CAATTS ADOPTION IN MALAYSIAN BIG 4 AUDIT FIRMS

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CAATTS ADOPTION IN MALAYSIAN BIG 4 AUDIT FIRMS

ABSTRACT

Technology has significantly revolutionised and altered countless businesses and facets of life, and the auditing field is no exception. The advent of various tools and innovations has transformed operational aspects and overall effectiveness within this crucial sector. The audit industry is evolving, incorporating tools like Computer Assisted Audit Tools and Techniques (CAATTs). However, the implementation of CAATTs in Malaysia is not as widespread and methodical as it could be, despite their potential to improve audit processes and outcomes. This study explores the adoption of CAATTs in Malaysian Big 4 audit firms using the Technology, Organization, and Environment (TOE) framework. It utilises a qualitative approach, featuring semi-structured in-depth interviews with diverse auditors from Malaysian Big 4 firms. This study reveals the use of both in-house and commercially available CAATTs and various factors influencing their adoption. Key findings include the existence of technological divide, with younger auditors being savvier with newer tools. This research underscores the necessity for firms to adopt specific technological strategies and highlights the importance of managerial support in managing the psychological demands related to CAATTs implementation. Focusing on Malaysia, this research enriches existing knowledge by understanding the changing landscape of auditing in the age of digital transformation. It provides deeper insights through interview-based data collection, highlighting both the factors that motivate or hamper the adoption of innovative audit technologies through the TOE framework, from the perspectives of Big 4 audit firms.

Keywords: CAATTs, TOE framework, Adoption, Malaysian Big 4 audit firms, Interview

PENERIMAGUNAAN *CAATTS* DI FIRMA AUDIT 4 BESAR MALAYSIA

ABSTRAK

Teknologi telah merevolusikan dan mengubah banyak perniagaan dan aspek kehidupan dengan ketara, dan bidang pengauditan tidak terkecuali. Kemunculan pelbagai alat dan inovasi telah mengubah aspek operasi dan keberkesanan keseluruhan dalam sektor penting ini. Industri audit sedang berkembang, menggabungkan alat seperti Alat dan Teknik Audit Berbantu Komputer *(CAATTs)*. Walaubagaimanapun, pelaksanaan *CAATTs* di Malaysia tidak begitu meluas dan berkaedah, walaupun ia berpotensi untuk menambah baik proses dan hasil audit. Kajian ini meneroka penggunaan *CAATTs* dalam firma audit 4 besar Malaysia menggunakan rangka kerja Teknologi, Organisasi dan Alam Sekitar *(TOE).* Ia menggunakan pendekatan kualitatif, menampilkan temubual mendalam separa berstruktur dengan pelbagai juruaudit daripada firma audit 4 besar Malaysia. Kajian ini mendedahkan penggunaan *CAATTs* dalaman dan komersial serta pelbagai faktor yang mempengaruhi penerimagunaannya. Penemuan utama termasuk kewujudan jurang teknologi, dengan juruaudit yang lebih muda menjadi lebih arif dengan alat yang lebih baru. Penyelidikan ini menekankan keperluan firma untuk mengguna strategi teknologi tertentu dan menyerlahkan kepentingan sokongan pengurusan dalam mengurus permintaan psikologi yang berkaitan dengan pelaksanaan *CAATTs*. Memfokuskan kepada Malaysia, penyelidikan ini memperkayakan pengetahuan sedia ada dengan memahami perubahan landskap pengauditan dalam era transformasi digital. Ia memberikan pandangan yang lebih mendalam melalui pengumpulan data berasaskan temubual, mengetengahkan kedua-dua faktor yang mendorong atau menghalang penerimagunaan teknologi audit inovatif melalui rangka kerja TOE, dari perspektif firma audit 4 besar.

Kata kunci: *CAATTs*, Kerangka TOE, Penerimagunaan, Firma audit besar 4 Malaysia, Temu bual

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LIST OF ABBREVIATIONS

1MDB	1Malaysia Development Berhad
3D	Three-dimensional
AASB	Auditing and Assurance Standard Board
ACCA	Association of Chartered Certified Accountants
ACL	Audit Command Language
AI	Artificial Intelligence
AICPA	American Institute of Certified Public Accountants
AOB	Audit Oversight Board
AR	Augmented Reality
ASA	Australian Auditing Standards
BIG 4	Referring to the four largest audit firms
BDA	Big Data Analytics
CAATTs	Computer Assisted Audit Tools and Techniques
COVID-19	Coronavirus Disease
CPA	Certified Public Accountant
CPS	Cyber-Physical Systems
DA	Data Analytics
DOI	Diffusion of Innovation
ERP	Enterprise Resource Planning
EY	Ernst & Young
FRC	Financial Reporting Council
GAS	Generalized Audit Software
IAASB	International Auditing and Assurance Standards Board
ICT	Information and Communications Technology

IDEA	Interactive Data Extraction and Analysis
IFAC	International Standards of Auditing
IMF	International Monetary Fund
INDUSTRY 4.0	Fourth Industrial Revolution
IoT	Internet of Things
IR 4.0	Fourth Industrial Revolution
ISA	International Standards on Auditing
IT	Information Technology
ITF	Integrated Test Facility
KPMG	Klynveld Peat Marwick Goerdeler
MIA	Malaysian Institute of Accountants
ML	Machine Learning
MOSTI	Ministry of Science, Technology, and Innovation
NLP	Natural Language Processing
PwC	PricewaterhouseCoopers
RPA	Robotic Process Automation
SAS	Statement of Auditing Standard
SAS	Statistical Analysis Software
SME	Small and Medium Enterprises
SQL	Structured Query Language
SSM	Suruhanjaya Syarikat Malaysia
TAM	Technology Acceptance Model
TOE	Technology, Organization and Environmental
UK	United Kingdom
UMREC	University of Malaya Research Ethics Committee
US	United States

UTAUT	Unified Theory of Acceptance and Use of Technology
VR	Virtual Reality
WEF	World Economic Forum
WSJ	Wall Street Journal

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

1.1 Overview

This chapter provides a general introduction to the study by describing its structure and background. It begins with a brief discussion on the Fourth Industrial Revolution (IR 4.0), followed by the overview of the audit industry in Malaysia and technology used by the profession in the country respectively. Next, the problem statement is presented, followed by the research objectives, research questions and the significance of the study. Finally, this chapter defines the key terms used in this study and outlines the contents of the remaining chapters of this dissertation.

1.2 Background of the Study

Following the technological advances and the unprecedented pace of digitalisation due to the advent of the Fourth Industrial Revolution (IR 4.0), industries worldwide have seen substantial changes in their operations (MIA, 2018). This is because the business environment is evolving quickly in tandem with the technological advancements (Ammirato et al., 2023; Deloitte, 2016; Enzmann & Moesli, 2022; Nikou et al., 2022). Accordingly, that has also led to changes in the auditing landscape and the future of the auditing profession (Deloitte, 2016).

In the audit industry, Computer- Assisted Audit Tools and Techniques (CAATTs) is slowly becoming important (Ghani, 2016). Generally, CAATTs refers to any use of technology to facilitate the execution of an audit (Bierstaker et al., 2014; Braun & Davis, 2003). While most audit firms have realised the importance of using audit tools, analytics, and technology, CAATTs are not as widespread as they can be (Gepp et al., 2018; Mazlina & Lai, 2017; MIA, 2018, 2023; Rosli et al., 2013; Siew et al., 2020; Widuri et al., 2016).

Using a qualitative approach, this study aims to analyse (1) the various types of CAATTs being adopted by Malaysian Big 4 firms in practice and the context of its usage; and (2) the factors that influences the adoption of CAATTs in the Big 4 audit firms. This study presents an in-depth analysis of the factors that affecting the adoption of CAATTs using the Technology, Organization and Environment (TOE) framework.

1.2.1 Fourth Industrial Revolution (IR 4.0) in Malaysia

The world is currently moving towards the Fourth Industrial Revolution (IR 4.0), despite the fact that the first three, being the era of science and mass production, the development of the steam engine, and the emergence of digital technology, were also pivotal in creating our contemporary society. According to a World Economic Forum article by Klaus Schwab, the Fourth Industrial Revolution is indeed an extension and development of the Third Industrial Revolution. However, it is not merely a continuation; rather, it marks the beginning of a new era with a unique velocity, scope, and systemic impact as a whole (WEF, 2016). Technology has become fully integrated into our daily lives as a result of these revolutions (Enzmann & Moesli, 2022).

IR 4.0 is characterized by various innovative technologies that fuse digital, biological, and physical language affecting all fields, economies, and sectors (MIA, 2018). *Figure 1.1* below shows the nine inter-related pillars of IR 4.0 as reflected by Malaysian Institute of Accountants (MIA) in the MIA Digital Technology Blueprint report (MIA, 2018). These technologies have the potential to revolutionise many industries, including but not limited to the manufacturing, services, professional sports, retail, and financial services, among others (Ammirato et al., 2023; Deloitte, 2016; Enzmann & Moesli, 2022; Nikou et al., 2022). The quick development of various types of technology and the widespread use of information systems in businesses has also proliferated the audit profession and is further reshaping how audits are being conducted (Ghani, 2016). As a result, new audit tools, technologies and methodologies are being introduced, pushing the

audit industry towards more sophisticated, effective, efficient and comprehensive practices (Deloitte, 2017). Audit firms should seize the opportunity to thrive by leveraging innovation to gain a broader competitive edge (Tarek et al., 2017).

