory is used to provide a theoretical explanation of how visual audit

evidence might unintentionally affect auditor's decision making, resulting in biases. The study specifically focused on the availability bias which is the tendency to use information that is easily accessible and retrievable from cognitive memory. Prior literature in information visualization suggests that evidence from visual ADA tools produces vivid information cues which can easily be brought to bear on cognitive memory and retrievable from it whenever making decisions. Despite this advantage of visualization, the auditing standards encourage auditors to use professional judgment to decide on the relevant piece of information for the assertion to be tested regardless of whether it was presented as visual or as textual evidence.

The study investigates whether auditors will make decisions according to the predictions of the dual process theory or make their decisions based on the relevance of the information for the assertion tested. To explore this issue, the study carried out an experiment with 91 auditors in Norway; these auditors had an average audit experience of approximately 22 months. In line with the prediction, the results shows that when auditors are presented with different information presented in different formats (visual or text), they are most likely to use the piece of information presented in visual. In addition, the study shows that those who made a decision using the visual audit evidence exhibit greater confidence in their decision than those who used the text.

The study contributes to both theory and practice. Theoretically, it extends prior research on decision biases to the research stream on digital technology. Additionally, the study addresses requests by previous research studies to investigate the unintended consequences of visual audit evidence on auditors' decision making. Practically, the study brings to the attention of audit firms the unintended decision-making tendencies which junior auditors might demonstrate when they use evidence gained through visualization techniques.

The third paper, "**Fraud Detection in the New Economy: Understanding Digital Fraud in Wirecard,**" investigates fraud in Wirecard. Wirecard was a financial technology organization which in 2020 admitted that approximately 2 billion Euros held in escrow accounts in the Philippines did not exist. This revelation led to its bankruptcy days later. Fraud is always a concern when the business environment changes as has happened to businesses operating in the "New Economy" where companies earn income by providing services to their customers rather than by selling goods. This particular case can be used to

teach readers about the difficulty of detecting fraud in companies that operate in the financial technology industry, whose business models handle large amounts of cash outside of the banking environment exercise minimal regulatory authority over the process.

The objective of the paper is to analyze this fraud with the aim of learning from such a fraud in order to avoid similar failures in the future. The fraud triangle provided the theoretical underpinnings of the paper. A qualitative approach of discourse analysis was used to analyze several publicly available documents including articles from financial newspapers and a variety of published and unpublished manuscripts. The analysis shows that of the three factors identified in the fraud triangle pressure, opportunity, and rationalization, opportunity was the most prevalent factor and rationalization was barely observable.

This fraud occurred in a new industry, the financial technology industry. In the context of the financial technology industry: opportunity emanated from fraud risk factors related to unique environmental risks associated with operating in this industry. These risk factors include: the processing of large sums of cash, complex revenue recognition models, the widely held belief that businesses in the industry were highly profitable, weak internal controls in the revenue business process and poor supervisory reviews from the boards of directors. In our investigation of Wirecard, we saw that management was under pressure from shareholders to generate record-breaking growth in net income year after year and that the CEO who was the largest single shareholder was obsessed with increasing the share price of the stock. Company management rationalized their actions by denying any wrongdoing and indicated that they were upholding the interests of the stakeholders.

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# Study 1: The use of process mining in assessing the risk of material misstatement during an audit: Experimental evidence

# The use of process mining in assessing the risk of material misstatement during an audit: Experimental evidence [1]

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**Abstract:**

In this paper, we investigate three issues of importance when auditors use process mining evidence in conducting the audit: (1) whether process mining evidence is perceived as relevant by auditors in assessing the risk of material misstatement; (2) whether the stage of the audit when the evidence is available makes a difference and (3) whether the presentation format of the process mining evidence affects the auditor's risk assessment decision. To achieve our objectives, we designed an experiment and collected data from 82 auditors. Our results suggest that auditors think that analysis of process mining evidence can be useful for determining the risk of material misstatement. Additionally, we find that process mining evidence has a larger impact on auditor´s risk assessment decisions at the substantive stage of an audit than it has during the planning stage, while the presentation format of the process mining evidence does not influence auditor decisions.

**Keywords:** Audit Data Analytics, Process Mining, Auditor Judgment and Decision Making, Relevant Information Content.

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# 1. Introduction

Business organizations are currently experiencing a technological revolution due to the availability of a host of new data analytic programs. Audit firms have joined the revolution as they adopt various Audit Data Analytic (ADA) tools in the audit process (Alles & Gray, 2016; Austin et al., 2021; Salijeni et al., 2019). ADA tools refer to an assortment of tools that might be used in the audit process to perform data analysis. Process mining tools are specific examples of ADA tools that can be useful for the analysis of transactions in a business process. Our objective in this paper is to investigate the auditor's assessment of the relevance of the evidence produced by a process mining tool; this investigation explores the assessments of experienced auditors as participants in the study. In addition, we investigate the audit stages (planning or substantive) to see where process mining evidence is most relevant, and we ask whether the presentation format of the evidence (text or graph) makes a difference in the auditor's decision about the relevance of the evidence.

Audit firms invest in process mining tools anticipating the potential benefits that these tools bring to the profession. The tool uses information stored in transaction logs to recreate what took place throughout a business process. Given this, evidence derived from process mining can be construed as objective, not prone to subjective decisions by the auditor (Jans et al., 2011). Previous researchers have suggested this type of audit evidence is unique and relevant to auditors in this era of digital transformation where a high volume of transactions take place within a particular business process (Werner et al., 2021). In addition, process mining tools enable the auditor to look at all transactions in a year from the beginning to the end including the various paths the transaction can take in a business process (Chiu & Jans, 2019; Werner et al., 2021). This advantage allows auditors to have more detailed audit evidence available to them than other ADA tools that perform comparisons from one time period to another, for instance month to month or year to year (Werner & Gehrke, 2019; Werner et al., 2021).It must be noted, however, that the mere availability of more evidence does not necessarily lead to better decisions (Stocks & Harrell, 1995) because some additional evidence may not be relevant to the decision to be made (Li, 2022). Given this, it is necessary for auditors and audit firms to understand how

the additional evidence produced by process mining tools might best be useful in the auditor's decision making process  (Krieger et al., 2021). [2]

No previous research has investigated experimentally the auditor's perception regarding the relevance of evidence produced by a process mining tool, the timing of the use of such evidence or how the information from the tool might be presented to auditors. Previous research that has examined other ADA tools in auditing had elaborated on how auditors process ADA evidence when both ADA and traditional evidence are presented to them (Rose et al., 2017). The Rose et al. (2017) study finds that auditors process ADA evidence more efficiently when after first viewing traditional evidence they follow up with visualized ADA evidence. Our study differs from the Rose study (2017) in that we are not investigating which type of evidence is presented first to auditors; by contrast, we investigate   whether process mining evidence provides relevant information over and above the information provided by the evidence garnered through traditional analytical procedures? [34]

Previous research Anderson et al. (2020) has investigated whether the timing of ADA evidence (obtained during the substantive or the planning stage) affects auditor's judgments. That study found that auditors view risk assessment procedures done during the planning stage differently from those risk assessment procedures done during substantive testing.  They find that planning stage risk assessments provide less evidence and more diagnostic information than do substantive stage risk assessment procedures. We build on the findings from this research to develop our study.  Anderson et al. (2020) used general graphical visualizations (rich or less rich) to present their ADA evidence.  In our study, we present evidence from a process mining tool. [5] Prior research has it that these tools can be used in various stages of the audit (Chiu et al., 2019; Chiu & Jans, 2019; Jans

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[2] The International Standards on Auditing (ISA 330, 500,540) refers to relevant audit evidence as evidence that adds to the appropriateness of audit evidence regardless of whether the evidence corroborates or contradicts the already available evidence.

[3] We define process mining evidence as information that is derived from process mining tools. This information can be in a process mining graph or in a textual memo which describes the process mining graph. We define traditional analytical procedure evidence as information obtained from the financial statements (a comparative Profit and Loss Statement and a Statement of Financial Position and ratios).

[4] Evidence is said to provide relevant information if it influences the decision of the auditor. (Beaver, 1968 &. Biddle et al 1995).

[5] Appendix A and B shows the graph and the text respectively. The textual memo was a description of the Celonis graph.

et al., 2013; Werner, 2017). We are investigating at which stage planning versus substantive process mining information is more relevant for the audit judgment.

Research pertaining to the presentation format has analyzed the benefits of presenting evidence in a variety of formats (Anderson et al., 2020; Anderson & Mueller, 2005; Backof et al., 2018; Boritz et al., 2014). Our study addresses the question of whether the relevance of evidence from a process mining tool (according to auditors' professional judgment) differs when that evidence is presented in either a graphic or a text format.

To test our hypotheses, we designed a research instrument using financial data obtained from an international software consulting company operating in Europe. The financial data was analyzed using Celonis, a process mining tool applicable in the auditing context (Werner et al., 2021). The research instrument includes background information about the company, information about whether work is conducted in the planning stage or in the substantive stage of the audit and two-years of data consisting of financial statement information and ratio analyses. Eighty-two auditors from Norway and Germany with an average of three years audit experience completed the research instrument.[6] Participants were first asked to assess the risk of material misstatement in the revenue business process based on the financial statement and ratio information. Then participants were given information from Celonis that summarized the transactions in the revenue business process in the form of a graph or a text format. After receiving the new information, participants were asked again to assess the risk of material misstatement in the company. We investigated three variables: information relevance, the audit stage where the decision is made and the presentation format.[7]

We find that auditors perceive evidence from a process mining tool to contain information that is relevant for both the planning and substantive stage of an audit. We also find that the auditors' risk assessment was higher in the substantive stage as compared to the planning stage. This suggests that auditors evaluate the same evidence presented at the substantive stage as containing more relevant information than identical evidence presented during the planning stage; since the auditing standards require the auditor to make an initial expectation of risk during the planning process and these expectations

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[6] We recruited 92 auditors but 10 failed the manipulation check question and were subsequently dropped from the main analyses.

[7] In addition to making the two risk assessment decisions the participants were asked to provide qualitative explanations of why they arrived at these judgments in both instances

maybe further refined during the substantive stage as the audit progresses (ISA 315 paragraph 7). By contrast, on the presentation format, we find that there is no difference in the auditors' assessment of the relevance of the information presented in graph format or in written text as they considered both the planning and the substantive stages. This suggests that the presentation format does not really matter when the evidence presented in the text is the same as the information presented in a graph. We note, however, when questioning participants about the facts of the case at the end of the study, that participants who received the information in the form of a graph remembered the information more accurately than those participants who received the information in text format. This demonstrates that although there is no difference between the respondents' decisions of risk assessment based on the format of the information (graphs or text) that was presented to them, there is a difference in how accurately they remember the information after their decisions were made.

Our study contributes to both auditing research and practice. First, our study introduces the behavioral implications of evidence from a process mining tool on auditors' decision making. Extant research has described how process mining information will change the auditing profession by bringing various benefits (Jans, 2019; Jans et al., 2013; Werner et al., 2021). However, little is known about the auditor's perception regarding the relevance of information content in process mining evidence and under what circumstances that information is more relevant. We show that auditors do perceive that evidence from a process mining tool contains relevant information (information that has an impact on their risk assessment).

Secondly, our study investigates the use of evidence from a process mining tool in the audit process. One of the difficulties of implementing ADA tools in the audit process is determining where to use them. Failure to understand properly how evidence from a process mining tool might affect auditor's judgment will limit the use of this tool as it provides detailed information which might be more useful latter in the audit process. For example, during the planning stage of the audit for the revenue business process the auditor must identify relevant assertions where the risk of material misstatement is highest and will gather evidence for these assertions in the substantive stage. Identifying these risks during the planning process does not require detailed information as when gathering evidence. We show that evidence from the process mining tool is more relevant during the substantive stage of the audit than during the planning stage.

Thirdly, we show that the relevance of information content in process mining tools is similar in a graph versus textual memo. When implementing process mining tools in an audit firm the format of the information provided by the tool is less important than the content of the information. This means that audit firms can rely upon the information in the process mining graph as it has the same information content as the text. However, there seem to be differences in the way information is retrieved from memory when auditors are presented with evidence from graphs and textual memos respectively. Participants with a graph are more likely to remember the information they receive than participants receiving the information in a memo format. This may have implications for other decisions in conduct of the audit, if the decision maker remembers evidence from an earlier decision that might be used to make a latter decision. The issue relating to ease of retrieval of information from memory might be an issue of interest for future researchers and may be helpful in shedding light on conflicting results about presentation format in auditing research.

The remainder of this paper is organized as follows. Section 2 reviews the literature and builds the hypotheses based on prior research and the regulatory requirement for gathering sufficient appropriate audit evidence. Section 3 outlines the research method and describes the case and variables of interest. Section 4 discusses the results of the hypotheses tests. Section 5 concludes the paper and discusses the limitations of the study.

## 2. Literature review and development of hypotheses
### 2.1 Adoption of ADA and Process Mining Tools in auditing

Data analytics are tools and technologies used to explore large amounts of data to discover hidden patterns and relationships in the data for the purpose of conveying valuable information to decision-makers (Cangemi, 2014). We use the term "Audit Data Analytic" (ADA) tools when we extend this group of data analytic tools to the field of auditing. In this setting, ADA tools are used by auditors to generate sufficient appropriate evidence to determine whether the financial statements have been prepared according to the applicable financial reporting framework.

Most of the ADA tools are new to the audit profession (ICAEW, 2016). Auditors adopt these tools in the hope of enhancing their understanding of financial statements (ICAEW, 2016; Tysiac, 2015) and improving the efficiency and effectiveness of the audit

process (Austin et al., 2021; Christ et al., 2021; Earley, 2015). The new tools can be used to gather evidence as required by ISA 500, *Audit Evidence.* They can be used to assess risk during the planning and substantive stages of the audit (Anderson et al., 2020). Audit firms also develop ADA tools to gain an advantage over their competitors, often using ADA tools in the bidding process for new audit engagements, especially for audits of big and listed corporations (Eilifsen et al., 2020).

Process mining tools are a specific type of ADA tool that can be used in the audit process (Jans, 2019). These tools use event logs (transaction records) to analyze specific transactions in a business process. The record of such transactions can tell us what activity was performed, who performed the activity and when the activity was performed (Jans et al., 2011; Roubtsova & Wiersma, 2018). Using the transaction records, process mining tools focus on the various ways transactions, in the year under audit, have been processed, beginning at the start of the process and following the transactions through the various actions that occur during the processing of these transactions (Jans et al., 2011). This understanding allows the auditor to assess areas of possible risk in a business process by seeing the process involving all transactions that took place and monitored by an accounting system during a year. There is no other audit evidence that can give the auditor as much detailed information as that can be provided by the processing mining tools.

Process mining can be used in various stages of the audit process (Werner, 2017). It can be used to test internal controls (Chiu et al., 2019; Chiu & Jans, 2019; Jans et al., 2013; Zerbino et al., 2018) or to perform substantive tests of transactions (Chiu et al., 2019; Jans et al., 2013; Jans et al., 2014; Zerbino et al., 2018). In addition, process mining, can be used in other audit contexts including fraud detection (Baader & Krcmar, 2018; Rodríguez-Quintero et al., 2021), auditing of complex technologies such as blockchain technologies (Corradini et al., 2019) and in monitoring transaction flow in continuous auditing (Jans & Hosseinpour, 2019).

Although process mining tools may provide valuable evidence, they cannot eliminate the inherent cognitive biases of the auditor in judgment decision making (Huerta & Jensen, 2017). This is true because most audit judgments are not automated (Lombardi et al., 2015). Auditors' judgment is still necessary to interpret the evidence from the process mining tools and to determine whether the information provided by process mining tool provides relevant information (Brown-Liburd et al., 2015). These tools do not remove the individual from the decision process (Brown-Liburd et al., 2015; Lombardi et al., 2015).

They only change the *presentation format* of the information. Before audit firms can determine how to use process mining tools to gather audit evidence, they must evaluate how the tools can be used to provide relevant information for the auditor's decision.

## 2.2 Relevant information

Decisions made during the audit process are carried out under conditions of uncertainty. In such situations, auditors should gather sufficient and appropriate audit evidence to reduce audit risk to an acceptably low level (ISA 500). The International Standard on Auditing does not categorically state the amount of evidence the auditor must gather to constitute sufficient and appropriate audit evidence but leaves this decision solely to the professional judgment of the auditor. In the past, audits have been carried out without the use of either general ADA evidence or specific evidence from process mining tools. With contemporary innovations, this is slowly changing. Due to technological advancements, the use of process mining tools has increased. These tools are, in effect, changing how audit evidence is collected (Jans et al., 2014; Werner, 2017), and their use can provide more evidence for the auditor than traditional methods (Werner et al., 2021). Even given this, the question remains whether the additional evidence has relevant information that might add to the sufficiency and appropriateness of the information that is already available in the evidence garnered by means of the traditional analytical procedures evidence. A piece of information is said to have relevant information if when viewing it, a decision maker will alter his or her behavior or decision (Beaver, 1968; Biddle et al., 1995; DeFond et al., 2007).