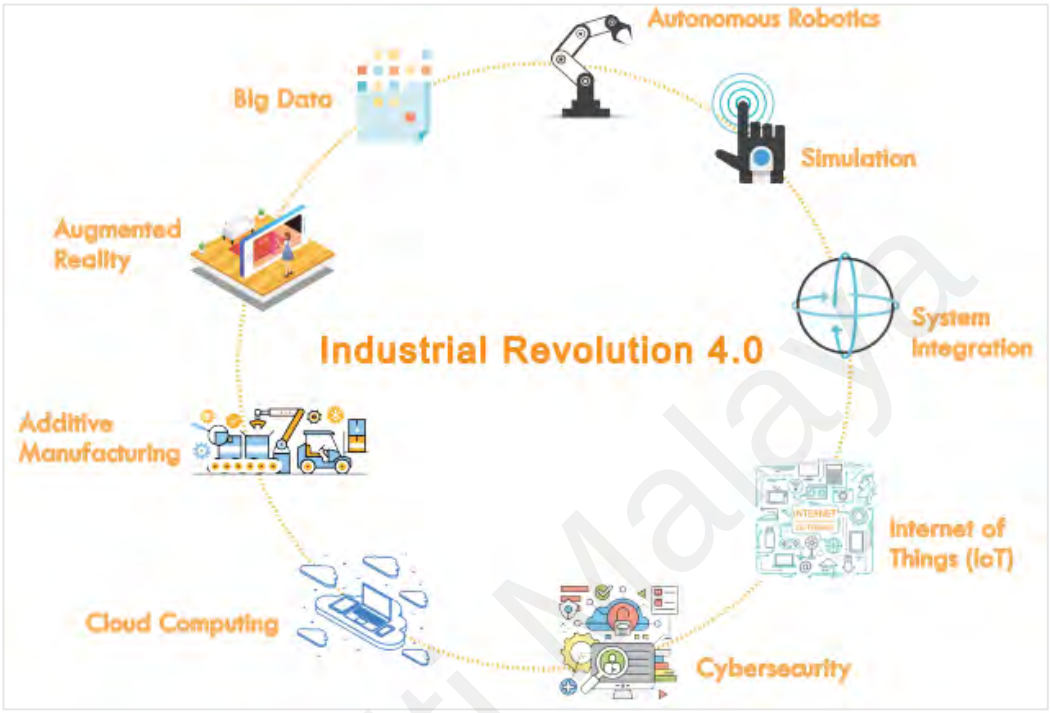

Figure 1.1: Nine inter-related pillars of Industrial Revolution 4.0

Source: MIA (2018)

1.2.2 Audit Industry in Malaysia

The audit sector is a global industry that offers clients expert services for the audit of financial statements, assurance, tax services, and other audit services (Thottoli et al., 2022). It has undergone numerous transformations due to economic turndowns, mergers, frauds, technological advancements (Alharasis et al., 2023; Carlin et al., 2009; Liew et al., 2022), as well as the recent COVID-19 pandemic (IMF, 2023; MIA, 2023).

The Malaysian audit market is said to exhibit behaviour best described as an oligopoly structure. Over time, there has been evidence that the large firms known as the "Big 4" firms, i.e., PricewaterhouseCoopers (PwC), Deloitte Touche Tohmatsu (Deloitte), Ernst & Young (EY) and Klynveld Peat Marwick Goerdeler (KPMG), are now the

remaining top players in the audit market (Abidin & Mohamad-Nor, 2015; FRC, 2021; Ishak et al., 2013; Raza et al., 2019).

These leading firms collectively control a significant portion of the market, shaping the overall dynamics of the audit industry in Malaysia. In line with IR 4.0, which has altered various aspects of businesses (David et al., 2022; Dubey et al., 2022; MOSTI, 2018; Shahbakhsh et al., 2022; Vaidya et al., 2018; Yunos & Din, 2019), the Big 4 audit firms strive to maintain a competitive advantage with the resources and capabilities they possess (Tarek et al., 2017).

1.2.3 Technology in Audit Industry

To stay up-to-date with the revolution, dynamic audits are required (Liew et al., 2022; Tarek et al., 2017). A dynamic audit is understood as the employment of cutting-edge data analytics and technology to analyse large quantities of data, delve deeper, and produce an audit outcome that meets high standards (KPMG, 2016). These technologies, when paired with the expertise and experience of auditors, enable the audit profession to transition from its history of labour-intensive manual processes and disjointed audit tools, towards a more streamlined and efficient approach. This shift allows audit teams to focus on the most important aspects of the audit, producing deeper insights and fostering more meaningful client conversations (AICPA, 2023; KPMG, 2016).

These developments are transforming audits, especially when combined with other significant factors such as authoritative guidelines and standards, workforce retention and upskilling, and evolving audit techniques (AICPA, 2023). Nowadays, the audit industry is slowly seeing the use of Computer Assisted Audit Tools and Techniques (CAATTs) (Ahmi & Kent, 2012; Al-Okaily et al., 2022; Kim et al., 2016; Shihab et al., 2017; Siew et al., 2020; Thottoli et al., 2022). Generally, CAATTs are perceived as the use of any type of technology to conduct audits (Braun & Davis, 2003). Traditional audit procedures are being revolutionised by CAATTs, including audit software, artificial

intelligence (AI), machine learning (ML), data analytics (DA), cognitive technology, blockchain, and cloud applications, among others (McKinsey, 2020; MIA, 2018).

Based on a survey conducted in 2019 by MIA, respondents indicated that tools such as Microsoft applications (almost 100% reported use), accounting software (over 90% reported use) and cloud applications (about 60% reported use) were used most pervasively. This contrasts with data analytics tools (over 40% reported use) and audit software and artificial intelligence, which were used slightly above 20% respectively (MIA, 2020), as shown in *Figure 1.2*.

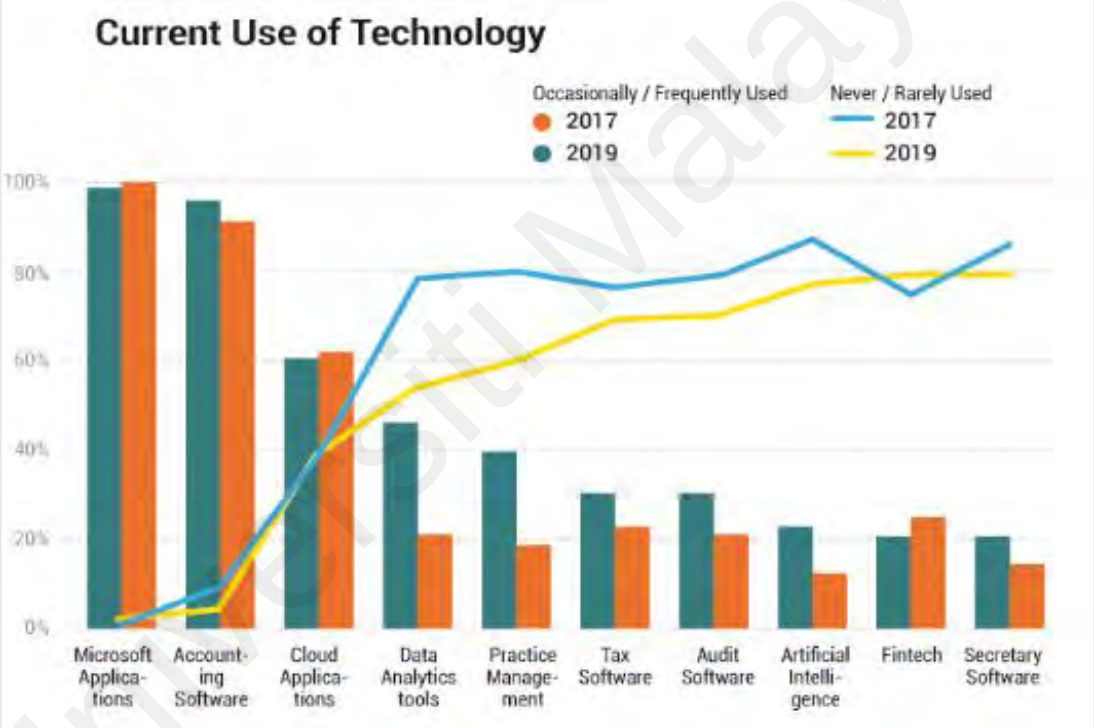

Figure 1.2: Current use of technology

Source: MIA (2020)

A similar survey was conducted by MIA in 2022 (MIA, 2023). The results of the survey indicated that the top five technologies adopted are video conferencing and group collaboration tools, Microsoft applications, cloud applications, accounting software, and data analytics. This is consistent with the results of the McKinsey Global Survey, which showed that the pandemic has indeed accelerated the adoption of digital tools and

techniques worldwide by several years (McKinsey, 2020). This change is necessary as it improves the quality and dependability of audits, giving auditors greater insights into financial records, and enables them to handle larger volumes of data more effectively.