For example, in the audit setting, a piece of evidence might be said to have relevant information if after viewing it, auditors alter their risk assessment position, either increasing or decreasing their assessment of the risk of material misstatement. In our study, if auditors perceive that the evidence from a process mining tool only contains information already available in the traditional analytical procedure evidence, the risk assessment judgment made by the auditors will not change (because these two pieces of information have the same relevant information content). That is, the traditional analytical procedure evidence already contains information that is sufficient to make a decision. By contrast, if the evidence from a process mining tool has relevant information, auditors will change their previous risk assessment that had been based on the evidence gathered by traditional analytical procedures (analytical procedure evidence that was developed through the

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examination of comparative financial statements for the current year and prior year and analysis of comparative financial ratios for the current year and prior year).

Several prior papers suggest that process mining tools provide evidence which might be useful in the audit process (Jans et al., 2014; Werner et al., 2021) , and if auditors change their previous risk assessment , then evidence from a process mining tool has relevant information. We propose the following hypothesis:

*H1: Auditors' judgment of the risk of material misstatement before receiving process mining information will differ from auditors' judgment of risk of material misstatement made after receiving process mining information.*

## 2.3 Audit Data Analytical Information used for Planning Stage Evidence or Substantive Testing Stage Evidence

Analytical procedures involve the assessment of financial information through the analysis of both financial and non-financial changes. Auditors typically use professional judgment to form expectations about the client's performance after incorporating both internal and external information. They can be used in various stages of the audit including the planning stage, the testing stage, and the decision stage (Mactavish et al., 2018). The auditing standards classify these audit procedures as risk assessment procedures (ISA 315) and substantive analytical procedures (ISA 520).

Risk assessment procedures are typically performed during the planning stage of the audit. These procedures increase the auditors' understanding of the business and provide a basis for identifying the risk of material misstatement for various financial statement accounts (Clikeman & Diaz, 2014; Hirst & Koonce, 1996). Analytical procedures performed to obtain substantive evidence are designed to detect misstatement at the assertion level of financial statement accounts. ISA 520 provides guidance on the use of analytical procedures to collect substantive evidence during the testing stage and decision stages of the audit (Koskivaara, 2004; Mactavish et al., 2018).

The discussion above shows that analytical procedures can be used to gather evidence related to risk assessment during the planning stage of the audit (these procedures are referred to as risk assessment procedures) or as substantive evidence during the testing stage of the audit (these procedures are referred to as substantive analytical procedures). The same procedures can be used in each stage (Anderson et al., 2020) and are categorized either as risk assessment procedures or substantive analytical procedures, depending on

when the procedure is employed in the audit process. Literature on cognitive processing suggests that once information categorization takes place, this will affect how information is processed (Fiske & Neuberg, 1990; Rips et al., 2012). For instance, classifying a person according to gender will have an effect on the estimation of that person's body measurements (Macrae & Bodenhausen, 2000). In the audit setting, analytical procedures in the two stages have two very distinct purposes. In the planning stage, the auditor is assessing the risk of material misstatement and uses this information to develop the audit plan. In the substantive stage, the auditor is gathering audit evidence related to relevant assertions for significant accounts and evaluating whether the transactions have been recorded according to the accounting standards. In light of this distinction, the auditor's mindset will likely vary between the two stages irrespective of the fact that they are presented with the same audit evidence. In addition, Anderson et al. (2020) finds that auditors view risk assessment procedures and substantive testing differently, with risk assessments being construed as less evidence-providing and more diagnostic than substantive testing.

ISA 315 paragraph 7 requires the auditor to make decision about the initial expectation of risk during the planning process and these expectations may be further refined during the substantive stage as the audit progresses. For example, during the planning stage of the audit for the revenue business process the auditor must identify relevant assertions where the risk of material misstatement is highest (ISA 315 paragraph 12h). For the substantive stage of the audit the auditor gathers evidence related to relevant assertions for significant accounts to determine whether the transactions in the business process have been recorded according to the applicable financial reporting framework (ISA 520).

Therefore, we hypothesize that auditors will find evidence from a process mining tool to have more relevant information when that information is categorized as substantive evidence rather than planning stage evidence because auditing standards state that risk assessment procedures during the planning stage are used to make an "initial expectation of the risk" of the client and its business environment while substantive analytical procedures are used to gather audit evidence, that is whether transactions are recorded according to accounting standards(Hirst & Koonce, 1996; Mactavish et al., 2018). This leads us to the following hypothesis:

*H2: Evidence from a process mining tool categorized as providing substantive testing stage evidence will be evaluated by auditors as having more relevant information than identical evidence from a process mining tool categorized as planning stage evidence.*

## 2.4 Perceived relevance of information presented in graph vs text

The information accessed in the decision-making process can be presented to the auditor in various forms. This variation in presentation might influence the auditor's judgment. Previous studies have found that the effectiveness of a presentation format is dependent on the characteristics of the task at hand (Kelton et al., 2010; MacKay & Villarreal, 1987). If the task at hand is  relationship-based, then graphs offer a better cognitive fit because they provide visual relationships of the data points while tables and texts offer a better cognitive fit when participants need to identify precise data values given that they provide discrete data (Kelton et al., 2010; Vessey, 1991). When the presentation format is not compatible with the task at hand, auditors are forced into exercising more cognitive effort to evaluate the evidence, and this may have a negative impact on their ability to make complex decisions.

As previously discussed, the availability of process mining tools provides the opportunity to provide more audit evidence to the auditors. Given that more evidence is not necessarily better (Stocks & Harrell, 1995), the question of how best to present this new evidence to enhance auditors' cognitive abilities becomes an important one. Indeed, the presentation format affects the auditor's cognitive abilities; that is, how auditors will interpret the evidence and use it in the decision-making process (Bierstaker & Brody, 2001; Hoffrage & Gigerenzer, 1998; Stone et al., 1997).

Prior research has found that visualizations are an important presentation format  in analytical procedure tasks because the use of visual evidence in these contexts requires less effort  by the decision maker in making a decision because it frees up the cognitive memory of the auditor (Anderson et al., 2020; Backof et al., 2018). This impact on cognitive memory occurs because visual evidence in analytical procedure tasks helps the auditor to see and identify relationships in the data points (Backof et al., 2018; Dilla & Raschke, 2015; Kelton et al., 2010). However, the studies that found graphs to be better than texts to present information from analytical procedures did not focus on the relevance of the information between the presentation formats, only on the effort it takes to review the

information. It is possible that analytical procedure evidence presented in graph form instead of text may take less effort to review, but not necessarily provide information that is more relevant than the text information. The information provided in text form may take more effort for the auditor to review but provide information that is of equal relevance as the graphic presentation to the decision maker. In our study, we present the same information either in a graph or a text and investigate whether the relevance of the information in risk assessment will be evaluated differently in one presentation format compared to the other.

Because the decision maker needs less effort to review visual analytical procedure evidence than text evidence, auditors may assess the relevance of the evidence received as visual evidence as different from the relevance of the information presented in text formats. In this context, then, we predict that:

*H3. Evidence from a process mining tool received in a visualized format will be evaluated by auditors as having more relevant information than identical evidence received in the form of a text.*


## 3. Research method
### 3.1 Case development

To test our hypotheses, we developed a research instrument using data from an international software consulting company which operates in Europe. The sales transactions in the revenue business process were analyzed using Celonis, a process mining tool that has been previously used in other audit studies (Baader & Krcmar, 2018; Werner et al., 2021).[8] Prior research has found that process mining tools can be very helpful to auditors (Chiu & Jans, 2019; Jans et al., 2013; Jans et al., 2010; Werner & Gehrke, 2019), especially when they carry out analytical procedures (Jans et al., 2014). The research instrument consists of both traditional analytical procedure financial information based on comparisons of two years of financial statements and ratios. It also makes use of process mining evidence generated using Celonis. The process mining evidence includes a process

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[8] We made some alterations to the data provided by the software company. These alterations were done so that the data could be used in Celonis. We also made some alterations on the Celonis output for easy interpretation to the auditors who might not be very familiar with Celonis. With this in mind, our output follows the original revenue business process scheme of the consulting firm, with only minor alterations.

chart for the revenue business process which was presented to the experimental participants either as a visualized chart or a text that elaborated on the chart. Appendices A and B of this paper show the graph and text respectively. After the instrument was developed, it was pilot tested with experienced practicing auditors and faculty who have worked as auditors. Revisions were made on the instrument based on the feedback from the pilot testing.

## 3.2 Participants

Using Qualtrics panels, we recruited 92 auditors with an average level of three years audit experience from two European countries, Germany and Norway.[9] This enabled us to collect data from a wide range of respondents and improved the generalizability of our study (Lyubimov et al., 2013). In addition, we asked our respondents four post-experimental questions. These four questions included one question related to the stage of the audit (planning or substantive stage), and this question was used as a manipulation check question. Ten original participants failed the manipulation check question about the audit stage which they were in and were subsequently dropped from the analysis. Participants were discouraged from discussing the experiment with colleagues and were encouraged to treat the case as a real-life working scenario. They were also told that their answers will be anonymous and that participation in the study was voluntary with no monetary benefit.

## 3.3 Case description and variables

Our case provides background information about the company we called "Smith Consulting." We explain that the company is listed on the Oslo stock exchange and uses International Financial Reporting Standards (IFRS) for its financial reporting. Participants also learn about the services that Smith Consulting provides, the billing process for the company, and the timing of revenue recognition for the company. Participants learned that their audit firm has been auditing this company for the past five years and that the company has received an unqualified audit opinion on its financial statements on each of the previous

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[9] Due to the current prevailing pandemic, it was difficult to access training workshops. Therefore, the survey link was distributed as an online link using Qualtrics panels (survey software) to auditors in Norway and Germany. The participant's responses to the survey were anonymous and no personal information was collected. Therefore, the research was conducted under the guidelines of the Norwegian NSD (Norsk senter for forskningsdata)

five years. The audits of the company have been conducted using auditing standards from the International Auditing and Assurance Standards Board (IAASB). The participants also learned that the engagement team has made a preliminary assessment of internal controls related to the revenue business process as being effective and that the preliminary risk assessment suggests a medium risk of material misstatement for the revenue business process. The participants were also informed that existence (occurrence) and valuation are relevant assertions for the revenue business process. In addition, they were informed that they will make two risk assessments and provide reasons why they were making those assessments.

We use a mixed randomized repeated design where after the background information, participants are randomly assigned to either the planning stage or the substantive stage of the audit.[10] All participants are given traditional analytical procedure evidence for two years.[11] We ask participants to assess the risk of material misstatement for the revenue business process based on the traditional analytical procedure information. The risk of material misstatement assessment for the existence (occurrence) and valuation assertions for the revenue business process is made on a 10-point Likert-scale, from very unlikely to be misstated to very likely to be misstated. We also asked participants to explain their decision once they had made the risk assessment.

In the second stage of the case, we introduce all participants to a comparative Profit and Loss Statement and a Statement of Financial Position and ratios, in addition to evidence from a process mining tool.[12] The evidence from the process mining tool provides transaction data for all revenue transactions for the year. It is presented to the participants with half of the participants receiving the evidence in a graph format and half receiving the evidence in text format. The process mining evidence shows cash collected on sales, sales

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[10] Participants were randomly assigned to either the planning or substantive stage before making the first decision. This was done to make sure that if there were a difference between decision one and two then that difference will be attributable to relevant information discernible in the evidence gathered during process mining.

[11] The traditional analytical procedure evidence was comprised of a comparative Profit and Loss Statement and a Statement of Financial Position and ratios.

[12] In order to ensure independence between decision one and decision two, the study was designed in such a way that participants could not move back to the previous decision once it had been made (decision one). The same traditional information was provided for the second time along with the new evidence from a process mining tool so that participants can make assessment two.

allowances and accounts written offs during the year, the uncollected sales at the end of the year, in addition to the sales transactions recorded during the year. We asked the participants to re-assess the risk of material misstatement for the revenue business process based on the traditional analytical procedure information plus the information generated by the process mining tool. If the respondents use the information from the processing mining tool, their risk decision will indicate an increased risk after reviewing the information.

After the second risk assessment, we ask participants to provide qualitative answers on why they arrived at that level of risk. We also ask them to choose the statement that best explains their use of the graph/memo in their risk assessment; that is, whether the information is conforming or disconfirming or did not provide any new information at all. After providing they had done these tasks and provided their responses the participants completed post-experimental questions to test each participant's general understanding of the case. Lastly, the participants completed demographic questions.

## 3.4 Independent variables

Three independent variables are studied: (1) information from a process mining tool (no-presence versus presence of this information) (2) audit stage (planning versus substantive stage), and (3) presentation format (graph versus text). To analyze whether the information from the tool is found relevant, we compare the judgments the respondents made before and after receiving the information from the process mining tool. Although a within-subject manipulation may be affected by practice effects, carryover effects, and demand effects, this research design has been found to be "very effective in examining certain types of research questions for example learning effects and cue usage" (Trotman, 2001, p. 185). The first judgment is made with only traditional analytical procedure evidence while the second judgment is made using both traditional analytical procedure evidence and evidence from a process mining tool. The other two independent variables are between-subject variables. Audit stage is manipulated by respondents being randomly assigned to either the planning or substantive stage of the audit. Lastly, the presentation format is a between-subject variable which is manipulated by the random assignment of each participant to either graphical visualization evidence or text evidence.

## 3.5 Dependent variable

The respondents were asked to make a decision about the risk of material misstatement for the existence (occurrence) and valuation assertions for sales revenue in the revenue business process. The risk assessment was made twice, first with only traditional analytical procedure evidence and then with the combination of traditional analytical procedure evidence and evidence from a process mining tool. We used a mixed model ANOVA (Field & Hole, 2002) where the two risk assessments were our within-subjects manipulations and dependent variables. As an additional robustness analysis, we used the difference between the participants' first and second judgment of the risk of material misstatement as the dependent variable.

# 4. Results
## 4.1 Participants' Demographics

Our final sample had 82 participants from Norway and Germany who were spread across Big 4 (50) and non-Big 4 auditing firms (32). [13] We included participants from both big 4 and non-big 4 firms because previous studies suggested that big 4 firms are not significantly more likely to use technology than non-big 4 firms (Lowe et al., 2018). [14] The majority of the participants have up to 4 years' experience (82.93% of the participants). [15] Approximately 71% of our participants have received training in using ADA software, and our participants indicated on average a process mining and other ADA tools familiarity score of 4.63 on a 10-point scale ranging from 1 – not familiar to 10 – very familiar. [16] In addition, 29.2% of our participants have a CPA license. [17] In both Germany and Norway,

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[13] There is no statistical difference in the risk assessment decision between auditors from Germany and Norway (0.733, p= 0.176) This suggests that country variable does not influence risk assessment decisions made in our study.

[14] There was no significant difference on the risk assessment decisions between big 4 auditors and non-big 4 auditors (0.473, p = 0.3221).

[15] Anderson, et al 2020 who conducted a similar study on risk assessment and ADA, had a mean audit experience of 3 years and 2 months.

[16] We have a sample which is below average in self-reported familiarity with process mining and other ADA tools. However, the majority has received some ADA training (71 %). This makes our sample appropriate for our process mining task.

[17] This is the "State authorized accountant" or "Registrert revisor" in Norway and the "Wirtschaftsprüfer" in Germany.

auditors are required to have three years of audit experience before they can apply for the CPA license. Table 1 contains detailed demographic descriptive statistics.

**Table 1 Sample Demographics**

| Variable | Categories | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|---|
| Audit Firm | Big 4 | 50 | 60.98 | 60.98 |
| | Other audit firms | 32 | 39.02 | 100 |
| | *Total* | *82* | *100* | |
| Country | Norway | 62 | 75.61 | 75.61 |
| | Germany | 20 | 24.39 | 100 |
| | *Total* | *82* | *100* | |
| Audit Experience | Less than 1 year experience | 8 | 9.76 | 9.76 |
| | 1-2 years' experience | 28 | 34.15 | 43.90 |
| | 3-4 years' experience | 32 | 39.02 | 82.93 |
| | 5-6 years' experience | 7 | 8.54 | 91.46 |
| | More than 6 years' experience | 7 | 8.54 | 100 |
| | *Total* | *82* | *100* | |

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| ADA and process mining familiarity | 4.634 | 2.631 | 1 | 10 |
| ADA training | 0.707 | 0.458 | 0 | 1 |
| ADA and process mining usefulness in future | 8.658 | 1.627 | 1 | 10 |
| CPA or equivalent | 0.292 | 0.457 | 0 | 1 |

## 4.2 Results for the hypotheses

### 4.2.1 Relevant information

Table 2 shows the descriptive statistics for our respondents' judgment of the likelihood of risk of material misstatement regarding existence and valuation in the revenue business process. Our first hypothesis predicts that if evidence from a process mining tool contains relevant information, the respondents' first and second risk assessment will differ. Mixed model ANOVA results in Table 3 shows that the risk assessment was significantly affected by the information provided by the process mining tool. We find that the average initial risk assessment is 5.00, while participants´ second risk assessment is on average 6.304 (Table 2). The difference is statistically significant ($p < 0.001$, two-tailed test). Thus, we find that overall, the participants perceive the evidence from the process mining tool as providing relevant information, i.e., the respondents use the information from the process mining tool when they make their second risk assessment decision.