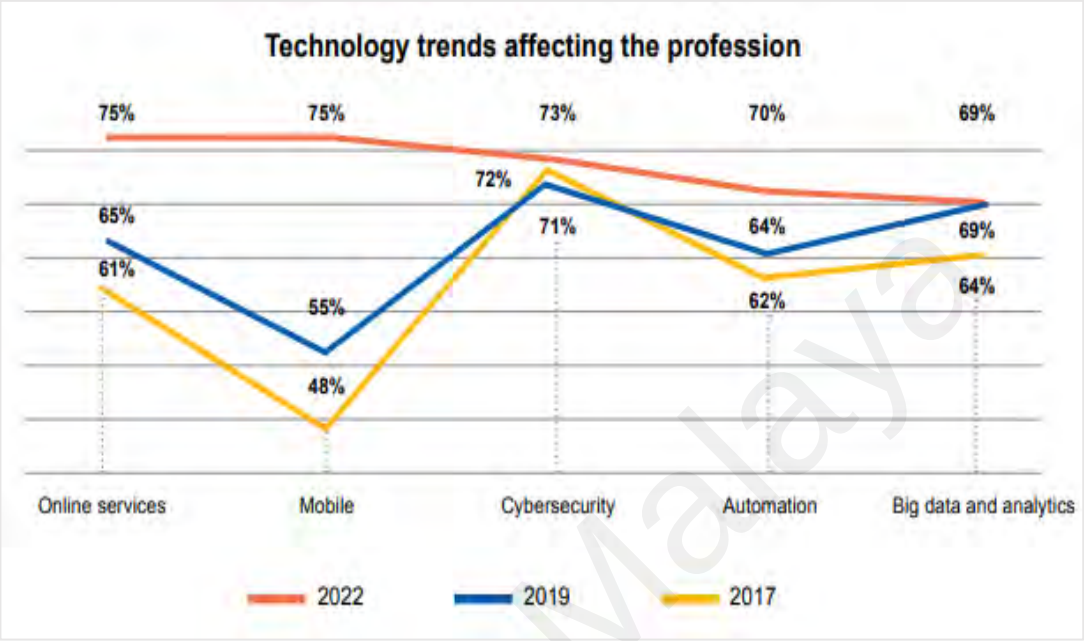

Figure 1.3: Technology trends affecting the accounting profession

Source: MIA (2023)

Additionally, over the years, automation and big data and analytics have slowly seen increased adoption (*Figure 1.3)*. Overall, CAATTs change the way data is collected, analysed, used, and even stored, reflecting effectiveness and efficiency. By eliminating manual labour and minimising errors, digital tools and techniques can automatically extract data from a variety of sources, including databases, accounting software, and enterprise resource planning (ERP) systems (Moll & Yigitbasioglu, 2019). They can also analyse unstructured data to gain a greater understanding of potential hazards and areas of concern (De Santis & D'Onza, 2021).

With the use of strong technological tools like artificial intelligence, machine learning, and data analytics, CAATTs enable auditors to spot patterns, trends, and anomalies that might otherwise go unnoticed with conventional techniques (Ferri et al., 2021). Subsequently, decisions can be made more intelligently because data-driven

insights obtained from CAATTs offer valuable information for risk assessment, audit planning, and reporting. These tools can be used for various purposes throughout the audit process (Abdennadher et al., 2022).

1.3 Problem Statement

Technology is essential for the audit profession, but research shows Malaysia has low technology utilisation and adoption among auditors (Rosli et al., 2013; Zuraidah et al., 2022). A study by Widuri et al. (2016), focusing on CAATTs adoption, revealed that only 43% of Malaysian auditors utilized advanced data analytics tools in their audits. Additionally, the Technology Adoption by the Accountancy Profession Survey 2022 highlighted information about the level of technology acceptance and use among auditors in Malaysia. The poll indicated that although Malaysian auditors are becoming more aware of and receptive to technologies such as fintech and cloud apps, certain obstacles to adoption and implementation continue to exist (MIA, 2023).

Audit standards advocate that the use of CAATTs improves audit effectiveness and efficiency (AASB, 2006; AICPA, 2007; Bierstaker et al., 2014). The ASA 240 issued by the Auditing and Assurance Standards Board states that auditors should use CAATTs when conducting an audit in a technology-based environment (AASB, 2006). Countries like the United States (US) have made using audit technology mandatory to improve audit quality (Widuri et al., 2016). According to the American Institute of Certified Public Accountants (AICPA)'s US Statement of Auditing Standard (SAS) No. 316.52, auditors "need to employ computer-assisted audit techniques to gather more evidence about data containing insignificant accounts or electronic transaction files" (AICPA, 2007).

Anecdotal evidence suggests that the Big 4 audit firms are applying technological tools and approaches in practise, but a survey by Gepp et al. (2018) reveals that CAATTs are still being underutilised (Debreceny et al., 2005; Siew et al., 2020), especially in developing countries, such as Malaysia (Mazlina & Lai, 2017; Omonuk, 2015; Rosli et

al., 2013; Widuri et al., 2016; Zuraidah et al., 2022). Additionally, the adoption of CAATTs is thought to depend on firm size, with Big 4 firms more likely to use technology as they have the resources to invest in and adopt significant IT (Rosli et al., 2013). Major firms often audit large clients with complex systems and requirements in place, necessitating investment in their own technology for efficient auditing operations (Curtis & Payne, 2008; Lowe et al., 2018). According to MIA, Malaysian Big 4 firms spend approximately $3–5 billion a year on technologies used in audits, but the adoption still in its early stages (ACCA, 2023b; MIA, 2018).

Nevertheless, the Big 4 firms' extensive resources, whether financial, technical, or human, do not guarantee a good audit outcome (Carlin et al., 2009; Lamboglia et al., 2021). The 1Malaysia Development Berhad (1MDB) scandal and Serba Dinamik lawsuit against three out of the Big Four audit firms in Malaysia being EY, Deloitte, and KPMG, due to insufficient audit evidence to detect fraudulent transactions and misappropriations of the company's financial standing, are further evidence of audit quality deficiencies. These scandals resulted from auditors' failure to identify fraud and misstatements as well as their incapacity to provide a fair and accurate assessment of the financial statements pertaining to the accounts of the companies they audited (PwC, 2016; WSJ, 2016). The Big 4 firms failed to use CAATTs for efficient audit, raising questions about their effectiveness. It is clear the Big 4 are only deemed competent and effective due to their investments in audit technology and human resources (Kamarudin et al., 2022).

Moreover, according to Ismail and Zainol Abidin (2009), Malaysian auditors' understanding of technology is less than their impression of its significance. This is concerning as it negatively affects firms' use of technology and the audit's conclusion. This can be further represented as a perception-implementation gap, which shows the discrepancy between the perceived prevalence and level of development of a technology and the actual level at which people or organizations are implementing it (ACCA, 2023b).

ACCA (2023b) further stated that there may be a several reasons for the discrepancy between perception and implementation, including return on investment, technical prowess, skills, or even determining the appropriate use of such technology. The perception-implementation gap reflects the challenges faced in adopting and implementing the technologies, even when the technologies' worth and prospective effectiveness are frequently debated.

Research suggests CAATTs adoption may be influenced by a variety of factors, but must begin at the organizational level with purchasing necessary equipment, making investments, and setting up workspaces. A handful of studies have explored CAATTs adoption from the organizational perspective. Widuri et al. (2016) studied CAATTs adoption in Indonesia and identified highly influential factors such as the availability of technology and technologically literate auditors, while Ismail and Zainol Abidin (2009) reported on IT expertise and the significance of audit technology among Malaysian audit firms. Furthermore, CAATTs are deemed different from other technologies due to environmental factors such as client requirements, competitive pressure, and support from accounting bodies (Bradford & Florin, 2003; Curtis & Payne, 2008).

Prior studies at the individual level mostly adopted Unified Theory of Acceptance and Use of Technology (UTAUT) theory and the Technology Acceptance Model (TAM). Those theories discussed technology attributes such as performance and effort expectancy, perceived usefulness and ease of use, social influence, and facilitating conditions in external audit settings (Abdul Ghani et al., 2022; Ferri et al., 2021; Ismail & Zainol Abidin, 2009; Janvrin et al., 2008; Kim et al., 2009; Widuri et al., 2016). A study in the Malaysian context employing UTAUT indicated that younger auditors were more likely to view CAATTs as useful for auditing than their older counterparts (Abdul Ghani et al., 2022). However, early research was constrained as it focused only on the technological aspects, ignoring the organizational and environmental factors (Siew et al., 2020).

This study uses the Technology, Organization, and Environment (TOE) framework, created by Tornatzky et al. (1990), to overcome these constraints. It analyses a wide range of technological, organizational, and environmental factors within an organization, which are determined by current and upcoming technologies, the resources available within the firm, and the external and industry aspects respectively (David et al., 2010; Venkatesh & Bala, 2012). By integrating these dimensions, the TOE framework provides a comprehensive understanding of the multifaceted influences on CAATTs adoption, offering valuable insights.

In light of the assertion that CAATTs use in Malaysia is not prevalent and that the Big 4 audit firms in Malaysia only began implementing technology like data analytics in 2016 to keep up with international trends (AOB & SSM, 2017), it would be useful to investigate such occurrence. This is critical as audits are essential for maintaining integrity of the financial reporting, especially in developing nations like Malaysia where there is concern about the accuracy and transparency. Due to the possibility of ineffective or low-quality audit outcomes, research is necessary to ascertain why CAATTs are ineffectively utilised and embraced. Moreover, most of the prior studies conducted were undertaken in developed countries like the United Kingdom (UK) and the United States (US) (Ahmi & Kent, 2012; Bierstaker et al., 2014; Bierstaker et al., 2001; Curtis & Payne, 2008; Kim et al., 2009; Lowe et al., 2018). The audit environment may not be as generalizable in a developing country like Malaysia. Therefore, understanding the current state of CAATTs implementation in Malaysian Big 4 audit firms as well as the factors influencing its adoption could be very valuable.