**Table 2 Descriptive statistics**

**Mean Comparisons – Auditors' risk assessments (SE)**

| Stage | Presentation Format | N | Initial risk assessment | Final risk assessment | Delta risk assessment |
|---|---|---|---|---|---|
| Planning Stage | Graph | 24 | 4.75 (0.336) | 5.875 (0.396) | 1.125 (0.471) ** |
| | Memo | 17 | 5.647 (0.401) | 6.117 (0.319) | 0.470 (0.412) |
| | **Combined** | **41** | **5.121 (0.264)** | **5.975 (0.264)** | **0.853 (0.324) ** |
| Substantive Testing Stage | Graph | 21 | 4.619 (0.296) | 6.666 (0.404) | 2.047 (0.460) *** |
| | Memo | 20 | 5.15 (0.412) | 6.6 (0.302) | 1.45 (0.444) ** |
| | **Combined** | **41** | **4.878 (0.252)** | **6.634 (0.251)** | **1.756 (0.319) *** |
| **Planning +Substantive** | **Combined** | **82** | **5.000 (0.181)** | **6.304 (0.185)** | **1.304 (0.231) *** |

*Notes:* Table 2 presents the mean values for participants' initial and final risk assessment as well as the difference between the two risk assessments. The initial judgment occurred following the stage (planning versus substantive) manipulation, while the participants made their second judgment after viewing the ADA output in either graph or memo format. Participants' risk assessments were measured by asking participants "Please evaluate the risk of material misstatement for the existence (occurrence) and valuation assertions for the revenue business process on a scale from 1 (not risky) to 10 (very risky)". $*p<0.10$; $**p<0.05$; $***p<0.001$; p-values are based on a two-tailed test.

**Table 3 Mixed Model ANOVA**

| Source | SS | df | MS | F-ratio | p-value |
|---|---|---|---|---|---|
| Relevant Information | 65.471 | 1 | 65.471 | 30.693 | 0.001*** |
| Relevant Information* Audit Stage | 9.131 | 1 | 9.131 | 4.28 | 0.042** |
| Relevant Information*Presentation format | 3.965 | 1 | 3.956 | 1.855 | 0.177 |
| Relevant Information *Stage*Presentation | 0.008 | 1 | 0.008 | 0.004 | 0.951 |
| Error | 166.381 | 78 | 2.133 | | |

*Notes:* Table 3 presents the results of the mixed model ANOVA test. Relevant information was the within subject variable and audit stage and presentation format are between subjects' variables. *p<0.10; **p<0.05; ***p<0.001; p-values are based on a two-tailed test.  N=82.

### 4.2.2 Risk Assessment versus Substantive stage

Our second hypothesis predicts that evidence from a process mining tool categorized as substantive evidence will be assessed as containing more relevant information than the same process mining evidence categorized as planning stage evidence. This is because we expect that auditors will find the substantive evidence as more persuasive with the planning evidence construed as more preliminary. Indeed, our mixed model ANOVA documents a statistically significant interaction term between relevant information and audit stage (p = 0.041)[18]. This tells us that the change in risk assessment was significantly different in the substantive testing stage (delta risk assessment 1.756, see Table 2) as compared to the planning stage (delta risk assessment 0.853, see Table 2). The initial risk assessment for the planning and substantive stages are 5.121 and 4.878 respectively, see Table 2. This difference is not significant (p = 0.506, two-tailed test) and indicates that our finding relating to hypothesis two is not caused by different interpretations of the background information or the financial statements and the ratios.

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[18] Untabulated ANOVA results using the difference between the initial risk assessment and the second risk assessment as the dependent variable shows the same results for audit stage, presentation format and interaction between audit stage and presentation as in the mixed model ANOVA (Table 3).

With these findings, our results suggest that auditors consider process mining evidence as having more relevant information for their risk assessment decision when the process mining evidence is provided in the substantive testing stage as contrasted to the planning stage. In summary, we find support for hypothesis two.

### 4.2.3 Presentation format

Table 3 also shows results for our third hypothesis. Our third hypothesis considers whether receiving information in a visual format is more likely to be seen as relevant by the participant than when the participant receives the same information in text format. We predicted that auditors receiving visualized process mining evidence will find the information to be relevant and will assess a higher risk than auditors receiving the same information in text format. Mixed model ANOVA results in Table 3, shows that there is no interaction between relevant information and presentation format (p = 0.177). Thus, we conclude that auditors react similarly to process mining evidence presented either in graph or text form. Overall, we do not find support for our hypothesis three. As an additional analysis, we tested for differences in the participants' understanding of the case analyzing the post-experimental questions. We find that participants who received the information as a graph had a higher mean (85.733) than the participants who received the information as text (74.405). The difference is significant (t = 2.2679, p = 0.026, two-tailed test).[19] This suggests that while there is no statistical difference in risk assessment decisions, there seem to be differences in how the information is retrieved from memory.

We performed an additional analysis for the interaction term between relevant information, audit stage and presentation format, and the results were not statistically significant; see Table 3.

### 4.3 Additional analyses

We further analyze how auditors made their risk assessments based on the quantitative answers provided during our experiment. First, we tried to understand why our participants generally assess the risk of material misstatements to be higher after receiving the process mining evidence than before receiving it. In our sample, 57% of our participants

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[19] The auditor's mean score on the level of understanding of the post experimental questions was 79.390 and 81.621 percent for planning and substantive stage respectively, and there was no significant statistical difference between these two groups (t = 0.0481, p = 0.632, two-tailed test).

indicated that the process mining output provides disconfirming information. We find that our dependent variable, the difference between participants' first and second risk assessment, is significantly different between participants who rate the information as disconfirming and participants who rate it as confirming (2.297 versus -.0285; p = 0.000, two-tailed test). In order to determine whether those who said evidence was confirming were already assessing the risk as higher (such that in decision 2 they no longer have anywhere to go) than those who said evidence was disconfirming, we analyzed the difference between their final decisions. Untabulated results show that participants who rated the information as disconfirming had a significantly higher final risk assessment (p > 0.001, two tailed test) than participants who rated it as confirming.

We performed a two-way ANOVA analysis (untabulated), using the difference between the initial risk assessment and second risk assessment (delta risk assessment) as the dependent variable and considering audit stage and presentation format as the two independent variables. Findings are the same as in the tests run using mixed model ANOVA.

Table 4 shows another robustness check analysis that was carried out using all 92 participants. The ten participants who failed the manipulation check question on audit stage were moved to the audit stage they identified, and we tested hypotheses two and three after making this adjustment. As shown in table 4, the results are approximately the same as using 82 participants. In addition, we included only those participants who passed at least two of the three post- experimental questions in the analysis, and we tested our main hypothesis on these 73 respondents. Our untabulated results show that there is no statistical difference in this test from using the whole sample of 82.

**Table 4 ANOVA results using implied conditions**

| Source | df | SS | MS | F-ratio | p-value |
|---|---|---|---|---|---|
| Model | 3 | 21.617 | 7.205 | 1.71 | 0.171 |
| Audit Stage | 1 | 20.639 | 20.639 | 4.89 | 0.029** |
| Presentation format | 1 | 2.419 | 2.419 | 0.57 | 0.450 |
| Interaction (Stage*Pres) | 1 | 0.036 | 0.036 | 0.01 | 0.925 |
| Error | 88 | 371.252 | 4.218 | | |

*Notes: Table 6* presents the results of the ANOVA test. *p<0.10; **p<0.05; p-values are based on a two-tailed test. The dependent variable is the difference (delta change) between the initial and second risk assessment. N =92. Ten who failed the manipulation check question on audit stage were put in the audit stages they said they were in.

As shown in Table 5, we ran several multiple regression analyses using two dependent variables. The first dependent variable was the change in the participants risk assessments, (risk assessment 2 minus risk assessment 1). The second dependent variable was risk assessment 2 while controlling for risk assessment 1. We expect risk assessment decision 1 to be a significant variable in a mixed experimental design with pre- and post-decisions. For this multiple regression analysis, we used different groups of participants (92, 82 and 73) and included control variables (audit experience, working for big 4 or not, country and familiarity with process mining and ADA) to see if some of the variables, despite participants being randomly assigned to the four treatment conditions, might still have had an impact. As shown in Table 5, results for our variables of interest (audit stage and presentation format) are consistent across the different models. Audit stage was significant and presentation format was not significant in all models. The control variables are found to be not significant.

**Table 5: Multiple regression analysis**

| VARIABLES | (1) Decision 2 | (2) D2-D1 | (3) Decision 2 | (4) D2-D1 | (5) Decision 2 | (6) D2-D1 | (7) Decision 2 | (8) D2-D1 |
|---|---|---|---|---|---|---|---|---|
| *Decision 1* | *0.225\*\** | | *0.235\*\** | | *0.215\*\** | | *0.195* | |
| | *(0.112)* | | *(0.118)* | | *(0.109)* | | *(0.133)* | |
| *Audit stage* | *0.719\*\** | *0.942\*\** | *0.655\** | *0.843\** | *0.717\*\** | *0.671\*\** | *0.756\** | *0.985\** |
| | *(0.362)* | *(0.454)* | *(0.378)* | *(0.469)* | *(0.342)* | *(0.347)* | *(0.416)* | *(0.514)* |
| *Presentation Format* | *-0.074* | *-0.625* | *-0.084* | *-0.601* | *-0.125* | *-0.250* | *-0.131* | *-0.371* |
| | *(0.371)* | *(0.948)* | *(0.388)* | *(0.472)* | *(0.350)* | *(0.350)* | *(0.423)* | *(0.514)* |
| Audit Experience | | | 0.101 | 0.201 | 0.037 | 0.028 | -0.040 | 0.154 |
| | | | (0.188) | (0.233) | (0.154) | (0.157) | (0.222) | (0.273) |
| Country | | | -0.537 | -0.766 | -0.500 | -0.449 | -0.390 | -0.851 |
| | | | (0.440) | (0.546) | (0.414) | (0.420) | (0.491) | (0.601) |
| Type of audit firm | | | -0.030 | 0.389 | 0.168 | 0.022 | 0.181 | 0.593 |
| | | | (0.391) | (0.480) | (0.359) | (0.357) | (0.426) | (0.522) |
| Familiarity | | | -0.024 | 0.018 | 0.064 | 0.060 | -0.019 | 0.015 |
| | | | (0.074) | (0.092) | (0.063) | (0.065) | (0.078) | (0.097) |
| R-squared | 0.051 | 0.045 | 0.021 | 0.036 | 0.041 | 0.008 | 0.007 | 0.039 |
| *N* | 82 | 82 | 82 | 82 | 92 | 92 | 73 | 73 |

*Note: Table 5* presents regressions on, audit stage, presentation format and the professional variables audit experience, country, working for a big 4 firm or not, and familiarity with process mining and ADA tools. Models 1,3,5, and 7 use decision 2 (dependent variable) and control for decision 1. Models 2,4,6 and 8 use delta change (decision 2 – decision 1) as dependent variables. $*p<0.10; **p<0.05$

# 5.Conclusion

Many audit firms are investing in technology related to data analytics. For this reason, an understanding of how they can implement these technologies in the audit process is critical for their successful use by auditors. In this study, we experimentally investigate whether auditors perceive that evidence from a process mining tool provides information that might be relevant for decision making during the audit process. Furthermore, we investigate at what stage of the audit process mining evidence might be relevant and in what presentation format.

We find that auditors do perceive evidence from a process mining tool to contain relevant information in both the planning and substantive stages of an audit. In addition, we find that auditors' risk assessments based on process mining evidence in the planning stage and the substantive stage differ. This suggests that auditors can suffer from categorization effects where the same information presented at the substantive stage is interpreted as containing more relevant information than identical information presented during the planning stage. On the presentation format, we find that there is no interaction effect between relevant information and presentation format. This suggests that auditors tend to assess the risk of material misstatement in similar ways if both presentation formats have the same relevant information. In addition, we tested for differences in the participants' understanding of the case analyzing the post-experimental questions. We find that participants who received the information as a graph had a higher mean score than participants who received the information as text. This suggests that while auditors arrived at similar risk assessment decisions, there seem to be differences in how the information is retrieved from the auditor's memory. The issue relating to ease of retrieval of information from memory might be an issue of interest for future research.

Our study has potential limitations. One limitation is we collected our data using Qualtrics panels. Although the link was shared with audit firms, there is always a risk that our survey was answered by some respondents who, in an ideal sample, should not have been included. The demographic and manipulation check questions seem to diminish the importance of this limitation. Secondly, advanced ADA and process mining are still new tools, and the respondents may consequently have little personal experience in this area. To control for this, we asked our respondents how familiar they were with ADA and process mining and received a mean response of 4.634 on a scale of 1 to 10. We also asked our respondents if they had received any ADA training. Seventy-one percent have received

training in ADA tools at their respective audit firms. Future research should continue to investigate the impact of using the ADA tool of process mining in the audit process given that this tool seems to provide information that is relevant to the decision-making process of an auditor.

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**Study 2: The unintended consequences of visual output from Audit Data Analytics tools on junior auditors' professional judgments: Investigating the availability bias.**

# The unintended consequences of visual output from Audit Data Analytics tools on junior auditors' professional judgments: Investigating the availability bias

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## Abstract

This study investigates how visual outputs from Audit Data Analytic (ADA) visualization tools can result in unintentional biases in auditor judgments. To investigate the effect of these biases, I develop an experimental case requiring auditor judgment based on evidence from ADA visualization tools, and I collect data from 91 auditors in Norway. I used the dual process theory to provide a theoretical explanation of how auditors might suffer from decision making biases. Specifically, the study investigates how junior auditors might suffer from the availability bias when they make decisions using audit evidence presented in both visual and text formats. The results shows that when auditors are presented with two pieces of evidence, with varying degrees of relevance related to their assessment of the risk of material misstatement, they are most likely to use the most available piece of information; the information presented in the visual format. In addition, the study shows that those who make a decision using visual audit evidence exhibit greater confidence in their decision than those who make the decision using the text format. This study contributes to both theory and practice. Theoretically, it extends prior research on decision biases to the research stream on digital technology. Additionally, the study provides evidence related to the unintended consequences of visual audit evidence from ADA tools on auditor's decision making. Practically, the study brings to the attention of audit firms the unintended decision-making biases to which junior auditors might be subject when using visual audit evidence. In light of such a bias, choosing less relevant visual audit evidence instead of more relevant textual evidence might lead to audit efficiency but does not lead to audit effectiveness.

**Keywords:** Audit Data Analytics, Visual Audit Evidence, Availability Bias, Dual Process Theory, Auditor Judgment.

# 1. Introduction

Although the adoption of Audit Data Analytics (ADA) tools has not been as widespread as had been initially anticipated (Eilifsen et al., 2020), audit firms are making strides toward integrating these tools into the audit process. Recent empirical studies suggest that ADA tools can improve audit efficiency while at the same time maintaining or improving audit effectiveness (Christ et al., 2021). One category of these tools, visualization tools, are the focus of this study. In this study, I investigate how visual outputs from ADA visualization tools can unintentionally affect auditors in making audit judgments, and I examine the consequences of such effects on the audit process.

According to prior research, visualization tools convert unstructured data into pictures or visual information that is easier to understand making it more available to the decision maker (Buchheit et al., 2020; Dilla & Raschke, 2015). I recognize the efficiency of visual audit evidence (Anderson et al., 2020), but I question the effectiveness of visual audit evidence. A more efficient audit process does not always lead the auditor to the correct decision nor does it necessarily follow that the decisions made based on an efficient audit process are immune to judgment biases (Chang & Luo, 2019; Ho & Beyan, 2020; Huerta & Jensen, 2017). The judgment biases that may occur because of using ADA tools that provide visual audit evidence are the subject of this paper.

Prior research done before ADA tools became available found that auditors do not always engage in deliberate reasoning but often rely on simple "rules of thumb" or decision heuristics to make decisions (Bedard & Wright, 1994; Joyce & Biddle, 1981; Libby et al., 1985). These heuristics can lead to the correct decisions in simple and familiar situations, but they can also lead to suboptimal decisions. While the evidence from research investigating the use of ADA visualization tools has found that evidence from these tools may be easier to use because they offer a better cognitive fit (Anderson et al., 2020; Backof et al., 2018), our understanding of judgment biases that might occur using ADA visualization tools is limited. As a result, there have been calls for additional research to investigate the limitations of evidence from ADA visualization tools and to explore how evidence from these tools might be susceptible to decision biases (Chang & Luo, 2019; Huerta & Jensen, 2017). I also want to learn how to avoid these biases, so the end result of the ADA visualization tool is an effective decision-making process as well as an efficient decision-making process. Given this, it is of practical and theoretical importance to

investigate the susceptibility of auditors to this decision-making bias when using visualized evidence.