1.4 Research Objectives

As emphasized, CAATTs adoption is only now gradually growing in Malaysian audit practice, making it crucial to fully comprehend its implementation, especially given the dearth of thorough study on CAATTs adoption and use in the Malaysian Big 4 firms. The main objective of this research is to study the adoption of CAATTs in the Big 4 audit firms in Malaysia. The specific research objectives are:

a. To study the various types of CAATTs being adopted by Malaysian Big 4 firms in practice and the context of its usage.
b. To study the factors that influences the adoption of CAATTs in the Big 4 audit firms through the use of Technology, Organization and Environment (TOE) framework.

1.5 Research Questions

The present research aims to investigate the extent of the adoption of CAATTs and the factors that motivate or hinder the adoption among external auditors in Malaysian Big 4 audit firms. Specifically, this study seeks to address the following research questions:

a. How are the various types of CAATTs currently being adopted and in what contexts are those used by the Big 4 audit firms in Malaysia?
b. How do the technological, organizational, and environmental factors influence the adoption of CAATTs among Big 4 external auditors?

1.6 Significance of the Study

Technology has revolutionised industries by increasing productivity, efficiency, performance, and flexibility, leading to better lives and economic outcomes (Moll & Yigitbasioglu, 2019). Given that Malaysia is experiencing profound technological changes in line with IR 4.0, the adoption of CAATTs has become a critical demand in the audit industry. Many studies have been conducted in other countries to discuss this subject matter, such as Indonesia, Singapore, New Zealand, the United Kingdom, and the United

States (Ahmi & Kent, 2012; Debreceny et al., 2005; Kend & Nguyen, 2022; Krieger et al., 2021; Liew et al., 2022; Lowe et al., 2018; Widuri et al., 2016). However, there are only a handful of studies conducted in Malaysia, and those are within different context (Ahmi et al., 2017; Rosli et al., 2012). Therefore, the lack of research in Malaysia necessitates additional studies, as it would contribute a number of new ideas to the field.

This study examines the adoption of CAATTs by Big 4 firms in an external setting in a developing nation, namely Malaysia. It is debatable to what extent previous studies apply to developing nations (Ahmi & Kent, 2012; Curtis & Payne, 2008; Debreceny et al., 2005), as their use of CAATTs is relatively new, unlike the obligatory norm in the US that compels the use of technology. This study offers a distinctive contribution to the understanding of how CAATTs are implemented and viewed in various economic and regulatory situations by examining the adoption in Malaysia. This increases the application of current theories to a wider range of international contexts and enriches the body of existing knowledge with a new viewpoint.

Apart from that, this study utilizes the TOE framework by Tornatzky et al. (1990), which has not been extensively used in previous research on technology incorporation in audits. Despite its capacity to elucidate that the adoption of technology is influenced by both internal and external factors, the TOE framework has not gained extensive utilization in research on the incorporation of technology in the audit field. Most prior studies have focused on individual technology acceptance models such as the UTAUT theory and the TAM (Ferri et al., 2021; Ismail & Zainol Abidin, 2009; Janvrin et al., 2008). By utilising the TOE framework, this study gains more from the simultaneous multi-dimensional influences of various technological, organizational and environmental adoption factors (Venkatesh & Bala, 2012), which broadens the scope of analysis beyond individual acceptance as well as representing a significant theory advancement.

By combining various technological, organizational, and environmental attributes into a unified framework to examine CAATT adoption, this study advances the theoretical conversation. The results of examining CAATTs adoption factors enable the comprehension of how various elements interact and affect the use of technology in audit firms, specifically within Malaysia. It emphasizes how complicated technology adoption decisions may be, going beyond straightforward or one-dimensional justifications. This can help advance the worldwide conversation on the use of technology in professional services and open the door for comparative studies.

Practically speaking, this study's findings offer direction for Malaysia's audit profession in developing, implementing, or enforcing CAATTs adoption. By understanding the adoption factors highlighted in the framework used for this study and how they might aid the audit industry, relevant parties such as accounting professional bodies, audit firms, technology professionals, and auditors can benefit. The insights gained from this study can play a crucial role in developing practical adoption strategies, plans, and guidelines. Subsequently, this could lead to increased CAATTs implementation, ultimately enhancing audit efficacy and efficiency.

1.7 Definition of Key Terms

In this section, the key terminology that is essential to this study is introduced and defined, providing clarity to the concepts discussed throughout.

1.7.1 Technology

Technology is the actual application of scientific knowledge. It is made up of information system operations, hardware and software products, reflecting both what things are made of and the people and expertise required to use those procedures and products, reflecting how things are made (Grubler, 1998). Technology is a combination of tangible tools and the intellectual skills required to use those tools across various fields and contexts (Ghasemi et al., 2011).

1.7.2 Computer Assisted Audit Tools and Techniques (CAATTs)

CAATTs are defined as the use of any type of technology to facilitate the execution of an audit. CAATTs extract and analyse data to assist auditors in the completion of an audit (Bierstaker et al., 2014; Braun & Davis, 2003).

1.7.3 Big 4

The term "Big 4" refers to the four largest international accounting and professional services firms that dominate and are the top players in the financial market. Namely, these are PricewaterhouseCoopers (PwC), Deloitte Touche Tohmatsu (Deloitte), Ernst & Young (EY), and Klynveld Peat Marwick Goerdeler (KPMG) (Abidin & Mohamad-Nor, 2015; FRC, 2021; Ishak et al., 2013; Raza et al., 2019). In addition to audit services, they also provide non-audit work such as advisory and management consulting (Dunne et al., 2023).

1.8 Organization of the Research

This dissertation report is structured into six (6) chapters in total. It consists of an introduction, literature review, research methodology, theoretical framework, findings, analysis, and conclusion, which will be discussed accordingly in the following chapters.

Chapter 1 presents the introduction and overview of the whole study, which includes the problem statement, research objectives, research questions, significance of the study and the definition of key terms. Chapter 2 presents the collection of relevant literature review associated with the topic of interest to this study, encompassing a general overview and specific focus on the concepts. This chapter mainly draws from broad areas of theories and findings related to the use and adoption of CAATTs in the audit industry. It also reviews the effects of industrial revolutions and COVID-19 pandemic on businesses, with a particular emphasis on the Fourth Industrial Revolution, which has led to the increased use of technology in auditing and CAATTs. Additionally, studies on the uptake and application of CAATTs and their role in audits are discussed in this chapter.

Chapter 3 describes the theoretical framework adopted in this study, which is discussed through the inclusion of the IT acceptance and adoption foundation. The theories discussed include the TOE framework, DOI theory, UTAUT, and TAM. This chapter concludes by providing justification for the application of the TOE framework in this study.

Chapter 4 outlines the research design and describes the research methods employed in this study. It begins with an overview of qualitative research, followed by an explanation of the philosophical assumptions underlying this research. The chapter further presents the research approach used, the ethical considerations applied, and how data is gathered and analysed in this study.

Chapter 5 presents the findings of this study based on the research methodology outlined in Chapter 4. It begins with the evolution of technology in auditing, followed by the extend of CAATTs adoption in Malaysian Big 4 audit firms, various influencing factors, and future directions.

Following that, Chapter 6 interprets and analyses the findings gathered from the perspective of the TOE framework in the context of Malaysian Big 4 audit firms. This chapter also reflects the conclusion of this study. It includes discussions on the contributions from both theoretical and practical aspects, followed by limitations of the study. The chapter concludes by offering possible avenues for future research and a summary of this study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter lay outs, discusses, and analyses the literature on the research topic, CAATTs Adoption in Malaysian Big 4 Audit Firms; leading to the development of the research objectives. It is imperative to analyse the extensive literature to discover and address any gaps in knowledge within this subject. This chapter explores the advancement of technology and its impact on businesses, particularly focusing on the audit industry and Big 4 audit firms. It also reviews the implications of the Industrial Revolutions, the role of CAATTs in auditing and factors influencing the current adoption of CAATTs. Conducting a thorough analysis of the present literature is necessary to attain a deep understanding of these fields.

2.2 Industrial Revolution

The Industrial Revolution is considered the most significant revolution in human history, due to its huge effect on people's daily lives. Since the First Industrial Revolution, there have been numerous revolutions that have significantly altered traditional manufacturing and production techniques in favour of electronic and technological applications, reshaping practically every area of human activity along industrial lines and giving rise to a large number of new industries (MOSTI, 2018; Vaidya et al., 2018). Each industrial revolution shares distinct features that sets them apart from other industrial revolutions. These revolutions have resulted in the integration of technology seamlessly into our daily lives (Enzmann & Moesli, 2022).

From the late 18th century through the 20th century, there were three industrial revolutions in the world, as shown in *Figure 2.1*. The First Industrial Revolution was the production of goods using steam and water. The use of electric power and mass production was the focus of the Second Revolution, while product automation and

information technology were the focus of the Third Revolution (Deloitte, 2018; Groumpos, 2021; Yunos & Din, 2019).