Empirical research on the unintended consequences of visualization in decision making contexts using ADA visualization tools is still limited (Barr-Pulliam et al., 2020; Holt & Loraas, 2021). The Barr-Pulliam et al. (2020) study found that the prevalence of false positives in visual audit evidence has a negative effect on auditor's professional skepticism. That is, a high rate of false positives makes auditors regard red flags found in the financial statements as false positives to that they perceive a low risk of material misstatement (low professional skepticism). The Holt and Loraas (2021) study investigated the consequences of using unstructured big data compared to structured and less ambiguous data on auditors' judgments. They found that unstructured big data resulted in suboptimum decision-making by auditors; that is, the inventory write downs proposed by auditors using big data were lower than inventory write downs of auditors using structured and less ambiguous data. In this current study, I am not interested in the prevalence of false positives in visual audit evidence or in the consequences of unstructured versus structured data formats. I am interested in investigating auditor's decisions when using evidence with varying levels of relevance presented in both text and visual formats. The evidence is generated by visualization tools from data from the client's Enterprise Resource Planning (ERP) system and is designed to investigate how information with different levels of relevance that is presented in different presentation formats is used by an auditor to evaluate the risk of material misstatement in an account balance.

The current study relies upon a cognitive psychology theory, the dual process theory (Kahneman, 2011; Tversky & Kahneman, 1974), to provide a theoretical explanation of the decision-making shortcuts auditors might use when making decisions using visual audit evidence. This theory proposes that decision makers can use two processing modes: System 1 and System 2. System 2 is deliberative and slow while System 1 is fast and intuitive. Although System 1 is useful in some instances, it normally results in decision making shortcuts commonly referred to as heuristic biases[20]. The current study is interested in the

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[20]There are a number of heuristic biases relevant to the auditing setting which include the following: confirmation bias, Halo effect, affect bias, representativeness bias, anchoring bias, availability bias, overconfidence bias, the law of small numbers, substituting questions and "what you see if all there is".

availability bias. In simple words, the availability bias can be defined as the tendency by decision makers to search for readily available information cues which can be easily accessed when making a decision (Tversky & Kahneman, 1973, 1974).

Research in information visualization suggests that visual audit evidence produces vivid information cues that are relatively easy to understand and can create impressions that are not easy to forget (Chang & Luo, 2019; Ho & Beyan, 2020). This improves the ease to which information can be brought to and retrieved from human cognitive memory when making a decision (Anderson et al., 1997). Dual process theory suggests that decision makers use information that is easily brought to and retrievable from cognitive memory when making a decision (Tversky & Kahneman, 1974). This implies that auditors are most likely to use visual audit evidence because it produces vivid and easily retrievable information cues.

Despite this advantage, the auditing standards encourage auditors to use professional judgment to decide on the relevant information after considering the available audit evidence. This means, the auditing standards encourage auditors to use information because it is the most relevant piece of information for the assertion to be tested regardless of whether it was presented as visual or textual evidence. Relevant information provides support for the conclusions and decisions the auditor makes in the audit process about the assertion being tested (ISA 500). In this context, the current study asks the question about how auditors make decisions when they are given both textual and visual evidence. I examine whether auditors make decisions according to the predictions of the dual process theory that says they are most likely to utilize visual audit evidence (because it produces vivid information cues), or whether they make decisions based on the relevance of the information for the assertion tested.

In addition, prior studies suggests that when using visual audit evidence decision makers tend to be more optimistic about that piece of evidence (Tang et al., 2013) and give too much weight to its importance. This makes the auditor more confident in their decision making than they ought to be in that instance (Chang & Luo, 2019; Ho & Beyan, 2020). In this vein, the current study asks whether the auditors who use visual audit evidence will exhibit higher confidence in their decision than auditors who have text only information.

To answer my research questions, a case was designed with financial data for a company analyzed by Microsoft Power BI, a visualization tool used by auditors (Eilifsen et al., 2020). The research instrument involves an initial risk assessment decision related to the existence and valuation assertion in the revenue business process. The case was administered to 91 junior auditors with an average audit experience of approximately 22 months. Junior auditors are used for this case because they perform initial risk assessments using analytical procedures which will be reviewed by experienced auditors (Plumlee et al., 2015; Trompeter & Wright, 2010).

The research instrument provides two pieces of evidence (sales returns and uncleared invoices), which were presented in one of two formats: textual evidence or visual evidence. In the experiment, there are four conditions. Condition 1, the text only condition; condition 2, textual and visual evidence with sales returns as visual; condition 3, textual and visual evidence with uncleared invoice as visual; and condition 4, the visual only condition, shows both pieces of information in the visual format. Participants were asked which piece of evidence indicates the highest risk of material misstatement (the most relevant information) and to state their level of confidence in their decision.[21]

In all four conditions, sales returns had more relevant information for the existence and valuation assertion in the revenue business process than uncleared invoices. Therefore, I tested whether there was a significant difference in the piece of information chosen to be riskier by auditors in the two conditions (condition 2 and condition 3) where the piece of evidence which was shown as visual was different in each group. If the auditors are to choose a piece of information because it has relevant information to the existence and valuation assertion (and not because of its presentation format), then the two-sample test of proportion will not be statistically different because the same piece is chosen in the two groups. If, however, there is a change, then the auditors were choosing not because of the

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[21] During a discussion after pilot testing the instrument with a few experienced auditors and faculty who have worked as auditors, they all agreed that one piece of evidence (sales returns) was most likely to be chosen by auditors as the one that provides more risk evidence than the other types of evidence. That is, the sales returns have more relevant information to the existence and valuation assertions in the revenue business process. I regard this piece of audit evidence as being more relevant to the assertion being tested by the auditors than the other piece of audit evidence. Therefore, there was a one piece of evidence (sales returns) which I was expecting to be dominantly chosen than the other across all the four conditions.

relevance of the information since it was constant in the two groups. The two-sample test of a proportion was statistically significant. This means the piece of information which was chosen to be providing more risk in the two groups was significantly different between the two groups. Descriptive statistics on these two groups show that sales returns, the most relevant piece of evidence, was dominantly chosen by auditors as the riskier one in the condition where it was presented in a visual format but not dominating in the condition where it was shown as textual information.

This result of choosing the less relevant piece of information as the riskier piece of information in the format in which that particular piece of information was presented as visual over a more relevant piece of information which was presented as text supports the prevalence of the availability bias in auditor's decision making. Where uncleared invoices were in visual format, the vividness of this visual presentation was misinterpreted for relevance; that is, wrongly considered as the type of information that provides relevant information for the existence and valuation assertions. Given this circumstance, audit managers need to be aware of this bias when they review decisions made by junior auditors, especially when these junior auditors use different pieces of information presented in either visual or textual formats. Junior auditors are more likely to use the information presented in visual format rather than the information presented in textual format without consideration of the relevance of the evidence.

I examined this question from a slightly different perspective to determine if the results were consistent across different methods of analysis. In this analysis, I used a one sample test of proportion. I combined the two conditions (condition 2 and condition 3) which had one piece of evidence as visual and the other as text. I used a hypothesized sample proportion of 0.5 which shows no preference of either visual or text. The one sample proportion was approximately 0.7 and significant. That is, approximately 70% choose a piece which was in visual format as the risk piece of information. This means that when junior auditors are presented with various pieces of audit evidence presented in different formats (either visual or textual formats), they are more likely to use the piece of information presented as visual audit evidence regardless of the relevance of that piece of information for the decision. My conclusion was supported between two methods of analysis. In both situations, visual audit evidence was selected as providing the most

relevant information for assessing the risk of material misstatement whether the visual evidence was the more relevant or not.

Furthermore, the current study finds that junior auditors who received the evidence as visual audit evidence exhibit a higher confidence in their decision than those who receive the evidence as textual evidence. This result supports prior research which found that auditors are more likely to be more confident when they use visual audit evidence (Tang et al., 2013). In a word: not only do junior auditors over-evaluate the relevance of visual information, considering less relevant visual information as more important for assessing the risk of material misstatement for the existence and valuation assertion in the revenue business process (considering this evidence as superior to more relevant text information), they are also more confident in their decision when they make a decision using visual audit evidence.

The paper contributes to both literature and practice. Academically, the current study extends prior auditing research which has described the effects of heuristic biases in judgment in the auditing context to heuristics when using digital technologies. Additionally, it answers calls from prior studies (Brown-Liburd et al., 2015; Chang & Luo, 2019; Huerta & Jensen, 2017) for experimental studies to investigate the unintended and behavioral consequences of auditors using various digital tools. For practice, the current study can inform auditors of the possible unintended decision consequences they might face whenever they use these new technologies to gather evidence. In general, auditors should "beware of the pretty picture" and rather look at the data behind the picture to evaluate its relevance for the particular decision under consideration. An impression from system 1 is generated automatically by the decision maker when they look at the surface of the picture. However, auditors should use system 2 thinking to evaluate the information behind the picture, and auditors should not just rely on their impressions gained by system 1 thinking. When presented with different pieces of information presented in either a textual or a visual format, junior auditors should be encouraged to focus and pay attention to both pieces of information and use professional judgment to decide on the correct course of action based on all the evidence presented to them. Senior auditors who normally act as reviewers for the work of the junior auditors are encouraged to check the work performed by junior auditors with a critical eye, especially when the work has been performed in contexts where both visual audit evidence and textual formats have been presented.

Choosing less relevant visual audit evidence because it is easier to interpret (in contrast to the more relevant textual evidence) might lead to audit efficiency but will not necessarily lead to audit effectiveness.

This paper is organized as follows: section 2 presents the literature review, theoretical framework, and development of research questions. This section is followed with section 3 for methodology. Section 4 then presents the results, and section 5 concludes the current study by suggesting implications for future research and acknowledging the limitations of this study.

## 2. Literature review, theoretical framework and research question development

### 2.1. Visualization and audit evidence

The term information visualization is a multifaceted term with a wide range of definitions. In simple words, information visualization can be defined as the transformation of complex discrete data into simplified visual displays (Jones, 2015). The displays can either be static or interactive. Interactive visualization allows the decision maker to manipulate how the information is displayed (Dilla et al., 2010), while in static displays, the preparer of the information selects how the information is displayed (Kelton et al., 2010). Interactive visualization tools offer many opportunities for the auditing profession (Dilla & Raschke, 2015), but they can be difficult to use especially for auditors who are not familiar with the software that is employed.

Recently, the auditing profession has witnessed the adoption of a plethora of data visualization tools (Alles & Gray, 2016). These tools are becoming an integral part of audit preparations because they have the ability to transform complex data into visual data which is easier to interpret than textual presentations (Salijeni et al., 2021). These tools also offer the possibility of providing more meaningful insights in the data than might be available through other audit procedures, and these tools may enhance the discovery of patterns and unexpected correlations in the data which would not be observable when using traditional tools (Borthick & Pennington, 2017; Murphy & Tysiac, 2015). Previous research has found that these insights, patterns and unexpected correlations to be helpful for decision making (Earley, 2015; Sun & Vasarhelyi, 2018). They can also be useful for reviewing analytical procedure evidence (Anderson & Mueller, 2005; Anderson et al., 1992; Schulz & Booth, 1995), when auditing complex estimates (Backof et al., 2018) or carrying out risk

assessments (Boritz et al., 2014).  In other words, visual audit evidence has the potential to improve auditor's decision making by reducing  the cognitive effort of the auditor, improving the efficiency of analysis (Anderson et al., 2020).

Previous studies have documented possible negative effects of visual audit evidence in the audit process. Decision making using visual audit evidence  has been associated with high levels of false positives (Salijeni et al., 2019; Vasarhelyi et al., 2015)[22]. A high rate of false positives from visual audit evidence lowers auditors' professional skepticism because they prompt the auditors to dismiss the red flags that are identified by visual audit evidence as merely false positives and consequently the auditors perceive a lower risk of the financial statements (that is, demonstrate a lower professional skepticism)  (Barr-Pulliam et al., 2020). Another article which discusses unintended consequences of the new forms of information on auditors' decision making treated the unintended consequences of big data information (Holt & Loraas, 2021). In that study, the research team showed the unintended consequences related to information ambiguity when addressing big data information. They found that the inventory write-downs proposed by auditors using big data were lower than inventory write downs of auditors who used more traditional data. I would like to extend the above-mentioned literature on unintended consequences of new forms of information on auditor's decision making by investigating negative decision-making tendencies that arise when auditors are presented both visual audit evidence and textual audit evidence. Specifically, I investigate decision biases which prior studies suggest that thrive whenever there is a subjective decision to be made (Bazerman et al., 2002). To do this, I am using the dual process theory to understand why these biases occur.

## 2.2. Theoretical Framework for Decision Making under Conditions of Uncertainty: The Dual-Process Theory of Thinking and Reasoning

To enhance my understanding of the potential unintended consequences on auditor's judgment of visual audit evidence compared with text audit evidence, I use the dual process theory from cognitive psychology (Kahneman, 2003, 2011; Tversky & Kahneman, 1974) to provide theoretical explanations of auditor's risk assessment behavior. This theory is relevant for the current study because it describes decision making under conditions of uncertainty and has been used to explain biases in judgment in the decision

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[22] . False positives are outliers which usually generate a concern that needs to be addressed by auditors' attention when in fact they are just outliers Earley (2015).

making process (Kahneman, 2011). The dual process theory proposes that human beings can use either of the two processing modes to make decisions under conditions of uncertainty (Evans, 2003; Evans & Stanovich, 2013; Kahneman, 2003, 2011). System 1 is the default or automatic mode; it processes information until the decision maker decides that System 2 is necessary (Evans, 2003). System 2 is slow, deliberative, and analytical.

System 1 will not stop working when System 2 is engaged, but it will continue running in the background generating suggestions for System 2. Most routine decisions by an individual are made using System 1. Ideally, a decision maker will use the two modes of processing information to maximize performance.

System 1 is quite effective in making decisions in certain situations. For instance, Zhong (2011) when asking individuals to make a choice about donating money to a charity fund found that decision makers who used System 2 in this situation donated less money than decision makers who used System 1. System 2 decision makers made fewer donations and donated less money than System 1 decision makers. This suggests that in some simple situations system 1 may result in better decisions than system 2 thinking. Yet in as much as System 1 is good in rapidly responding to some situations, when applied in complex decision making conditions such as during the audit process, it is prone to cognitive biases commonly referred to as heuristic behaviors (Ranzilla et al., 2011). Due to System 1's susceptibility to biases, the general notion is that the analytic and deliberative mode of processing (System 2) results in better decisions than the default mode ( System 1) (Kahneman, 2011; Tversky & Kahneman, 1974).

In their classical 1974 paper, Tversky and Kahneman identified three main heuristic judgements: (1) representativeness, (2) anchoring and adjustment and (3) availability (Tversky & Kahneman, 1974). In this study, I focus on the availability bias as I think this bias is likely to be relevant to decision making that makes use of visual or textual information. The availability bias is found whenever a decision maker makes a decision based on the frequency or ease with which an instance or piece of information comes to the decision maker's mind (Trotman, 1998; Tversky & Kahneman, 1974). The availability bias is influenced by the frequency, familiarity, imaginability  and vividness of the information (Tversky & Kahneman, 1973). It seems likely that visual audit evidence will enhance the imaginability and vividness of the evidence for the auditor and that the visual evidence will then become the evidence used by the auditor simply because it is easier for

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the auditor to understand than is textual evidence. The visual evidence is embedded in the auditor's cognitive memories, potentially resulting in the availability bias (Chang & Luo, 2019; Ho & Beyan, 2020).

## 2.3. Effects of visual audit evidence on junior auditor's judgment

Dual process theory suggests that decision makers tend to search for information that is readily available and easily retrievable in memory when they make a decision (Tversky & Kahneman, 1974). This information will be deemed by the decision maker to be more relevant for a judgment even though this might not actually be the case. Previous audit research suggests that auditors are susceptible to this judgment bias (Bedard & Wright, 1994; Fay et al., 2015; Libby, 1985; Maradona, 2020; Ranzilla et al., 2011). Libby (1985) found that auditors when evaluating an audit decision based on analytical procedure evidence, used the frequency of occurrence of errors in their estimate of financial statement errors, because frequently occurring errors can easily be brought to cognitive memory. In addition, auditors tend to use personal experiences and general audit firm standard procedures when assessing risk related to fraud (Fay et al., 2015). In other words, the procedures which are commonly thought to indicate risk in fraud setting were the ones which quickly came to auditors' mind when they were conducting fraud risk assessment. In addition, Bedard and Wright (1994) showed that auditors can use readily available information such as previous misstatements to predict future possible misstatements by that organization. Availability bias can also influence auditors to be inclined towards prior period audit procedures because they are the most available working procedures (Ranzilla et al., 2011). These studies show that decision making in auditing context is prone to judgment biases which are influenced by the ease with which certain information is brought to mind and can be retrieved from auditor's cognitive memory. Even though prior research has documented the prevalence of the availability bias in auditing, none have done so upon examination of the new visual evidence that is now available from ADA tools. Given this deficiency in current research, our knowledge is limited on whether the availability bias might be present and problematical for audit practice in using the new forms of evidence brought by ADA visualization tools.