The First Industrial Revolution, according to Schwab (2016), mostly ushered in mechanical production. The changes then further led to a shift from agrarian and handicraft-based economies to industrial and machine-based economies. The invention of electricity and the assembly line during the Second Revolution enabled mass production. The need for specialised human talents was diminished as machines took over the division of labour and production stages, leading to further industrialisation and globalisation (Enzmann & Moesli, 2022).

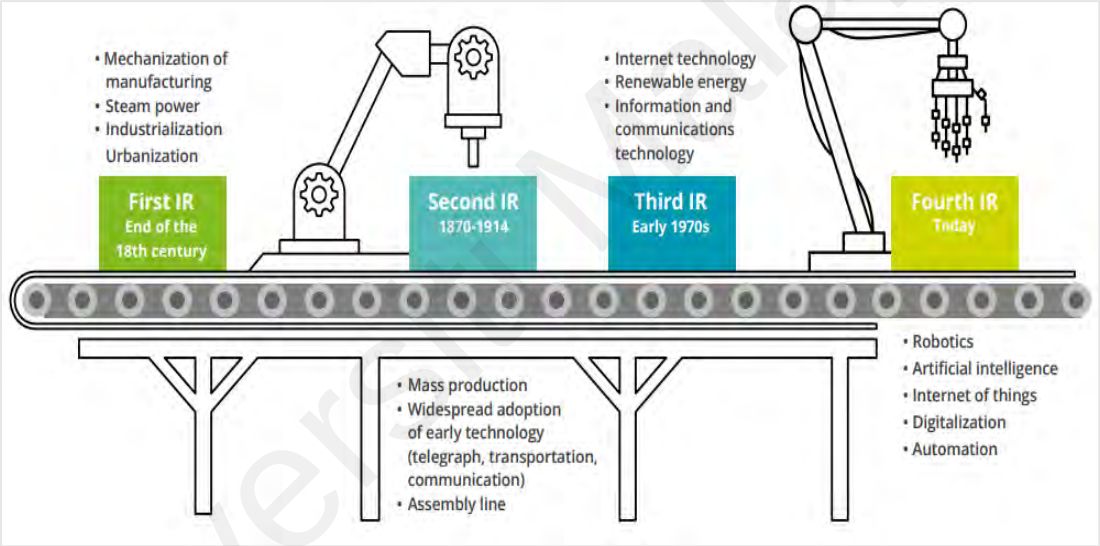

Figure 2.1: Chronology of the Industrial Revolutions

Source: Deloitte (2018)

However, the Third Industrial revolution, also known as the Digital Revolution, saw a significant increase in the usage of computers and digitisation due to the development of semiconductors, computing, personal computing, and most significantly, the Internet. The development of the Internet during this time made it possible for people to connect whenever and wherever digital technologies were available (Enzmann & Moesli, 2022; Sekiyama, 2020). It marked the arrival of the computer era and the growth

of information technology, bringing about dramatic changes in the way data and information are saved, processed, stored and shared (Gaviria et al., 2022).

Currently, the Fourth Industrial Revolution is underway. The Fourth Industrial Revolution is thought to have been in implementation since the late 20th century, although some believe it may have begun earlier as a result of technological advancements that accelerated the digitalisation of industries (Groumpos, 2021).

2.2.1 Fourth Industrial Revolution (IR 4.0)

Building on the developments of the Third Industrial Revolution, this period, often known as Industry 4.0 or IR 4.0 represents the union of physical, biological, and advanced digital technologies (David et al., 2022; Deloitte, 2020). The term "Industry 4.0" was first used in 2011 by the Germans to highlight their manufacturing competitiveness (Shahbakhsh et al., 2022). With the use of information and communication technology (ICT), IR 4.0 refers to "the intelligent networking of machines and processes for the industry" (Rasool et al., 2022). Yunos and Din (2019) mentioned that the Internet of Things (IoT), cyber-physical systems (CPS), and a system that will likely create new occupations unrelated to current careers are what the term "Industrial Revolution 4.0" represents.

This revolution saw the introduction, adoption, and development of numerous technologies, which are said to be the pillars of the Fourth Industrial Revolution. In the IR 4.0 age, technologies are unexpectedly and quickly combining and converging (David et al., 2022; Dubey et al., 2022; MOSTI, 2018; Shahbakhsh et al., 2022; Vaidya et al., 2018; Yunos & Din, 2019). Those digital technologies, which are in interaction and mutual conditioning, include innovations like, big data analytics (BDA), artificial intelligence (AI), cloud computing, machine learning (ML), blockchain, the Internet of Things (IoT), robotics, 3D printing, augmented reality (AR), virtual reality (VR), cybersecurity, robotic process automation (RPA), nanotechnology, and sophisticated

automation (David et al., 2022; Dogaru, 2020; Enzmann & Moesli, 2022; Groumpos, 2021; Schwab, 2016).

As much as the various technologies are the heart of the IR 4.0, it actually includes five (5) main technologies and five (5) emerging technologies respectively (Koh et al., 2019). The main and foundational technologies are the cloud computing, BDA, IoT, 3D printing, and robotics, while the emerging technologies include ML, AI, digital twin, blockchain, and 5G (Groumpos, 2021). *Table 2.1* summarizes the interconnected technologies of IR 4.0, developed for this research, based on ACCA (2023b); David et al. (2022); Dubey et al. (2022); Ferri et al. (2021); Groumpos (2021); Shahbakhsh et al. (2022); Vaidya et al. (2018); Yunos and Din (2019), in no particular order.

Table 2.1: IR 4.0 technologies

Technology	**Feature**
Internet of Things (IoT)	Network of physical world embedded in technology to interact, connect, and exchange data
Big Data Analytics (BDA)	Information processing of big and large set of complex data that enhances decision making, data analytics and process automation
Digital Twin	Replica of a physical system, used for simulation and analysis
Autonomous Robots	Self-governing machine capable of performing human tasks using sensors and AI to interact with its environment
Cloud Computing	Data storing and management allowing on-demand and real-time communication using enabling technology
Artificial Intelligence (AI)	Encompasses systems that perform complex tasks associated with human intelligence, but with superior capacity
Blockchain	Digital record with entries that are concatenated chronologically and whose integrity is protected by cryptography

Table 2.1: IR 4.0 technologies, continued

Technology	Feature
Augmented Reality	Technology between virtual reality and telepresence, allowing interaction of an actual reality in a synthetic environment
Machine Learning (ML)	A branch of AI focusing on creating systems that can learn from data, see patterns, and make decisions with little to no human input
Cybersecurity / Cyber- Physical Systems (CPS)	Integration of visual and real world; monitoring and collaborating in real time through a combination of ICT and physical systems while protecting technologies against cyberattacks
Virtual Reality	Simplifying, using visualisation to make decisions, and optimising using real-time data to mirror the physical world
Additive Manufacturing	Process of creating 3D objects by layering material, based on digital models
Advanced Materials	Creation of innovative substance with enhanced and unique performance characteristics for specialised applications

Developed from the authors ACCA (2023b); David et al. (2022); Dubey et al. (2022); Ferri et al. (2021); Groumpos (2021); Shahbakhsh et al. (2022); Vaidya et al. (2018); Yunos and Din (2019)

The foundation and essential requirements of IR 4.0 are its components and technology, which have rapidly permeated a wide range of global sectors. The existence and vast application of these technologies in line with IR 4.0 have altered and have the potential to continue altering how people perform their jobs. It can draw people into more intelligent networks, leading to more productive work (Groumpos, 2021). The boundaries between the physical, digital, and biological worlds are explicitly being blurred in this era, allowing humans to reshape the globe (Shahbakhsh et al., 2022).

However, the diverse range of available technologies is not as extensively implemented as it could and arguably should be. According to The Digital Horizon survey conducted by ACCA in March 2023 among its members, there is a varying degree of acceptance and experimentation with these technologies in the business environment; whereby some technologies are not being pursued yet (ACCA, 2023a, 2023b), as reflected in *Figure 2.2* below. This survey highlights a notable gap between the potential benefits of these technologies and actual use in the business sector, underscoring the need for further exploration to fully comprehend such occurrence.

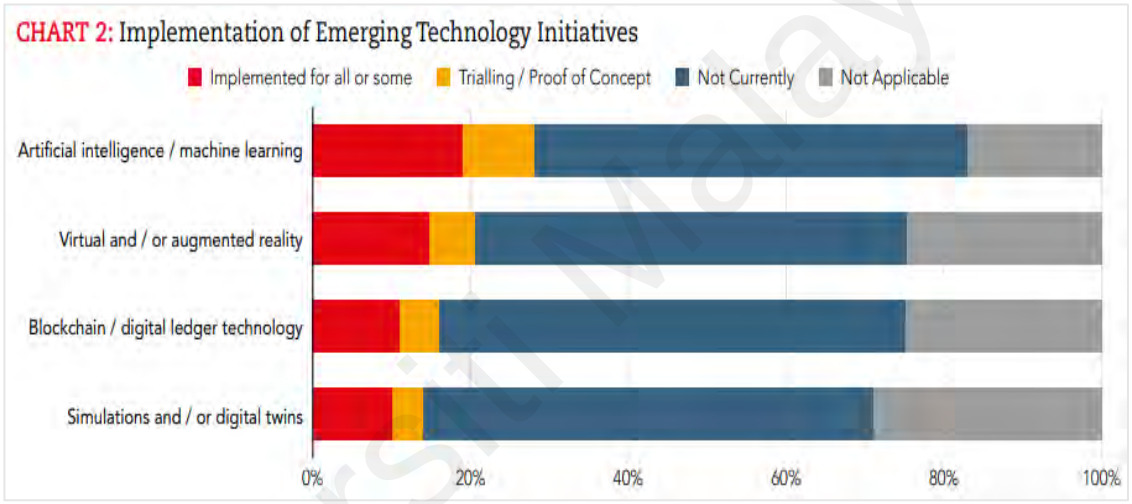

Figure 2.2: Implementation of emerging technology

Source: (ACCA, 2023a)

2.2.2 The Implication of Industrial Revolutions

In this fast-paced contemporary world, technology plays an integral role across diverse domains. The advent of Industry 4.0 has led to transformations in production, organizational protocols, and economic strategies in various nations, demanding a strategic examination of its impact on the global economy (David et al., 2022). Over the past few decades, IR 4.0 has changed the way people work. It is not limited to the manufacturing industry but has also penetrated the services industry (Enzmann & Moesli, 2022). Around the world, technology is dramatically changing how occupations are

generated, staffed, planned, and how people conduct business (Ammirato et al., 2023; Nikou et al., 2022).

For more than 20 years now, technology has been used more widely and extensively, having a tremendous impact on how people, society, and the economy are connected (Yang et al., 2021). Eshet (2004) suggests that in today's technologically advanced workplace, it is crucial to emphasise the value of digital literacy and that "individuals must be able to use a variety of technologies" to flourish. Aside from information literacy, employees are expected to have other forms of literacy as well, such as media literacy, ICT literacy, technology literacy, and net or online literacy. This is because workplace technology is changing quickly, and the local, national, and international economies have high expectations. It is essential for employees to possess the necessary knowledge and a variety of literacy skills to engage with technology, understand it, and be able to use it (Nikou et al., 2022).

Advances in technology have allowed for the digitisation of physical assets, the integration of vertical and horizontal value chains, the ease of communication, virtual collaboration, and the automation of previously unfeasible activities (Jain & Ranjan, 2020). A 2018 Quality of Work Life Survey conducted in Finland found that 90% of wage and salary workers use digital applications at work (Krutova et al., 2022). Individual performance has been proven to be faster and more accurate with the use of technology in back-office jobs, resulting in an annual return on investment of up to 200% (Jain & Ranjan, 2020).

The digitalisation of production processes in the manufacturing sector has been made possible by the connection between business process management and RPA. This has not only increased internal efficiency and streamlined manufacturing processes, leading to higher production speeds and improved quality, but it has also significantly impacted labour working routines and habits (Ammirato et al., 2023). Generally, data-

driven technologies can be used for a variety of jobs, from the routinely tedious to the exceedingly complicated, such as the natural language processing (NLP) of office conversations and payroll processing systems that can identify certain keywords in resumes (Bernhardt et al., 2022). Additionally, RPA has more recently made it possible to automate more complex "swivel chair work," such as taking inputs from various electronic mediums like emails and spreadsheets, processing the data according to predetermined rules, combining additional data from various sources, and feeding the finished data analysis into resource planning systems (Jain & Ranjan, 2020).

Yang et al. (2021) states that technologies for human-computer interaction, autonomous driving, emotion recognition, brain-computer interface, and bionic software robots are making steady progress. AI and robotics will play a bigger role in the manufacturing, transportation automation, and healthcare industries, in addition to changes in other fields such as travel, financial services, real estate, entertainment and other service industries (Gupta et al., 2022). Moreover, the accounting profession has not escaped such evolutions. The transition from physical or paper management to a fully digital administration of the financial systems has had a significant impact on the accounting industry (Gaviria et al., 2022). To effectively serve businesses and meet the demands of their clientele, the accounting industry, which offers audit, advisory, consulting, tax, accounting, risk management, and other related services, must indeed closely monitor their clients' internationalisation endeavours (Kee et al., 2013).

Despite the potential of these revolutions to generate fresh employment prospects, major apprehensions stem from the rapid advancement of technology, the substitution of jobs by automation, and the widespread integration of advanced technologies like computers and robots across all sectors. However, there is a potential for adverse impacts on the well-being of workers and employees, such as moral and ethical challenges (Ammirato et al., 2023). Ethics seeks to provide standards of evaluation by which to

compare options and to make suggestions for making life more humane (Fernández Fernández et al., 2021). The growth and revolution brought by the technological advancement have highlighted an adjustment to the code of ethics in the work environment; due to the application of information technology to technology distinguishing the automation and control which brings the rise of emerging realities that subsequently may have an impact on the workplace and have a wider reach (Gaviria et al., 2022).

In the long run, companies with comprehensive and robust Industry 4.0 strategies are performing well, outperforming, and far more successful while others lag behind (Deloitte, 2020). Industries are rapidly innovating and expanding, effectively incorporating IR 4.0 technologies, and improving their ability to recruit and educate the workforce required for the future. The are also able to communicate, analyse and act upon information, enabling organizations, consumers, and society to be more flexible and responsive and make more intelligent, data-driven decisions (David et al., 2022; Dogaru, 2020).

Despite the disruptive and improvement potential of IR 4.0 in many aspects of businesses, global executives and industry leaders do not seem to be utilising IR 4.0 technologies as broadly across their organizations as they should. According to Deliotte Global's third annual survey, which involved over 2,000 C-suite executives from 19 countries, some leaders might still be unaware of the implications of IR 4.0 or its potential benefits. The survey focused on the intersection of readiness and responsibility to see how leaders are balancing the transition to Industry 4.0 to help their businesses. A mere 4% of the executives said that integrating technology into their operations was "very important," while nearly a third indicated that it was "not that important" (Deloitte, 2020).

2.3 Auditing Industry in the Technological Era

Technology plays a significant role in our increasingly digitised environment, affecting a wide range of businesses (Kuusisto, 2017). The auditing profession is one of the many fields impacted by the global advancements brought about by the digitalisation, information and the technological revolution (Jaber & Abu Wadi, 2018). It is no secret that technology has revolutionised businesses and audit firms due to its ability to process, store and analyse enormous volumes of data. For the output of the system to be used for the preparation of reliable financial statements, the auditing procedure for commercial organizations using computerised systems necessitates that auditors evaluate both the system's output and the software employed. Therefore, auditors must use appropriate methods and tools to audit a variety of clients who incorporate various technologies and information systems. This is especially necessary for commercial organizations using fully computerised information systems (Ghani, 2016; Siew et al., 2020). Thus, it is crucial to actively explore how technology is applied in the audit industry and how it affects the audit undertaken (Xing et al., 2020).

2.3.1 Imperatives for Technological Transformation in Auditing

Prior literature indicates several reasons why the audit field must continue evolving, emphasizing the need to adopt relevant technologies. Firstly, it is due to the shareholders desire to obtain reliable and comprehensive assurance on the financial integrity and performance of a company. Auditing, viewed as a service, is perceived to fulfil this need by offering a measure of reasonable assurance to the shareholders. Furthermore, there is often a delay in preparing the audit report, typically spanning several months after the conclusion of the fiscal year, which contributes to its reliance on historical financial data. Lastly, the standardized nature of the audit report fails to cater to the specific requirements of its diverse user base, thereby limiting its utility in facilitating informed decision-making for future endeavours. Consequently, managers often regard the auditing process

as a mere cost rather than a value-addition, primarily because the reports seldom incorporate recommendations for addressing identified historical issue (Manita et al., 2020). Therefore, to maintain a competitive edge and distinguish themselves from other firms, audit firms must adapt their service offerings by adopting and integrating advanced technology. This approach enables them to present pertinent strategies and address the changing demands of clients effectively (Sahut et al., 2013).

In addition, major crisis, scandals, and the recent COVID-19 pandemic have historically acted as catalysts for significant shifts in technology adoption within the auditing sector. The collapse of large corporations such as Enron and WorldCom due to accounting frauds highlighted the need for greater audit transparency and accountability in financial reporting worldwide. Consequently, more and more companies begun using technologies like enterprise resource planning (ERP) systems, which include financial modules that aid in accurate reporting. Within the Malaysian context, the 1MDB scandal involving the Malaysian Big 4 firms had a similar effect, putting a spotlight on the necessity for robust financial oversight. This scandal revealed widespread corruption and money laundering within the Malaysian financial system, heightening public mistrust of financial organizations and the auditing profession. Moreover, the 2007–2008 global financial crisis underscored the necessity of risk management and the need for up-to-date information to make wise decisions. During this time, there was also a shift towards stricter regulatory compliance, as evidenced by the growing popularity of technology like compliance management software (Al-Okaily et al., 2022; Sharma et al., 2022; WSJ, 2002; WSJ, 2016; Xin, 2021).

These scandal and crises highlighted the shortcomings of conventional auditing and financial reporting techniques, increasing the demand for advanced technologies such as AI and DA to improve financial transparency and fraud detection came to rise. There

was a drive to employ data analytics technologies more frequently in auditing procedures to spot irregularities and prevent fraud (KPMG & Forbes, 2017).