Recent technological innovations have led to the introduction of powerful visualization tools. When used in the audit process, these tools can transform discrete data that might be difficult to remember and understand into useful audit evidence. Indeed, in

prior research, visual audit evidence has been found to assist auditors in decision making (Anderson et al., 2020; Backof et al., 2018). Despite these positive contributions, the current paper argues that interpretation of visualized audit evidence can be undermined by biases (Chang & Luo, 2019) since prior research in auditing has documented that the ease with which the information that is brought to the auditor's mind may adversely affect the auditor's decision making process (Bedard & Wright, 1994; Libby, 1985; Ranzilla et al., 2011).Visual audit evidence increases the vividness of that information which improves how it will be retrieved from memory when used in the future (Chang & Luo, 2019; Ho & Beyan, 2020). In addition, when provided with both visual and non-visual information, decision makers tend to focus on the visual, because it is more readily available and easily retrievable in cognitive memory (Ellis & Dix, 2015; Jones, 2015). In other words, the vividness of the visual audit evidence information and its easy retrieval from cognitive memory may be wrongly interpreted to construe particular information as relevant audit evidence.

In this regard, in as much as I acknowledge the cognitive benefits brought into the decision-making process by visual audit evidence, in line with the dual process theory, I argue that junior auditors will use the visual evidence over the text evidence regardless of the relevance of information contained in the text evidence. This is unfortunate; decisions arrived at without considering all the information presented are biased decisions and might not result in ideal choices. By contrast to such circumstances, the auditing standards encourage auditors to use professional judgment to decide on the relevant information only after considering the available audit evidence in and of itself. That is, auditors are encouraged not to put emphasis on the presentation format of the audit evidence but rather they should only focus on the relevance of the information to the particular assertion that is being tested. With this in mind, I ask the following research question:

*R1: When presented with two pieces of information, one in text form and one in visual form, will junior auditors be more likely to find the visual information to be more relevant for the decision, even if the visual information is less relevant than the textual information?*

## 2.4. Effects of Visualized Audit Evidence on auditor's confidence

When making a decision, it is crucial that auditors maintain an appropriate level of confidence in the decisions they make because they are responsible for their decisions. If

the level of confidence the auditors have in their decision is higher than warranted based on the evidence they use, this may lead to a decision to perform fewer audit procedures than necessary to evaluate the risk of material misstatement in a given account.

Prior research suggests that auditors can also have extreme confidence in their knowledge (Kennedy & Peecher, 1997) and their ability to carry out a task (Owhoso & Weickgenannt, 2009). Confidence in decision making is influenced by the quality and nature of the information used to make that decision (Koriat et al., 1980). This study argues that visual audit evidence typically increases the confidence of decision makers in the decisions they make (Chang & Luo, 2019; Ho & Beyan, 2020). This is because visual audit evidence improves vividness and renders the information easily retrievable from the auditor's memory (Anderson et al., 2020; Stacy & MacMillan, 1995). This vividness and easy retrievability of information from memory increases the auditor's optimism and reliance in that piece of evidence. Being optimistic about a piece of information allows the decision maker to be more self-assured about their decision (Ho & Beyan, 2020); this increases the level of confidence in their decision (Roese & Vohs, 2010). Given this, I ask the following research question:

*R2: Will auditors who use visual audit evidence to make a decision have higher confidence in their decision than auditors who use textual evidence?*

## 3. Methodology
### 3.1 Case Development
To answer my research questions, I designed an experiment. The experimental case presents background information on the company and provides two pieces of information to be used by the auditor to evaluate the risk of material misstatement related to the existence and valuation assertion for sales revenue. The two pieces of information provide information about sales returns for the year and uncleared invoices at the end of the year. The information was shown to auditors as (1) visual only, (2) text only, or (3) one piece of information in the visual format and one piece of information in the text format (varying which piece of information is visual or textual). During pilot testing, experienced auditors identified the information about sales returns as the evidence most likely to be chosen by auditors as the piece of information that provides more risk evidence than uncleared invoices. I regard sales returns as being more relevant to the assertions tested by the auditors and uncleared invoices as less relevant to the assertion. This assumption was

verified during testing and in both the visual and text only condition, sales returns was selected as more likely to provide evidence about the risk of material misstatement for the existence and valuation assertion.

## 3.2 Case description and measurement of variables

The case described Good Attire; a sportswear distribution company listed on the Oslo Stock Exchange. Good Attire sold high quality sportswear in bulk to retail stores as well as in small quantities to sports clubs and gyms in the Nordic region. Participants were told that they were part of the engagement team and were currently in the planning stage of the audit for the revenue business process. Revenue and accounts receivable were significant accounts in the business process, and existence and valuation were the relevant assertions for the revenue business process. Participants were told that they will be given two additional pieces of information to assist them in evaluating the risk of material misstatement.

The experiment had four conditions: (1) text only, (2) text and visual evidence with visual as the more relevant information; (3) text and visual evidence with text information as the most relevant information; and (4) visual only. The information used in the experiment was developed using Microsoft Power BI, a data visualization tool commonly used by auditors (Eilifsen et al., 2020). Ninety-seven auditors were recruited from Norway. Six were removed from the analyses because they had more than 4 years working experience and were not considered to be junior auditors.[23] The participants were randomly assigned to one of the four conditions in the experiment. In all four conditions, the piece of information that appears first was randomized to rule out recency effects when making a decision. The case also included four comprehensive questions which were general questions about the case intended to measure participants' general understanding of the case material. The mean score on these questions as a percentage was 77% for all participants across all conditions, indicating that the participants paid attention to the material in the case.

### 3.2.1 Independent variables

Independent variables are the variables that are manipulated by the researcher (Trotman, 2001). As described above, in the experiment I manipulated the relevance of the

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[23] Average auditing experience was 29 months when I have 97 auditors. When I removed the 6 auditors who had more than 4 years of experience, the average working experience becomes 22 months.

information and the presentation format. The two pieces of information had different relevant information content. Sales returns had more relevant information than did the uncleared invoices in about the risk of material misstatement related to the existence and valuation assertions in the revenue business process. Presentation format was manipulated in different ways: visual only, text only, or text and visual. In the text and visual format conditions, the participants received one piece of information in text format and one piece of information in visual format. These two conditions were used to examine the first research question on whether auditors are more likely to use the piece of information presented in the visual format over the text format without considering the relevance of the information provided. In the two remaining conditions, the participants received both pieces of information in text only format or in visual only format. The visual only and text only conditions were used to examine the second research question on the effect of presentation formats on auditor's confidence and to confirm which piece of evidence participants considered to be most relevant to the risk assessment decision.

### 3.2.2 Dependent variables

The participants were asked to evaluate both pieces of information and decide whether sales returns or uncleared invoices provided the highest risk of material misstatement in the revenue business process. This decision was made by participants in all four conditions. In addition, the text only and the visual only groups make an additional decision. This decision was to measure their level of confidence. This decision was made on an 11-point Likert Scale.

## 4. Results

### 4.1. Participants demographics

Using Qualtrics, an online survey software to administer the questionnaire, I recruited junior auditors from audit firms in Norway. My final sample had 91 junior auditors. These auditors had an average work experience of 22 months. A total of 78% of the auditors were from Big 4 audit firms, and 71% have received training in the data analytics tools they use in the audit process. On an 11-point Likert Scale (with 10 as high familiarity and 0 as low familiarity), the participants had an average of 5.07 on familiarity of risk assessment in the revenue business process. Table 1 shows a detailed description of the participants' demographics

**Table 1: Sample demographics and summary statistics of evidence which provides risk and level of confidence**

**Panel A: Sample Demographics**

| Variable | Categories | Frequency | Percentage | Cumulative Percentage |
|---|---|---|---|---|
| Audit Firm | Big 4 | 73 | 80.22 | 80.22 |
| | Mid-tier | 13 | 14.29 | 94.51 |
| | Other audit firms | 5 | 5.49 | 100 |
| | *Total* | *91* | *100* | |
| Gender | Female | 37 | 40.66 | 40.66 |
| | Male | 54 | 59.34 | 100 |
| | *Total* | *91* | *100* | |
| Position/Rank | Audit assistant/Staff Auditor | 34 | 37.36 | 37.36 |
| | Audit Senior/Senior Associate | 57 | 62.63 | 100 |
| | *Total* | *91* | *100* | |

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Experience | 21.75 | 10.10 | 1 | 48 |
| ADA training | 0.71 | 0.45 | 0 | 1 |
| Familiarity with risk assessment in the revenue business process | 5.076 | 2.14 | 0 | 10 |

*Notes*: Panel A shows the demographical summary statistics. Experience is in months of audit experience, with 48 months being the highest in the sample. ADA training is a dummy variable where 1 is when an auditor receives training in ADA tools, they are using in their audit firm and 0 otherwise. Familiarity with risk assessment in the revenue business process is measured on a 11-point Likert scale from 0 to 10.

**Panel B: Summary statistics of evidence which provides risk and level of confidence**

| | | Condition 1 (All picture) | Condition 2 (Sales returns Picture) | Condition 3 (Uncleared invoice picture) | Condition 4 (All text) |
|---|---|---|---|---|---|
| Riskier Information | Mean | 0.88 | 0.818 | 0.409 | 0.863 |
| | (St.dev) | (0.331) | (0.394) | (0.503) | (0.351) |
| | N | 22 | 22 | 22 | 25 |
| Confidence | Mean | 6.27 | | | 5.28 |
| | (St.dev) | (1.315) | | | (1.208) |
| | N | 22 | | | 25 |

*Notes*: Panel B shows the summary statistics of the piece of information that provides more risk, the level of participants' confidence and the amount of substantive testing they will do. On the variable of the piece of information that provides more risk, 1 is coded when participants choose sales returns and 0 if participants choose uncleared invoices.

## 4.2 Results for Research Questions
### 4.2.1 Availability bias

Table 2 shows the results for the first research question. In this research question, I asked whether junior auditors are more likely to find the visual information to be more relevant for the decision, even when the visual information is less relevant than the text information. Sales returns was most likely to be picked as the piece of information that provides riskier information because it has more relevant information for the existence and valuation assertion in the revenue business process than do uncleared invoices. Given this, the study tested whether there was a difference in the choices made by the auditors in the two groups when one piece of information was in visual format and the other was in text format. To do this, a two-sample test of a proportion was used and coded 1 if a participant chooses sales returns as the piece of information that provides more risk and 0 if they choose uncleared invoices. If the auditors are to choose a piece of information because it has relevant information to the assertions being tested not because of its presentation format, then the two-sample test of proportion will not be statistically different because the same piece of information would be chosen in the two groups. Results in table 2 panel A show that in the condition where sales returns were a visual, approximately 82% of participants choose sales returns as the piece of information that provides more risk while in the other condition where uncleared invoices were in visual format approximately 41% choose sales returns as the piece that shows the risk of material misstatement. This difference was statistically significant (p= 0.0053 two tailed). Going back to the preference of visual over text research question, this result means that in the condition where sales returns was presented in a visual format, approximately 82% choose sales returns; in the condition where uncleared invoices was presented in a visual format approximately 59% of the participants choose the uncleared invoice, (this despite the fact that sales returns has more relevant information for the existence and valuation assertion than do uncleared invoices). This result answers my research question by showing that when presented with two pieces of information, auditors are most likely to use evidence in visual formats rather than textual formats.

**Table 2: Results for two sample tests of a proportion and results for one sample test of a proportion**
**Panel A: Results for two sample tests of a proportion**

| Condition | N | Mean | Standard Error | P-value |
|---|---|---|---|---|
| Sales returns as picture | 22 | 0.818 | 0.082 | 0.002*** |
| Uncleared invoice as picture | 22 | 0.409 | 0.104 | 0.393 |
| Difference | | 0.409 | 0.133 | 0.005*** |

*Notes*: Table 2 panel A presents results of sample tests of proportion. 1 is coded when participants choose sales returns and 0 if participants choose uncleared invoices. The row written difference presents the results for the two-sample test of proportion for the two conditions which have a picture and text combined. The first two results present the individual one sample tests of proportions for the named variables. ***p<0.001.

**Panel B: Results for one sample test of a proportion**

| Condition | N | Mean | Standard Error | P-value |
|---|---|---|---|---|
| Sales returns as picture and Uncleared Invoice as picture | 44 | 0.70 | 0.068 | 0.0067*** |

*Notes*: Table 2 panel B presents the one sample t test results of the two conditions which have a picture and text combined. ***p<0.001.

In addition to the two-sample test of proportion discussed above, I evaluate the results using a one-sample test of proportion on the two groups (condition 2 and condition 3) to provide another way in which to address the research question. Participants who chose the piece of information that was displayed in a visual format were coded as 1, and participants who chose the piece of information which was displayed in a text format were coded as 0. A one sample test of proportion with a hypothesized proportion of 0.5 was used to test the first research question. A hypothesized proportion of 0.5 represents what the proportion would be if there were no preference for a piece of information with regard to the format in which that information was presented (in visual format or text format). This

means that if auditors choose a piece of information based on the relevance of that piece of information to the assertions tested, then the sample proportion will not be statistically different from the hypothesized 0.5. If there were a preference towards a particular type of presentation, then the sample proportion will be significantly different from the hypothesized proportion of 0.5. As shown in Table 2 panel B, the proportion mean is 0.704. This was significantly different from the hypothesized proportion of 0.5 (p= 0.0067 two tailed test). This means approximately 70% of the participants in the two conditions combined chose the piece of information which was presented in visual form as the piece of information that provides the most relevant information to evaluate the risk of material misstatement in the revenue business process.  This result provides further evidence to support the findings made earlier that when given two pieces of evidence, auditors are most likely to use evidence presented in visual format than evidence presented in text format (because evidence presented in visual format is more vivid and easily retrievable from their cognitive memory than is textual information).

In addition, I investigate whether audit experience and familiarity with risk assessment in revenue business process influenced whether junior auditors choose either the piece of information presented in visual or that presented in text format. Untabulated results using logistic regression show that neither of these variables influenced the decision to choose either the piece of information presented in visual or that presented textually.

**4.2.2 Effects of visual audit evidence on auditor's confidence**

Table 3 shows the results of the second research question. In this research question, I asked whether the presentation format in which the auditors received the information has an effect on the level of confidence which the junior auditors express on the subsequent decisions they make. A regression analysis of confidence on the condition which participants were in (picture only condition or text only condition) was performed, while controlling for audit experience and familiarity with risk assessment in the revenue business process. The results in Table 3 show that the variable for "condition in which the participants were in" was significant, meaning this variable has an effect on auditors' level of confidence. Mean comparison between these two groups (visual only versus text only) shows that auditors in the visual only group have a higher mean confidence (6.27) than auditors who were in the text only group (5.28), p= 0.009 (two tailed tests). With these findings, the results suggest that when the auditor makes a decision using visual

representation, the decision is accorded a higher level of confidence in their decision than when an auditor makes a decision based on information presented in a text format. This result indicates that not only might junior auditors be subject to a decision bias where they select less relevant visual information over more relevant text information, but also, they are more confident in the decision they made using visual audit evidence. This level of confidence may lead the auditor to underestimate the risk of material misstatement for the existence and valuation assertion in the revenue business process.

Familiarity with risk assessment in the revenue business process was also significant. This means the more familiar the junior auditors are with risk assessment in the revenue business process, the more confident they become with their decisions. By contrast, the experience variable was not significant. Overall, I found evidence which suggests that the presentation format and the level of familiarity with risk assessment in the revenue business process has an effect on the level of confidence.

**Table 3: Regression analyses on confidence**

| Variable | Coefficient | Standard Error | p-value |
|---|---|---|---|
| Picture only condition or Text only condition | 1.177 | 0.372 | 0.003*** |
| Audit experience | -0.013 | 0.020 | 0.512 |
| Familiarity with risk assessment in revenue business process | 0.179 | 0.091 | 0.056* |

*Notes:* Table 3 presents the ordinary least squares regression on confidence (dependent variable) on whether participants were from the picture only or text only condition, audit experience, type of audit firm and familiarity with risk assessment in the revenue business process. *p<0.01; **p<0.05, ***p<0.001.

## 4.3 Additional Analyses

In addition, in the experiment there was a question that was answered by the two groups which had the two pieces of information as either in a picture only or in a text only format. These participants answered a question which was measured on a Likert Scale of 0 to 10 on the amount of substantive testing they were going to perform based on the information they received. With this question, the study endeavors to investigate the factors that can affect the level of substantive testing done to evaluate the risk of material misstatement associated with the existence and valuation assertions for the revenue business process. To do this, a regression analysis which included an interaction term of confidence and condition while also controlling for the audit experience and familiarity with risk assessment in the revenue business process was performed. The results as shown

in Table 4 shows that the condition variable (whether participants were in a picture only or a text only condition) is marginally significant. Interestingly, even though the confidence variable is not significant, the interaction term between confidence and condition is significant. This result suggests that if a participant has a higher level of confidence and is in a picture only condition, that participant will most likely not perform more substantive testing than a participant with lower confidence who addresses a text only condition.

**Table 4: Regression analyses of the amount of substantive testing to be done**

| Variable | Coefficient | Standard Error | p-value |
|---|---|---|---|
| Picture only condition or Text only condition | 4.491 | 2.508 | 0.081* |
| Confidence | 0.512 | 0.320 | 0.117 |
| Interaction (picture or text only condition*confidence) | -1-000 | 0.432 | 0.026** |
| Audit experience | -0.002 | 0.028 | 0.937 |
| Familiarity with risk assessment in revenue business process | -0.118 | 0.138 | 0.397 |

*Notes:* Table 4 presents the ordinary least squares regression on the amount of substantive testing to be done (dependent variable) on whether participants were from the picture only or text only condition, confidence, audit experience, type of audit firm and familiarity with risk assessment in the revenue business process. $*p<0.01; **p<0.05$.

# 5. Conclusion

Audit firms are investing in ADA tools because these tools have the potential to improve audit efficiency. Even though the current study acknowledges important benefits to the audit profession from adding ADA tools to an audit, the current paper argued that audit decisions are made under conditions of uncertainty, and therefore unintended consequences can result from adding visual tools to the audit process. This current study shows that when auditors are presented with two different pieces of information presented in either visual or text format, they are most likely to choose the piece of information that is displayed in visual over the one that is displayed in text format, without taking into account the relevance of information in the piece of evidence. This decision-making bias is consistent with the availability bias, where decision makers use information that is easily accessed in their cognitive memories. The study further shows that when auditors make a decision using information in visual format only, they are more likely to be more confident about their decision than auditors who use the same information in textual form.

The current study has several contributions to both theory and practice. Theoretically, the study extends prior research on decision biases to the recent research stream of digital technology. By doing so, the study answers calls for research by several prior studies to provide empirical evidence of how visual audit evidence affects auditors' decision biases (Chang & Luo, 2019; Huerta & Jensen, 2017). In addition, the study extends contemporary studies (Anderson et al., 2020; Backof et al., 2018; Boritz et al., 2014) that have investigated how the use of visualization tools in the audit process affects auditor's decision making. This study shows the unintended consequences of focusing on this information. The study also has practical implications for the audit profession. First, the study informs the reader that in as much as visual audit evidence has been purported to bring several benefits to the auditor's decision-making process, these tools are still prone to judgment bias which can unintentionally jeopardize the benefits associated with visual audit evidence. Acknowledging this, audit managers and other senior audit executives need to review the work of junior auditors with a critical eye whenever they make audit decisions where there is a mixture of information presentation formats.

In addition to these important findings and implications, the current study acknowledges a number of limitations. First, the study used participants with an average of only 22 months' work experience; given this, the study cannot be generalized to the whole profession. Future studies can carry out a similar study using more experienced auditors to determine whether results can be generalized to the audit profession as a whole. In addition, the experiment was an online experiment, and I did not control for time. Future studies can carry out similar studies under controlled environments, where researchers control the time used to complete the study and see whether there are significant different findings from those of this study.

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**Study 3: Fraud detection in the New Economy: Understanding digital fraud in Wirecard.**

# Fraud detection in the New Economy: Understanding digital fraud in Wirecard.

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## Abstract

The purpose of the paper is to investigate the fraud risk factors associated with fraud detection in financial technology organizations using Wirecard as a case reference. We use discourse analysis to analyze several publicly available documents such as articles from financial newspapers and published and unpublished manuscripts. These documents were analyzed using the fraud triangle as a theoretical framework. Our analysis shows that of the three factors identified in the fraud triangle, opportunity was the most prevalent factor. Opportunity emanated from fraud risk factors related to unique environmental risks associated with operating in the financial technology industry. These risk factors include: the processing of large sums of cash, complex revenue recognition models, the widely held belief that businesses in the industry were highly profitable, weak internal controls and poor supervisory reviews from the board of directors. Pressure was also present as a fraud factor as shareholders expected record-breaking growth in net income year after year. Rationalization was barely observed. An important way auditors and regulators avoid the mistakes of the past is to analyze audit failures whenever they occur with the goal of learning from past failures. Therefore, our study assists regulators and auditors to better anticipate and deal with the possible misstatements related to the types of business transactions that are processed in the financial technology industry.

**Keywords:** New Economy, Financial Technology, Digital Fraud, Fraud Triangle, Wirecard

# 1. Introduction

Over the past years, world economies have witnessed several changes in business models such as advancements in technology and most recently their responses to the COVID 19 pandemic. These changes have resulted in businesses moving towards cashless operations and business organizations adopting new business models of the New Economy.  The term New Economy can have several interpretations, but in this study, "New Economy" refers to the transition of businesses from traditional business models of physically selling goods or providing services to providing new technology-enhanced services to other companies selling either goods or services and thereby earning sales revenue when they facilitate such services (Angeloska-Dichovska & Petkovska-Mirchevska, 2017; Feng et al., 2001).

The New Economy has resulted in the formation of several new industries, one of which is the financial technology industry.  The financial technology industry is an emerging industry that uses technological software to automate the delivery and use of financial services *(*Arner *et al*., 2015). Because the financial technology industry is rapidly evolving, the past years have witnessed a rapid increase in activity in this industry, including an increase in instances of fraud (Álvarez, 2022; Faccia et al., 2020; Haverstock & Kauflin, 2021).

The paper focuses on the fraud risks associated with auditing companies in the financial technology industry. Because fraud is always a concern when the business environment in which an industry functions undergoes significant changes, understanding the fraud in this industry will assist regulators and auditors to better anticipate and deal with the possible misstatements related to the types of business transactions that are typically processed in the financial technology industry. An important way auditors and regulators avoid the mistakes of the past is to analyze audit failures whenever they occur with the auditors' goal of learning from past failures and developing ways to avoid audit failures in the future. In this context, we use the Wirecard AG (here after Wirecard) [24] fraud, from 2020 in Germany and Asia, to illustrate these points and understand how the fraud was perpetrated and suggest how the audit failure related to this fraud might have been avoided.

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[24] In its 2018 annual financial statements, Wirecard AG described itself as "one of the world's leading technology companies for electronic payment processing and payment solutions (company) which provides tailor-made and comprehensive digital solutions within the entire payment ecosystem for all sales channels" Wirecard (2018). *Annual Report* https://www.wirecard.com/wp-content/uploads/2020/12/Annual-Report-2018.pdf

Founded in 1999, Wirecard had been criticized for its financial reporting almost since the company's beginnings, criticized sometimes by independent research groups who questioned the size of its operations in Asia, and at other times by newspaper journalists, including Daniel McCrum writing for the *Financial Times.* In 2016, anonymous short sellers of company stock published a report that raised suspicions about money laundering operations in the company. Despite these financial reporting concerns and public criticisms, Wirecard received unqualified audit opinions from Ernst & Young GmbH (EY). During this time, the company carried on an extensive expansion plan, while its share price continued to increase, rising to a high of € 191 per share (McCrum, 2020). As a result of its growth and apparent prosperity, in 2018 Wirecard was listed on the prestigious DAX30 index[25] as one of the top 30 "most-valuable stocks" on the Frankfurt Stock Exchange in Germany. Before the accounting fraud was exposed in 2020, the company was considered to be one of the "rare success" stories of the financial technology industry in Germany.

In June 2020, the business world was shocked when Wirecard admitted that about €1.9 billion held in escrow accounts in the Philippines might not exist. Based on this report, Wirecard's share price crashed. The Germany company, once considered a rare success story of the financial technology industry, filed for bankruptcy days later. Many were left baffled by how a company, which had recently been added to the DAX30 index, had ended up with a stock price of €0.03 per share (Bloomberg, 2022)[26]. Wirecard's stock became almost worthless in a matter of days and lenders were left with debt exposures for billions of Euros. Wirecard become the first company to apply for bankruptcy while still being listed as one of the 30 most valuable companies on the Frankfurt Stock Exchange.

This study investigating the accounting fraud at Wirecard is important because economies around the world continue to move towards cashless societies that transfer cash electronically. This revolutionary change in the way companies move currency from one location to another has created an opportunity for financial technology organizations to

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[25]DAX is a stock market index for blue-chip companies trading on the Frankfruft Stock Exchange. By making it into DAX 30 index, Wirecard becomes one of the 30 most valuable companies trading on the Frankfurt Stock Exchange. This index was increased to 40 companies in 2021.

[26] The share price was retrieved on 1/07/2022 via the following link: https://www.bloomberg.com/quote/WDI:GR

offer unique services in areas such as payment and transaction processing[27], wealth management[28], crowdfunding[29] and capital markets[30]. In a drive to offer unique services in the marketplace and to separate their services from the services of banks, financial technology organizations encourage creativity and innovation in business operations (Lee & Shin, 2018; Lee, 2015). Offering unique services brings rapid growth for companies in this industry, and allows them to quickly evolve from small startups to large conglomerates (Lu, 2018).

Encouraging creativity and innovation allows them to use complex and aggressive revenue recognition models. These aggressive revenue recognition models push accounting standards to their boundaries, thereby complicating fraud detection by auditors. In addition, companies in this industry have a high appetite for risk and often do business in highly profitable but potentially illegal online businesses such as gambling and sometimes they associate themselves with money laundering practices (Álvarez, 2022; Faccia et al., 2020).

Fraud detection in online business transactions such as gambling, and activities of money laundering is complicated and always a concern for the auditors and regulators. In this context, Wirecard provides us with a unique platform to understand the types of fraud auditors are most likely to face in the financial technology industry. Understanding how the fraud occurred in Wirecard may allow us to understand how to prevent and detect frauds in the financial technology industry in the future.

To understand this instance of a complex fraud involving a financial technology organization with a digital revenue stream, this paper uses the fraud triangle, a theoretical framework provided by the Auditing Standards, and the risk factors identified in ISA 240 to analyze the fraud. The fraud triangle is a theoretical framework that can be used to explain why fraud occurred, identifying three key elements that are present whenever fraud occurs: opportunity, pressure, and rationalization (Albrecht et al., 2008; ISA 240). Opportunities are various types of circumstance that allow fraud to occur. Pressures are the

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[27] For example, Wirecard, PayPal, Venmo (a subsidiary of PayPal), Alipay (a subsidiary of Ant Group), Worldpay etc

[28] For example, Betterment, Wealthfront Inc,

[29] For example, Kickstarter, Indeogogo, GoFundMe

[30] For example, eToro, Plus 500 etc.

personal and social factors that push decision makers to engage in fraudulent activities, and rationalizations are the self-serving justifications offered by the decision makers to legitimize their own actions.

This study uses several publicly available documents including articles from reputable financial newspapers, published and unpublished manuscripts. Using discourse analysis, we analyzed these several discourses (sources of information) to construct the Wirecard fraud case that was consistent with the fraud triangle, a theoretical framework provided by the auditing standards in ISA 240. Financial newspaper articles are important because investigative journalists played an important role in exposing the accounting irregularities in Wirecard. In addition, Wirecard is still an ongoing case and financial newspapers continue to report new events as information about business transactions and the fraud is disclosed by   regulators or the company itself.

 The analysis of documents in the Wirecard fraud suggests that opportunity was the most dominant factor allowing the fraud to occur and with pressure playing a somewhat lesser role. Opportunities can be discerned in an examination of the types of transactions processed by Wirecard, the way it recognized revenue based on its financial services, its business model and the distinctive features of its financial reporting structure.

In addition, internal control weaknesses played a major role, especially related to the regulations involving Third Party Acquirers (TPAs).  TPAs are business partners which were used by Wirecard to trade in countries where Wirecard did not have a banking license. Wirecard used these business partners in its Asian operations where the Wirecard cash processing facility did not have a license to process debit or credit cards for merchants. Cash from these transactions was sent to escrow accounts supposedly overseen by a trustee in the Philippines, but these accounts did not exist. Other internal control weaknesses were related to a lack of oversight in acquisitions. Wirecard was expanding its operations through acquisition of various startup companies in Asia. It is alleged that particular executives benefited from these transactions when Wirecard overpaid for these acquisitions and there was no adequate system of oversight to monitor the authorization and approval of these specific acquisitions.

ISA 240, Appendix 3 provides examples of situations that indicate a possibility of fraud. These situations include tips or complaints to the auditor about alleged fraud. In

Wirecard, several allegations were raised for years by investigative journalists and short sellers which were ignored by the auditors and the regulators. This created an opportunity for fraudulent activity to continue.

ISA 240, Appendix 2 provides a list of audit procedures which an auditor might use to address the risk of material misstatements due to fraud or error. These procedures include surprise visitations and performing substantive analytical procedures using disaggregated data. Given that investigative journalists raised concerns about Wirecard's operations in Asia (some of which were sharing offices with bus companies) and its reliance on a few subsidiaries to make profits, if auditors had followed the guidelines given in ISA 240, Appendix 2 such as making surprise visits, performing substantive procedures on disaggregated data and seeking additional evidence from external sources other than Wirecard's own (direct from the banks), they would have detected the fraud earlier. Failure on the part of auditors to comply with these guidelines and make use of suggested procedures to detect fraud in effect created an opportunity for fraudulent financial reporting.

In addition to opportunity, pressure also played a role in the Wirecard fraud. Pressure emanated from the expectations of the analysts about the financial capabilities of Wirecard. Wirecard was perceived by external stakeholders as a high performing company in the financial technology industry and once a business entity has attained this status, there is increasing pressure to maintain the status of a high performing company. This status and the motivation to maintain it probably exerted strong pressure on management to meet the financial expectations of external stakeholders and to uphold the company's image in the marketplace of the "rare success story".

The study compliments prior literature on fraud detection which suggests that even though not sufficient, opportunity is the most prevalent of the three factors of the fraud triangle (Homer, 2019; Schuchter & Levi, 2015), and rationalization is barely observable in certain situations. In addition, the study extends the literature on fraud detection and audit failures to business transactions produced by financial technology organizations. Most of the previous fraud literature discuses fraud in entities which earn revenue through selling goods and services (e.g., Ahold, Parmalat, Enron, WorldCom). Although many organizations still earn revenue in this way, computer technology has resulted in organizations that earn revenue in new ways by offering innovative financial services to

facilitate other company's ability to function within the New Economy. This study offers a unique example for readers to learn about fraud in an important (maybe representative) organization of the New Economy, thus providing readers with knowledge important to their future careers as auditors, regulators, or specialized fraud detectors.

The paper proceeds as follows: the next section sketches key features of the financial technology industry and discusses the theoretical framework used to analyze the fraud. Section 3 outlines the methodology and section 4 describes events occurring in the Wirecard fraud. Section 5 discusses the Wirecard fraud using the theoretical framework provided in ISA 240. Section 6 discusses the corporate governance failures in Wirecard. Section 7 concludes and discusses the lessons from the fraud and notes some limitations of this study.

## 2. The Financial Technology service industry and the theoretical framework used by researchers to analyze frauds.

This section describes the financial technology industry, auditors' responsibility related to fraud, the theoretical framework provided by the regulators to identify where fraud is likely to occur and how to detect it.

### 2.1 The Financial Technology Industry Operates in the "New Economy"

The availability of technology has greatly transformed how business organizations carry out their business. Many organizations today embrace business models of the New Economy which are technology-oriented and often focused on the provision of services to various client companies. In the New Economy, businesses generate revenue by providing services based on advanced technological developments (Angeloska-Dichovska & Petkovska-Mirchevska, 2017; Feng et al., 2001). An important feature of businesses operating in this economy is that they often do not rely on banks to process financial transactions but set up new services to perform this function. This puts them in direct competition with banks, and today we often find that banks have reacted to this development by changing their own business models to avoid losing this lucrative business of processing cash flow in accounting transactions (Munk, 2022).

Organizations in the New Economy typically have a highly imaginative younger generation of employees (Chuen, 2017) who work in a dynamic and innovative environment. Due to the level of innovation in this environment, organizations in the New

Economy often adopt complicated revenue recognition models. This makes fraud detection more difficult than in traditional business models. In addition, the rapid changes in business models outpace auditors who are slow to adapt and sometimes unable to adjust to innovations in financial practice within the New Economy (Alles, 2015). These factors further complicate fraud detection in the oversight of organizations of the New Economy.

Financial technology organizations operate in the New Economy. When we speak about financial technology as an industry we are referring to the use of technological software to automate the delivery and use of financial services (Arner *et al.*, 2015). The phrase "financial technology" refers to various innovations in accounting information systems which re-shape how businesses process financial transactions and exchange cash. Companies working in this area come in different forms from new startup companies to international technology companies that provide financial services to businesses so they can operate efficiently on a global basis (Gomber *et al.*, 2017).