The recent COVID-19 pandemic has also accelerated technology adoption in auditing practices. Prior to the pandemic, the International Monetary Fund (IMF) reported that nations with advanced economies had experienced an average growth in digitalisation of 6% (IMF, 2023). However, there were still large disparities, particularly in underdeveloped countries. As a result of the pandemic, many developing nations were compelled to adopt digital technology more quickly than they had previously. This reduced the digital divide somewhat while also safeguarding their economies and labour forces (IMF, 2023).

This change also allowed for the continued provision of crucial financial services while also opening the door for cutting-edge auditing techniques in a remote working setting. Auditors and their clients had to quickly adjust as control processes and audit engagements moved to virtual operations, made possible only through the adoption of various technologies (Al-Okaily et al., 2022; IMF, 2023; Pozzoli et al., 2022).

2.3.2 Audit Transformation in Big 4 Firms

The public's confidence in the then Big 5 audit firms was severely damaged by Arthur Andersen's bankruptcy in 2002 as a result of its involvement in the Enron disaster and unprofessional practices, leading to a decline in audit quality and underscoring the need for stronger laws and moral behaviour (WSJ, 2002). It highlighted the necessity for auditors to maintain independence and objectivity, stand up against malpractices, and ensuring that audit findings are reported accurately. Nik Mohd Hasyudeen Yusoff, one of the Audit Oversight Board (AOB) founding board members, said that the audit scandals over the past decades are establishing a new foundation for good audit as well as the profession itself (PwC, 2016).

In reaction to the Enron incident and other significant financial disasters over the years, many nations strengthened corporate governance laws, raised audit standards, and integrated advanced technology into auditing practices. Technology adoption is required by US auditing standards because it is thought to increase audit quality (Widuri et al., 2016). According to the US Statement of Auditing Standards (SAS) No 316.52, auditors must "employ computer assisted audit techniques to gather more extensive evidence about data contained in significant accounts or electronic transaction files" (AICPA, 2007). According to Willborn (1989), audit quality requires the application of cutting-edge audit technology and cannot merely be defined as compliance with audit standards. The next subtopic will further discuss on Computer Assisted Audit Tools and Techniques.

In response to the digital imperatives, the now Big 4 audit firms are slowly adopting a revolutionary strategy by incorporating cutting-edge technology such as, but not limited to, AI and DA, to improve audit quality and efficiency. The major firms have witnessed notable changes in technology investment and adoption due to the influence of major crises and scandals (FRC, 2020). For instance, Deloitte invests several hundred million dollars in DA and AI along with some other advanced applications (Deloitte, 2016). Additionally, EY announced an investment of US$1.4 billion for the launch of an AI platform that incorporates extensive AI, data, and analytics (EY, 2023a). Lessons from financial crises like Enron and WorldCom have fuelled this movement, prompting a considerable re-evaluation of audit procedures and a push towards openness (Stoel et al., 2012). The financial crisis of 2007–2008 further highlighted the need for firms to have strong risk assessment instruments, which led to an early adoption of advanced audit software (IFAC, 2018).

In Malaysia, the Big 4 firms, namely PwC, KPMG, EY, and Deloitte are the leading players in the industry. Research by Ishak et al. (2013) shows in year 2003, the Big 4 audit firms in Malaysia dominated about 72% of the market audit share. Despite

being a big firm with many resources, regardless it be financial, technical, technological, or human, it does not guarantee an upheld of good outcome in their audit processes (Carlin et al., 2009; Lamboglia et al., 2021). The inability of the auditors to reach a conclusive finding in 1MDB's audit has highlighted the shortcomings and imperfections in the auditing process, underscoring its ineffectiveness in detecting and preventing fraud (PwC, 2016; WSJ, 2016). This circumstance is the representative of larger problems in the audit sector, as audit outcomes are not solely determined by a firm's size and resources. It implies that to ensure the integrity and dependability of audit processes, there is a need to continuously improve with more advanced audit technologies being adopted, combined with auditor knowledge, professional scepticism, and skills accordingly, as highlighted by the deficiencies of the 1MDB case (WSJ, 2016).

Beyond that, amidst worldwide interruptions caused by COVID-19, the Big 4 showed some agility by promptly deploying their remote auditing capabilities to sustain the provision of essential services. Rapid adaptation ensured that audits could be conducted without experiencing major delays, preserving the integrity and reliability of financial reporting during a crucial time. This promptness demonstrated their dedication to using technology, to overcome previously unheard-of challenges and continue operating (Moll & Yigitbasioglu, 2019).

Recent developments in audit technology shows that the application of tools such as artificial intelligence (AI) has the potential to greatly improve audit quality and increase fraud detection efficiency. According to a write up by the Financial Times, EY's use of AI system flagged suspicious activities in two of the first ten companies it reviewed, which were later confirmed to be frauds. This achievement demonstrates why AI may be a very effective tool within the industry for lowering workloads and raising audit quality. AI systems are capable of analysing enormous amounts of data, giving auditors rapid alerts to potential issues and misconduct, making the auditing process more efficient and

effective in preventing frauds. AI systems are designed to identify problems by utilizing machine learning and data derived from numerous past instances of misconduct. It guides auditors on the types of irregularities and anomalies to look for and where to find them in company accounts (Wright, 2024).

Nevertheless, the adoption of technologies within the audit industry in Malaysia is not as widespread as it should be. According to a survey by the MIA, conducted during the occurrence of COVID-19, the data indicates that the audit industry has adopted AI and audit software at a rate of only 14% respectively (MIA, 2023), as reflected in *Figure 2.3*. This indicates that these technologies are not as widely used as others, such as cloud applications, Microsoft applications, video conferencing and group collaboration tools, which showed higher adoption rates. The relatively low adoption rate could be attributed to several factors and thus suggests it is worth exploring for further understanding on this subject matter.

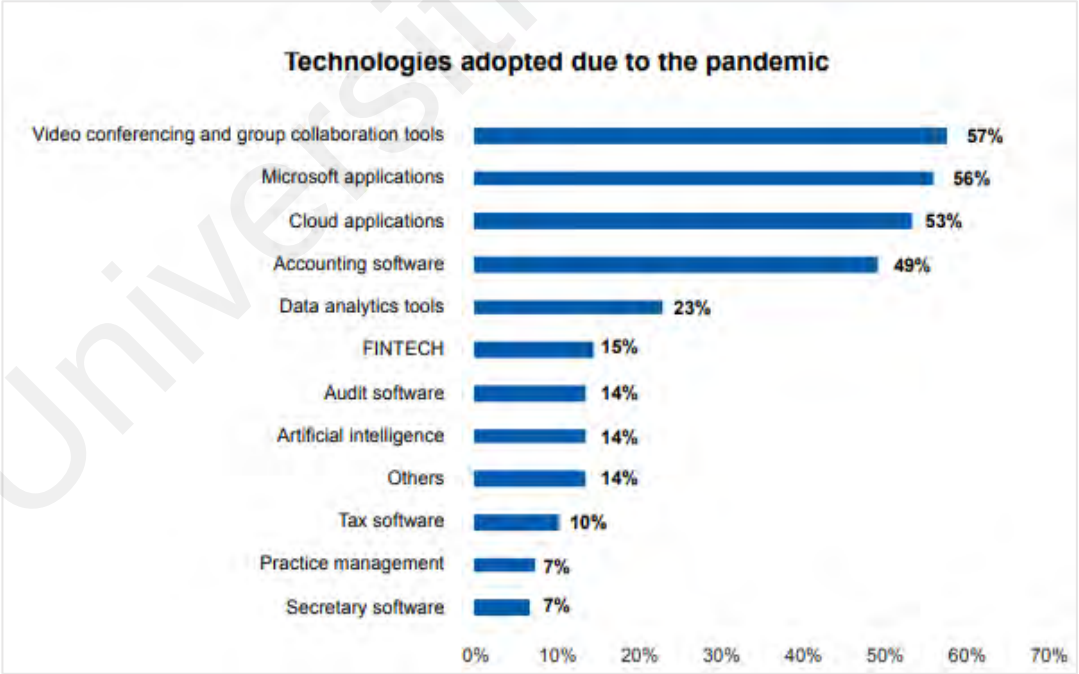

Figure 2.3: Technology adopted due to the pandemic

Source: MIA (2023)

2.4 Computer- Assisted Audit Tools and Techniques (CAATTs)

The quick development of various types of technology, owing to the revolutions, and the widespread use of information systems in businesses and audit practises have made it possible for auditors to perform their duties more effectively and efficiently using technologies (Ghani, 2016). The increasing prevalence of information systems and technological advancements has led to a growing significance for Computer- Assisted Audit Tools and Techniques (CAATTs) in the audit field, which refers to the use of any technology to facilitate the execution of an audit (Bierstaker et al., 2014; Braun & Davis, 2003). Zhao et al. (2004) defined CAATTs as computer programmes that enable auditors to acquire and analyse audit evidence using a computer in an information system environment; and Debreceny et al. (2005) understood CAATTs involve AI technology for financial failure prediction, analysing financial statements, and as an instrument for performing tasks such as listing data in a file.