A company providing financial technology services to businesses might operate in several different markets. They may provide payment and transaction processing services; they may operate as lenders of funds; they may work in the area of wealth management. They may provide crowdfunding financial services, or they may operate in the capital market and insurance services area (Haddad & Hornuf, 2019; Lee & Shin, 2018). Crowdfunding business models are mainly concerned with networking entrepreneurs who need funding with contributors who have the funds that are sought (Lee & Shin, 2018). Innovative models in lending businesses facilitate the direct transfer of money from lenders to borrowers at a fee without the use of a bank (Lu, 2018). Wealth management business models use sophisticated artificial intelligence to advise investors on possible investment opportunities (Haddad & Hornuf, 2019). Capital market business models offer a platform for traders and investors to interact, and exchange commodities and stocks (Lee & Shin, 2018). The payment and transaction processing business model includes financial technology organizations that offer innovative payment and transaction processing methods (Haddad & Hornuf, 2019). The payment and transactions business models are the most popular, the fastest growing, and highly innovative of these business models (Lee & Shin, 2018; Lu, 2018; Walker, 2017). The general acceptance of new payment applications such as Google Wallet, PayPal, Apple Pay, Samsung Pay, various mobile

payment applications and crypto currencies have added to the growth of the payment and transaction business model (Haddad & Hornuf, 2019; Lee & Shin, 2018; Walker, 2017).

Due to their creativity, financial technology organizations tend to quickly evolve from simple organizational structures to sophisticated conglomerates with complex organizational structures and business models (Jakubeit, 2021; Lu, 2018). This makes it difficult to understand their revenue recognition process. In addition, financial technology organizations have a high appetite for processing business transactions from companies engaged in high risk activities offering credit services to unsecured customers, and even providing services to businesses engaged in illegal activities, transacting cash earned from gambling and prostitution and funds from money laundering operations (Jagtiani & Lemieux, 2018). Processing high risk or even illegal transactions allows these companies to charge high fees and to generate exorbitant profits (Davies, 2021). The assumption that these organizations are highly profitable coupled by their complex business models and relationships with questionable clients suggests that they function within an environment conducive for them to manipulate revenue recognition, conceal losses and facilitate the cash flow of companies engaging in illegal activities. Furthermore, regulation of financial technology service organizations tend to lag behind the innovation since regulations do not change as fast as technology (Shapiro *et al.*, 1998). In addition, it is difficult to regulate technological innovations and at the same time to ensure that the regulations do not deter innovations that may serve business and public interests (Chiu, 2016; Lu, 2018; Walch, 2016). What is more, lack of proper regulation of financial practices within a rapidly changing business environment has at least one significant consequence: it increases the susceptibility of financial technology organizations to illegal activities (Davis *et al.*, 2017). In a word, the organizations may be tempted to engage in fraud (or they may themselves be victimized by fraudulent activities.)

## 2.2 The auditor's responsibility for fraud detection during a financial statement audit (ISA 240)

According to the International Standards on Auditing (ISA, 240:4), management and those charged with governance have the primary responsibility to prevent and detect fraud. They are responsible for designing mechanisms which deter their employees from engaging in fraudulent activities.   These mechanisms can include strong internal controls, a culture of honesty and good ethical practices in the organization. The auditor's responsibility related

to fraud is to obtain reasonable assurance that the financial statements are free from material misstatements related to fraud or error (ISA, 240:5). This basically means the auditor is responsible for designing audit procedures which can detect misstatements due to fraud or error. It is, however, difficult for misstatements related to fraud to be detected by the auditor because fraud involves intentional, sophisticated, and well-calculated deceptions.

The standards further state that auditor's ability to detect fraud depends on factors such as: how skillful the perpetrator is, the size of the amounts involved, how many times the manipulation was done, at what level was the fraud committed (hierarchy) and degree of collusion involved. In addition, the auditing standards require the audit team to discuss the susceptibility of the financial statements to fraud. This discussion should be documented in working papers for future references. Once the auditors believe that the misstatement in the financial statements is due to fraud, they must bring knowledge of the fraud to the appropriate level of management which is usually one level above where the fraud occurs. Before this is done, auditors must carefully assess the evidence gathered and be confident of their allegations.

## 2.3 The fraud triangle: a theoretical framework provided by regulators to identify situations where fraud is likely to occur.

The Auditing Standards in ISA 240 provide a theoretical framework which can be used by auditors to analyze where fraud might occur. When the fraud has already occurred, this theoretical framework can be used to analyze why it occurs (Albrecht *et al*., 2008). The theoretical framework proposes that for fraud to occur, there is some pressure to commit it, opportunity to do so and some ability to rationalize the fraudulent actions (ISA, 240). These three factors are referred to as the fraud triangle.

Opportunity is construed as the factors which provide a conducive environment for fraud to occur. Common factors include complex organizational structure, poor internal control systems and inadequate employee supervision. Opportunities can also include the nature of the industry; that is, the complexity of transactions typically associated with a particular industry, the complicity which makes concealment of fraudulent transactions possible, difficult to detect by auditors and regulators. Other external factors include audit failures and inadequate supervision from the regulators.

When fraud is committed, there is normally some form of perceived pressure to commit it. Typically, this pressure comes in various forms such as financial pressure, vices, work related pressure and other pressures (Albrecht *et al.*, 2018). Financial pressure is when an individual is living beyond his or her income or is faced by unanticipated financial needs. Vices include pressure emanating from activities like alcoholism, drugs, gambling, and expensive extra-marital affairs. Work-related pressure is incurred by the employee's desire to harm his or her superiors due to the feeling of not being adequately recognized or the employee's experiencing some form of workplace grievance. Other pressures include the pressure to circumvent the system, or family pressures for better lifestyle.

Normally, the people who are involved in fraudulent activities rationalize their actions by justifying that their actions were acceptable. This basically means the culprits acknowledge that something was not properly done but at the same time they deny any wrongdoing on their own part (Albrecht *et al.*, 2018). Grounds for the rationalizations can take various forms such as denials, attention-seeking or attempts to settle past grievances (Dellaportas, 2013). Almost anything can be rationalized if pressure is present and the opportunity to commit fraud is available.

Whenever these three factors come together; they increase the inherent risk for fraudulent activities. They do not necessarily have to be of equal importance; one or two factors might be more prevalent than the others (Homer, 2019). For instance, the more opportunity there is to commit fraud or the more pressure an individual has to commit fraud the less rationalization is needed to engage in fraudulent activities. By contrast, the more ethically dishonest one is, the less opportunity and pressure are needed to influence them to engage in fraudulent activities (Albrecht *et al.*, 2018). The availability of these three factors, in their different level of influence, create "the perfect storm" for fraudulent activities. Table 1 shows the fraud risk factors in ISA 240 applicable to Wirecard.

**Table 1: The fraud risk factors in ISA 240 applicable to Wirecard.**

| 0pportunity | |
|---|---|
| 1 | Significant, unusual or highly complex transactions |
| 2 | Significant operations located or conducted across international borders in jurisdictions where differing business environments and cultures exist |
| 3 | Significant bank accounts or subsidiaries or branch operations in tax-haven jurisdictions for which there appears to be no clear business justification |
| 4 | Domination of management by a single or small group without compensating controls. |
| 5 | Oversight by those charged with governance over the financial reporting process and internal control not effective |
| 6 | Overly complex organizational structure involving unusual legal entities or managerial lines of authority |
| 7 | Inadequate monitoring of controls. |
| 8 | Large amounts of cash on hand or processed |
| **Pressure** | |
| 1 | High vulnerability to rapid changes such as changes in technology, product obsolescence or interest rates |
| 2 | Access to personal loans secured on company stocks |
| 3 | Rapid growth or unusual profitability especially compared to that of other companies in the same industry |
| 4 | Profitability or trend level expectations of investment analysts, institutional investors, significant creditors or other external parties (particularly expectations that are unduly aggressive or unrealistic), including expectations created by management in for example overly optimistic press releases or annual report messages. |
| 5 | Marginal ability to meet exchange listing requirements or debt repayment or debt covenant requirements |
| 6 | Perceived or real adverse effects of reporting poor financial results on significant pending transactions such as business combinations or contract awards |

## 2.4 Examples of circumstances that indicate the possibility of fraud and the audit procedures to address the assessed risk of material misstatement due to fraud.

In addition to the fraud triangle, ISA 240 also provides additional tools for the auditor. ISA 240, Appendix 3, *Examples of Circumstances that Indicate the Possibility of Fraud*, provides a list of circumstances that might indicate the possibility of fraud. These circumstances can be grouped into four main categories which are discrepancies in the accounting records, conflicting or missing evidence, unusual relationship between auditor and management and others. These circumstances are useful to auditors when they seek to determine whether there is a risk of fraud in the financial statements. Table 2 shows some circumstances which are applicable in Wirecard. If auditors in Wirecard had paid attention to these circumstances, they would have detected the fraud earlier. Failure to pay attention to these circumstances resulted in delayed fraud detection, creating an opportunity for fraudulent activities to continue.

INSERT TABLE 2 HERE

ISA 240 Appendix 2 also provides guidance that might be useful to an auditor to detect accounting fraud in financial technology companies. This appendix provides audit procedures which the auditor might use to address the risk of material misstatement due to fraud. Even though the procedures provided in Appendix 2 are general, they provide guidance to auditors on how they can react to the assessed risks of material misstatements or in circumstances they suspect that there is a risk of fraud. The responses will differ depending on several factors such as the fraud risk factors identified, the classes of transactions, account balances, disclosures, and assertions the misstatement affects. Table 3 shows some of the audit procedures from ISA 240 which could have been used by the auditors in Wirecard. The audit procedures in Table 3 would have helped Wirecard's auditors to detect the fraud earlier. Failure by EY auditors to implement these audit procedures delayed fraud detection in Wirecard, creating an opportunity for fraudulent activities to continue.

INSERT TABLE 3 HERE

**Table 2: Circumstances that indicate the possibility of fraud from ISA 240 Appendix 3 applicable to Wirecard.**

| | |
|---|---|
| **1** | Unsupported or unauthorized balances or transactions |
| **2** | Tips or complaints to the auditor |
| | **Conflicting or missing evidence** |
| **1** | Missing documents |
| **2** | Documents that appear to have been altered |
| **3** | Availability of only photocopied or electronically transmitted documents when originals are expected to exist. |
| **4** | Unusual changes in balance sheet, or financial statements trends, ratios or relationships |
| **5** | Inconsistent responses from management or employees arising from inquiries or analytical procedures. |
| | **Other** |
| **1** | Frequent changes in accounting estimates that do not appear to result from changed circumstances |
| **2** | Tolerance of violations of the entity's code of conduct |
| **3** | Accounting policies that appear to be at variance with industry norms |

**Table 3: Examples of possible audit procedures provided in ISA 240 Appendix 2 to address the risk of material misstatement due to fraud applicable to Wirecard.**

| | **Considerations at assertion level** |
|---|---|
| 1 | Unannounced visitations to locations or surprise counting of cash on a particular date |
| 2 | Altering the audit approach such as seeking more or different audit evidence. |
| 3 | Performing a detailed review of the entity's quarter-end or year-end adjusting entries |
| 4 | Performing substantive analytical procedures using disaggregated data |
| 5 | Investigating the possibility of related party transactions especially for significant or unusual transactions taking place towards the year end. |
| 6 | Performing computer-assisted techniques to test anomalies in a population |
| 7 | Testing the integrity of computer-produced records and transactions |
| 8 | Seeking additional audit evidence from sources outside of the entity being audited. |
| | **Misstatements due to misappropriation of assets** |
| 1 | Counting cash or securities at or near year end |
| 2 | Confirming specific terms of contracts with third parties |

# 3.Research Methodology

We used several publicly available documents such as articles from reputable financial newspapers namely *The Wall Street Journal* and *Financial Times*, published and unpublished manuscripts to analyze the fraud in Wirecard. Founded in 1889, *The Wall Street Journal* is one of the leading reputable financial newspapers which covers several aspects of finance, economics and company performance (The Wall Street Journal 2022).[31] Due to its high reputation in reporting business matters, several academic studies published

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[31] This information was retrieved from https://www.wsj.com/about-us?mod=wsjcorphat on 28 September 2022

in highly ranked accounting journals were conducted using data from *The Wall Street Journal* (see Stice, 1991; Thompson et al., 1987). Similar to *The Wall Street Journal*, the *Financial Times* was first issued in 1888 and the newspaper prides itself in objectively covering several finance and economic issues around the globe  (see Durham, 2007). The journalists from the *Financial Times* led by Daniel McCrum played a pivotal role in exposing fraudulent financial reporting in Wirecard therefore this financial newspaper is crucial in analyzing the fraud in Wirecard. We complemented information from these two reputable financial newspapers with information from both published and unpublished manuscripts. Table 4 shows the number of newspaper articles, published and unpublished manuscripts used in the study.

<div align="center">INSERT TABLE 4 HERE</div>

To analyze the information from these several source documents mentioned above, we adopted a qualitative approach of discourse analysis. Discourse analysis can be carried out in many different ways (Hannam & Knox, 2005). In our study context, discourse analysis was carried out through a systematic analysis of a wide range of texts (discourses) to discover their meaning and determine how those meanings can be reconstructed into reality (Phillips & Hardy, 2002). Epistemologically, discourse analyses is founded on the premise that reality can be reconstructed through meaningful interactions of interrelated discourses (Hardy *et al*., 2004).  Therefore, the meanings cannot be limited to a single discourse but can be attributed to interactions of a collection of discourses (Waitt, 2005).  In addition to this, discourse analysis does not only focus on what is written in the various discourses, but it also strives to reveal what has been left out (Hannam & Knox, 2005). Thus, discourse analysis takes an inductive approach (Hardy *et al.*, 2004). We used the discourse analysis to construct the Wirecard story that is consistent with the theoretical framework provided by the auditing standards.

**Table 4 Source of documents used in the study**

| Source | Number of Documents |
|---|---|
| Financial Times | 22 |
| The Wall Street Journal | 8 |
| Published Books & Peer reviewed articles | 4 |
| Unpublished manuscripts (Available on SSRN) | 2 |
| European Securities and Market Authority | 1 |
| SAFE Policy Letter | 1 |
| KPMG report | 1 |
| Texas Society of CPAs | 1 |
| Total | 41 |

# 4.The Wirecard accounting fraud

Wirecard AG (Wirecard) was a Germany company designed to respond to the push for a cashless society. Wirecard collected credit and debit card information from purchasers, processed payments and delivered the money to the seller's account. It generated revenue by charging the seller a service fee for each transaction processed. In 2002, Markus Braun became the Chief Executive Officer (CEO) of the company, and he led the expansion of Wirecard's business. In 2005, the company was listed on the Frankfurt stock market. In 2010, the company announced its plan to become an international business. English, not German became the primary language for communication, and Jan Marsalek became the new Chief Operating Officer (COO). After this time, the company raised funds from its shareholders and embarked on a rapid international expansion. The company had

operations around the world. In countries where it didn't have a banking license, Wirecard operated using a sale's arrangement known as Third-Party Acquirers (TPAs). Cash from these TPA transactions was deposited in an escrow account overseen by a trustee in the Philippines.

Questions surrounding the issue of potential fraud in Wirecard's financial statements began as early as 2008 when some shareholders raised concerns related to its statement of financial position (McCrum, 2020). EY, which subsequently becomes Wirecard's auditor, was hired to conduct a special audit and found no accounting irregularities. The suspicions about fraudulent financial statements returned in 2015 when allegations ranging from money laundering to revenue recognition concerns were raised. Over the coming years, British *Financial Times* journalists wrote extensively about Wirecard in a series published in the newspaper referred to as the "House of Wirecard".

In 2018, a former Wirecard employee contacted the *Financial Times* with whistle blower information related to operations in Singapore. The *Financial Times* published the results related to its investigation of the whistleblower information in 2019. Shortly after this publication, authorities in Singapore investigated and raided Wirecard's Singapore office to gather information for the investigation. Rather than react to the potential fraud in the Wirecard financial statements, the Germany regulators viewed the information from the whistleblower as an attempt by short sellers and journalists to destabilize the financial market. Germany regulators temporarily banned short selling of Wirecard shares for two months and investigated the journalists and short sellers rather than considering the possibility of financial fraud. In this period, the investigative journalists continued publishing articles about allegations relating to accounting manipulations.

As the investigations progressed, the company was alleged to have been involved in several accounting malpractices. These malpractices included the recording of fictitious revenue through the TPA business model. For example, one of Wirecard's TPAs in the Philippines shared an office with a local bus company yet it reported moving hundreds of millions of Euros in business transactions per year contributing a fifth of Wirecard's profits (Palma; Storbeck & McCrum, 2020). Another TPA in Dubai contributed half of Wirecard's profits, yet the TPA had less than 10 employees and majority of its key clients were out of business or could never be identified by investigative journalists (McCrum, 2019). The allegations also included round tripping between business partners involving transferring

money between related parties to show favorable income generating positions. For example, money can be transferred from the parent company to subsidiary A which transfers it to a related party external entity who then moves it to subsidiary B as revenue. After consolidation, the parent company will recognize that money as legitimate revenue (McCrum & Palma, 2019). Other allegations include overvaluation of assets, falsifying evidence, and money laundering.

In late 2019, the supervisory board in Wirecard commissioned a special audit conducted by KPMG to clear the accounting manipulation allegations raised by investigative journalists. After several delays, the special audit report was published on 27 April 2020. The report stated that KPMG had faced several obstacles in carrying out its work. It failed to either confirm the existence and accuracy or the nonexistence and inaccuracy of the bulk of Wirecard's profit and revenue from 2016 to 2018, in particular, the revenue generated via TPA's in Asia (KPMG, 2020; McCrum, 2020; Storbeck, 2020d). KPMG also questioned the classification of cash held in escrow accounts as cash or cash equivalents. Rather in KPMG's view, that cash could be classified as other financial assets (KPMG, 2020). In June 2020, Wirecard confirmed that the cash did not exist; this preceded its bankruptcy filing a few days later.

# 5. Understanding the likelihood of the Wirecard fraud using the theoretical framework provided in ISA 240

ISA 240, *The Auditor's Responsibilities Related to Fraud in an Audit of Financial Statements* provides three factors that might be useful for an auditor when considering the likelihood that fraud has occurred during a financial statement audit. These factors are opportunity, pressure, and rationalization, referred to as the fraud triangle. The use of these factors for the Wirecard fraud is discussed below.

## 5.1 Opportunity
Several of the fraud risks factors identified in ISA 240 were present in Wirecard. These risk factors include: (1) the company did business across international borders in different business environments and cultures, (2) Wirecard used highly complex financial reporting structures, (3) Wirecard operated with inadequate monitoring controls and (4) Wirecard had significant bank accounts in tax haven countries. These risk factors created an opportunity for fraud in Wirecard and are discussed in more detail in the sections below.

The first risk factor present in Wirecard is that fact that they operated across international borders and in a variety of business environments and cultures. According to prior research, this risk becomes more significant if the international operations are conducted using external associates, (Healy & Palepu, 2003; Lou & Wang, 2009) as these associates often operate off the books and they could be used to overstate revenue and conceal debts and losses (Healy & Palepu, 2003; McCrum, 2022; Newman, 2006). Wirecard operated in over 60 countries (McCrum & Storbeck, 2020a) as a financial technology company processing cash transactions. In jurisdictions where it didn't have a banking license, Wirecard used external associates known as Third Party Acquires (TPA) (McCrum, 2022). These external associates were used to overstate revenue and profit. This method of operating the business created an opportunity for fraudulent financial reporting.

A second risk factor present in Wirecard is the fact that the company managed operations based on a complex financial reporting structure. Wirecard processes many transactions using Third Party Acquirers. These TPA's operated in different time zones, had different rates of commissions, and used a variety of currencies (ESMA, 2019). Determining the mathematical accuracy of revenue recognized through more than 100 TPAs, using different currencies, exchange rates and rates of commission was a complicated process for the auditor (McCrum & Storbeck, 2020a). In addition, Wirecard had more than 50 wholly owned subsidiaries spread around the world (Jakubeit, 2021). Wirecard reported all the income for the company in consolidated financial statements, and separate reports were not prepared for the individual subsidiaries. The result was a complicated financial reporting structure vulnerable to manipulation, creating an opportunity for fraudulent reporting.

The third risk factor present in Wirecard is the lack of an effective internal control system, creating an opportunity for fraudulent financial reporting. Even though having perfectly working internal controls doesn't necessarily mean that financial statements are free from material misstatements due to fraud or error, the presence of effective internal controls can make fraudulent reporting more difficult to carry out. Wirecard was a prestigious financial technology company but its internal controls were equal to those of a startup company (Chazan & Storbeck, 2020). This view was substantiated by the KPMG special audit report which highlighted several weaknesses in Wirecard's financial reporting system (KPMG, 2020; McCrum & Storbeck, 2020c). In addition, a renowned consulting

firm McKinsey & Company warned Wirecard of the inadequacy of its internal control system, especially related to the TPA relationships (Storbeck, 2020c). Other internal control weaknesses were related to lack of monitoring controls in acquisitions. Wirecard expanded its operations through acquisitions of various startup companies in Asia. Business writers report that executives benefited from these transactions when Wirecard overpaid for these acquisitions. This was related to the lack of a proper system of oversight, authorization, and approval of acquisitions (McCrum, 2022).

A fourth risk factor present in Wirecard is the fact that the company had significant bank accounts in tax-haven countries. The 1.9 billion euros that was never found was said to have been in a bank account in The Philippines. While The Philippines is not categorized as a tax haven country, the country is well known for high levels of corruption (Guth, 2010; Johnston, 2008).

## 5.2 Pressure

Pressure, the second element of the fraud triangle can also be found in the Wirecard fraud. The pressure risk factor in this fraud came from the fact that management held a significant number of shares of stock in the company and when the company grew, their wealth grew. In addition to pressure from management, the company was also seen as a growth company by analysts, and these market observers assumed the company would continue to report impressive growth figures. The company also faced pressure to generate cash flow to meet their debt obligations.

When management has substantial stake in the company, they are likely to experience financial pressure directly related to company performance (Efendi et al., 2007; Lou & Wang, 2009). In Wirecard, the CEO was the largest single shareholder (Storbeck, 2021e). He accessed financial loans secured against his shareholding in Wirecard. For these loan obligations, if the share price of Wirecard were to go down, he was obliged to sell his stake (McCrum, 2020; Trimble et al., 2022). In other words, the CEO had a personal incentive to maintain a high share price. Observers reported that he was obsessed with monitoring the share price movement on his mobile phone (McCrum & Storbeck, 2020b). Whenever the share price moved in a negative direction, he would call for action from his executives. When the KPMG report was about to be released, he threatened the supervisory board asserting that if the report resulted in a reduction of the company's share price, they would be held responsible (Storbeck, 2021d). The CEO also exaggerated the complexity

of the technology in Wirecard which increased the share price (Daly & Touron, 2022), when in fact the technology failed to provide reliable services to big clients (Storbeck, 2021f). All these instances suggest that the CEO was under pressure to maintain a high share price to protect his personal interests in the company.

ISA 240 states that high performing companies with rapid growth rates and unusual profitability are under pressure to continue to produce impressive financial reports to meet analysts' expectations. Wirecard operated in an industry associated with high profit innovations which led analysts to develop high expectations of Wirecard's financial abilities and to label the company as a rare success story in Europe. Analysts expected profitability to continue to grow rapidly in this industry as economies continue to move towards cashless societies. Wirecard endeavored to meet these expectations, and it posted rapid sales growth, hitting earnings targets that were in line with the rare success story (Davies, 2020; Jo et al., 2021).

ISA 240 also states that management can be under pressure to engage in fraudulent financial reporting if the company has financial commitments which can be negatively affected by reporting poor financial results. Wirecard had such financial commitments. For instance, when it delayed reporting its 2019 financial results, it lost a 2 billion Euro line of credit (Davies & Steinberg, 2020). Having such financial commitments exerted pressure on Wirecard's management to produce fraudulent financial reports to protect the available lines of credit.

## 5.3 Rationalization

Rationalization, the third factor in the fraud triangle, is also present in the Wirecard fraud. Rationalization happens when the individuals who engage in fraud try to legitimize their actions as acceptable. This normally happens when there is a thin line between what is acceptable and unacceptable. The grounds for justifications can just be denials or unwillingness to take full responsibility of their actions. Because fraud investigations are still in progress, regulators have not filed court cases related to the fraud. The manager in charge of Asian operations where the bulk of the accounting manipulations took place is still on the run. For this reason, the rationalizations from company management have not reported in the press. Even though Wirecard's longtime auditor, EY acknowledged that the whole scam had been a deliberate attempt to deceive the auditors and other stakeholders (Kowsmann; Davies & Chung, 2020), Wirecard's former executives (the CEO, head of

accounting and chief financial officer) all deny any wrong doing (Chazan & Storbeck, 2020). When the former CEO appeared before a parliamentary hearing in Germany, he maintained his innocence and even said he hoped the prosecutors will be successful in finding out what really happened to the missing money.

## 6. Corporate governance failure

The corporate governance system in a company involves many individuals including management, shareholders, the board of directors, regulators, and auditors. In this section, we discuss the corporate governance failures that were apparent in Wirecard. These include audit failures in EY, failures by the supervisory board and regulatory failures.

The International Standards on Auditing (ISA 240) states that it is the auditor's responsibility to design audit procedures that give reasonable assurance that the financial statements are free from material misstatements whether due to fraud or error (ISA 240 paragraph 5). In other words, it is the auditor's responsibility to design audit procedures to identify material misstatements caused by fraud if it occurs. Business writers have stated that the audit procedures used by EY had loopholes (Kowsmann; Maurer & Yang 2020). For instance, in December 2018 EY wanted to verify Wirecard's operations in Asia. They intended to do this by using Wirecard's online merchants to process some sample transactions. EY used the access cards given to them by Wirecard executives. This decision enabled Wirecard to manipulate the transactions (Storbeck, 2021b). Skeptical auditors would have questioned the use of management provided access cards and would have requested access to the accounting system directly. EY also failed to obtain audit evidence from sources outside the company. Auditors failed to confirm the existence of cash directly from the banks where the escrow accounts were held (Storbeck; Kinder & Palma, 2020). Instead, the auditors relied on verbal and vague written explanations from management (Storbeck, 2021c). When KPMG conducted its special audit, it complied with the requirement in the auditing standards to request outside confirmation for financial assets by asking for bank confirmations and account statements from the banks managing the escrow accounts. The confirmation replies were never delivered to them (KPMG, 2020). In addition, Wirecard failed to set up an audit committee until 2019, so another form of corporate governance oversight was lacking in the company.

Furthermore, lack of adequate regulatory supervision created a loophole in corporate governance structure in Wirecard. Generally, it is difficult to regulate financial technology organizations since they lie on the border of technology institutions and financial institutions. This subjects them to possible supervision by various regulatory authorities, but also offers no clear guidance on who should supervise them (Cole et al., 2021; Steenis, 2020; Trimble et al., 2022; Wilmarth, 2021). Wirecard described itself as a leading technological organization for electronic payment processing solutions (Wirecard, 2018). The description that it was a technological organization means Federal Financial Supervisory Authority (BaFin) could not directly supervise Wirecard, the holding company, even though it could exclusively supervise Wirecard Bank because it was a financial institution (Engelen, 2021; Krahnen & Langenbucher, 2020). As a result, German financial regulators were directly regulating only a very small portion of Wirecard's operations (Wirecard bank).

Bad decisions by Germany financial regulators also contributed to corporate governance failures in Wirecrard. Although direct regulatory supervision of Wirecard did not fall under Bafin's mandate, it could have supervised Wirecard under the general market supervision of listed companies (Jakubeit, 2021). BaFin is criticized for failing to investigate adequately the concerns which were raised by skeptical journalists and fund managers like the investigations made by Singaporean authorities. Instead, BaFin went after those who criticized the financial reporting system in Wirecard and temporarily banned short selling of Wirecard's financial instruments (Fairless; Kowsmann & Davies, 2020; Möllers, 2021; Storbeck, 2021a). As a result of this, Wirecard was temporarily shielded from its critics which may have delayed the detection of fraud (Jakubeit, 2021; Storbeck, 2020a). Other regulatory authorities which were criticized include the Germany's anti-money laundering agent, the Financial Intelligence Unit (FIU) which was criticized for delaying to address money laundering concerns in Wirecard (Chazan, 2021). These money laundering concerns were only handed over to prosecuting authorities after the company admitted that there was a financial hole in its financial statements. In addition, Germany's accounting regulator, the Financial Reporting Enforcement Panel (FREP), operated on a small budget which wasn't enough to investigate complex organizations (Chazan & Storbeck, 2021; Trentmann, 2021). Failures by these organizations contributed to corporate governance failures in Wirecard.

# 7. Conclusion and contribution

The objective of this paper is to understand the Wirecard audit failure using the fraud risk factors provided in ISA 240. An important way auditors and regulators avoid the mistakes of the past is to analyze audit failures whenever they occur with the goal of learning from the past to prevent audit failures in the future. Wirecard was in the financial technology industry where technological innovations are radically revamping the traditional ways of generating revenue. In such a situation, the study offers a unique opportunity for readers to learn about fraud detection in financial technology organizations.

The study contributes knowledge about the industry that is useful to auditors. Auditors will be forced to review the financial statements of companies in this industry. Understanding how the fraud occurred at Wirecard will enable auditors to learn that financial technology organizations are highly innovative and tend to adopt complex organizational structures, business models and financial reporting systems due to the nature of their business. Auditors are often trained to audit companies in particular industries as the companies in an industry share the same business models. As industries develop and innovation characterizes the business environments in which entities function, auditors are challenged to stay abreast of developments and innovations in financial transactions and their reporting. The financial technology industry is a new industry, and it is important for auditors to understand the risk factors associated with the industry.

Therefore, it is important for auditors to invest more time to familiarize themselves with these organizations. If the transactions are too complicated, auditors must consider the use of specialists rather than continue to audit transactions which they don't fully understand themselves. Auditors should also remember that no matter how big, successful, or profitable the organization is, auditors must comply with the requirements of the International Standards on Auditing (ISA) when conducting audits. These standards require auditors to gather sufficient, appropriate audit evidence even they address innovative transactions and deal with complex business organizations in emerging industries. This implies getting relevant and reliable evidence such as direct external confirmations on significant accounts instead of relying on vague third-party confirmations. External confirmations are one of the most reliable procedures an auditor can use to gather evidence unless the source of the confirmation is unreliable. Auditors

must consider the reliability of the confirmation they request, and when the most reliable piece of evidence fails, then the auditor must consider whether the balance reported in the financial statements can be relied upon.  Lastly, auditors must exercise high levels of professional skepticism no matter how successful and profitable a business organization is. These demands are significant challenges when auditors deal with financial service organizations that operate in fluid circumstances of the so-called New Economy.

Regulatory authorities should learn that financial technology organizations are highly innovative. Their operations tend to include various business models which makes classifying them into a certain regulatory category difficult. Regulators must therefore come up with strict and clear guidelines on how these organizations are monitored. If sufficiently clear and pertinent to the industry and its entities under review, these guidelines will ensure that financial technology organizations are not taking advantage of the loopholes that may exist in the current regulations or traditional audit practices. Regulators must try to enforce stricter auditor litigations in jurisdictions where they are not yet clear or strict enough to deal with contemporary business practices. For instance, in Germany before the Wirecard case, the maximum  financial auditor liability to a client was capped at €4 million (Möllers, 2021; Storbeck, 2020b). Stricter auditor litigation will improve how auditors monitor financial statements produced by their clients. In another matter: the regulatory authorities need to be well equipped with resources which will enable them to monitor organizations with complex operations. These resources include adequate employees, employees with relevant expertise and state of the art technology.

Given the complexity of the new business environment and the ongoing development of the Wirecard case, the study acknowledges some limitations. Germany prosecutors are still investigating Wirecard case. Therefore, there might be some valuable information which is not yet publicly available. To be sure, there have been various streams of reliable information about Wirecard that can be examined in more detail. For instance, the German parliament held formal inquiries about Wirecard where various stakeholders testified to identify the company's practices and manipulative behavior. These inquiries provided valuable information into what took place in Wirecard.

Another limitation is the study makes use of an assorted sources of information such articles from reputable financial newspapers namely *The Wall Street Journal* and *Financial Times*, published and unpublished manuscripts. Even though newspapers undergo less

rigorous review than peer reviewed articles, newspapers played a pivotal role in unearthing the fraud therefore they are a valuable source of information regarding this matter. More so, newspapers contain current events. Lastly, the study used documents which were in English and some potentially valuable information in German and other languages was lost.

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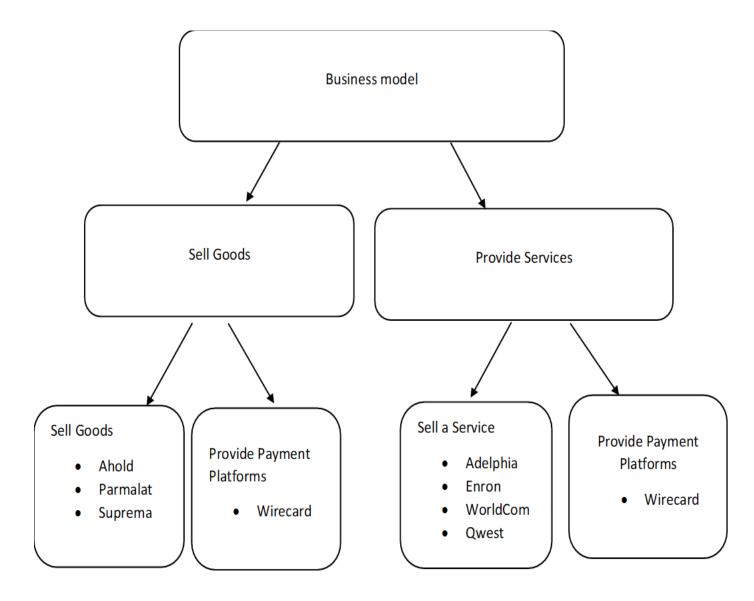
**Figure 1 shows the past frauds and where they fit in terms of business models.**