By applying those definitions, CAATTs can be categorised using a variety of different approaches. Different CAATTs may be used for a different purpose in continuous auditing. According to Widuri and Sari (2017), there are various sorts of CAATTs, including word processing, electronic spreadsheets, and expert systems. Further, the four categories of CAATTs utilised by auditors can be categorised into fraud detection, continuous monitoring, generalised audit software (GAS), and electronic audit working papers (Widuri & Sari, 2017). Braun and Davis (2003), however, noted that there are five different CAATTs, which can be divided into two additional categories. The first is those that are directly used to examine the internal logic of the application, namely Integrated Test Facility (ITF), Test Data and Parallel Simulation. The second group consists of tools used indirectly; specifically Embedded Audit Module and GAS respectively.

Other experts stressed that CAATTs cover technology such as database applications, business intelligence software, and electronic audit documents (Al-Okaily et al., 2022; Siew et al., 2020). The software can range from basic Microsoft Word, Excel, and Access, which support basic productivity functions like text processing, spreadsheet analysis, and graphics, to sophisticated database and data analysis tools such as Oracle, Crystal Report, Statistical Analysis Software (SAS), Structured Query Language (SQL) and PowerBuilder. Furthermore, there are specific audit related software such as Audit Command Language (ACL), Interactive Data Extraction and Analysis (IDEA), ProAudit and ActiveData (Ahmi & Kent, 2012; Debreceny et al., 2005), which are used to analyse financial and operational data, and risk identification, subsequently enabling auditors to keep an eye out for high-risk areas and improve audit quality (Zhao et al., 2004).

Widuri et al. (2016) further added that within the Big 4 firm context, in general, they employ commercially available audit software, such as, but not limited to, ACL and IDEA, for data analysis, sampling and anomaly detection, in addition to the internally designed proprietary software tailored to their specific auditing methodologies and internal processes. This further demonstrated the Big 4's investment in technology. It is indicative of a larger trend in the industry towards digital transformation, whereby the application of advanced software programmes is more widely regarded as necessary to preserve audit quality, accuracy, and dependability in a financial environment that is changing quickly. However, a gap arises in understanding the specific challenges and outcomes of this technological integration in the Malaysian Big 4 firm context.

2.5 Role of CAATTs in Auditing

Audit standards have shown that using CAATTs can boost audit effectiveness and efficiency, although it may not be widely used yet (AASB, 2006; AICPA, 2007), hence auditors ought to adopt it (Jaber & Abu Wadi, 2018). According to various sources, the adoption and use of CAATTs will be able to improve audit calibre (Braun & Davis, 2003;

DeAngelo, 1981; Mardiana, 2019), and ultimately, the integrity of financial reporting (Widuri et al., 2016). Nowadays, audit data analytics as well as other automated tools and techniques have been integrated into the auditing profession which changes the way data is collected, analysed, used, and even stored throughout the auditing processes (Abdennadher et al., 2022; De Santis & D'Onza, 2021; Ferri et al., 2021; Kend & Nguyen, 2022; Lin & Wang, 2011; Moll & Yigitbasioglu, 2019; Tarek et al., 2017).

Researchers have classified CAATTs functions into nine categories, including assessing fraud risks, selecting journal entries and adjustments to be tested, verifying the accuracy of electronic files, re-performing procedures, choosing sample transactions, sorting transaction with specific characteristics, testing an entire population instead of samples, assessing the existence and completeness of inventories, and lastly obtaining data on client's controls; which, when taken together, has a favourable and positive impact on the audit's outcome (Ahmi et al., 2014; Al Natour et al., 2023; Bierstaker et al., 2001; Lowe et al., 2018).

Generally, CAATTs empower auditors to extract and analyse data from clients' information systems, databases, and accounting systems (Al Natour et al., 2023). CAATTs not only enhances auditors' processing speed, minimise mistakes, and automate audit processes (Bierstaker et al., 2001), but also enable data extraction, manipulation, querying, result compilation, and comprehensive data analysis and comparison (Widuri et al., 2016). The use of various technologies through CAATTs not only simplifies and automates previously manual audit processes and testing but also leads to decreased audit hours for the task and the simplicity of testing 100% of a population, greatly increasing the reliability of conclusions drawn from those tests, which when done improves the audit outcome (Ghani, 2016). The audit quality is greatly improved by testing the complete population rather than choosing samples that might not accurately represent the entire client entity (Moll & Yigitbasioglu, 2019).

One very important element associated with the use of technology in the audit profession and its relation to the audit efficacy and effectiveness is the extent of technological skills, knowledge, and training of the fellow auditors. Financial Reporting Council (FRC)'s survey further showed that the audit quality level is dependent and positively related to the competency of the audit team members towards the application of technological resources (FRC, 2020). This is supported by another study that mentioned that auditor's skills and expertise are one of the most important aspects of financial audit quality (Stoel et al., 2012). Big 4 firms tend to face challenges in ensuring audit processes, tests, controls, and risk assessments, performed by the auditors via technological resources on the client's large amount of data are reliable and well-founded. CAATTs enhance efficiency and quality control, but may pose risks when new auditors take too long to become familiar. For instance, in the Enron scandal, intricate financial structures and transactions were not fully examined, partly because in-depth critical analysis was not conducted beyond what was required by normal protocol (WSJ, 2002).

The existence of BDA in auditing adds to the problems involving auditors' judgement and decision-making. While auditors are probably used to implementing CAATTs to analyse structured data, their existing abilities are insufficient to mine unstructured, non-financial data using more advanced statistical techniques. Auditors face a variety of obstacles, including information overload, data relevancy, and the capacity to recognise trends affecting audit quality, hindering the adoption of CAATTs; suggesting it is worth analysing (Moll & Yigitbasioglu, 2019). Overemphasis on CAATTs software compliance compromises audit quality by overlooking distinctive audited entity features and understanding the audit's uniqueness (IFAC, 2018). The professional judgement of auditors may be impacted due to overreliance towards the results from the use of technology tools. Therefore, the intention of the application of technology to revamp audit quality may become a downside for the audit firm, as the data must be polished and re-

examined before any further analysis can be conducted to form an audit opinion (FRC, 2020).

In recent years, the use of CAATTs has become increasingly prominent as an effective means to reduce fraud incidences (Al Natour et al., 2023). This trend is understandable as Tarek et al. (2017) highlighted that while technology offers many benefits, it also creates opportunities for fraud. It is much easier to alter data electronically than when it is stored in traditional hardcopies. This creates room for missing out on errors or possible frauds by the client entity which further lowers audit reliability. The manipulation may be intentionally, but that requires auditors to further examine and conduct more audit tests to detect such circumstances to maintain good audit outcome. On the contrary, Ghani (2016) mentioned that via the use of CAATTs, fraud misstatements may be detected, through the study of financial data and error inspection. Therefore, it is crucial for auditors to exercise their professional judgment, leveraging CAATTs to detect fraudulent activities that might otherwise go unnoticed (KPMG, 2018). However, studies reveal a gap in understanding the need for auditors to strike a balance between using technology tools sparingly and relying on professional judgement while conducting audits (FRC, 2020; Stoel et al., 2012).

2.6 Adoption of CAATTs

In the auditing sector, the trajectory of technology adoption has evolved significantly since the 1980s, transitioning from initial efforts to enhanced efficiency and audit quality to the contemporary integration of more sophisticated tools. Early research illustrated the onset of technology use in audits, primarily focused on improving basic audit processes (Braun & Davis, 2003; DeAngelo, 1981). This trend was further expanded upon in the works of Debreceny et al. (2005), highlighting the introduction of advanced tools such as electronic workpapers and decision aids. Now, firms are progressively using audit technology to integrate electronic workpapers, decision aids, and knowledge repositories

into their processes (Lowe et al., 2018). CAATTs applications are becoming essential components of the audit profession, driven by the exponential growth of data and the increasing complexity of modern information systems (Al Natour et al., 2023).

Despite the recognized benefits of CAATTs in enhancing audit efficiency, their adoption in developing countries, including Malaysia, remains limited, as highlighted by Siew et al. (2020). This underutilization indicates several obstacles that are particularly pertinent in the context of Big 4 audit firms operating in these areas. It also underscores a lack of comprehension regarding the challenges faced in implementing CAATTs within these specific regions. Challenges related to technology infrastructure and accessibility can impede the effective implementation of CAATTs (Siew et al., 2020).

Research tells that successful technology adoption requires support from both auditors and the firms (Ahmi et al., 2017). Financial Reporting Council's survey revealed that audit quality is positively correlated with audit team members' technical aptitude (FRC, 2020). The success of CAATTs heavily depends on the availability of trained professionals; however, there is often a skills gap in developing countries that hinders the full utilization of these advanced tools (Ahmi & Kent, 2012).

Moreover, technology use varies by firm size, with Big 4 firms using technology audit applications more frequently than smaller firms (Siew et al., 2020). The initial cost investment for CAATTs, although beneficial in the long term, may pose a barrier, particularly in budget-conscious environments (Janvrin et al., 2008). It is beyond doubt that Big 4 firms have the resources and capability (Brownlee, 2023; Deloitte, 2023; EY, 2023b; PwC, 2023), causing no hindering effect towards audit technology investment, allowing them to further maintain their reputation and audit quality (Tarek et al., 2017).

The readiness of clients in Malaysia to engage with technology-driven audits and the availability of digitised data also play a crucial role in the adoption of CAATTs (FRC, 2020). This is related to the fact that clients with sophisticated accounting systems are

likely to select auditors with necessary skills, technology, and expertise such as the Big 4, mainly due to considerations such as the complexity of their accounting information system (Siew et al., 2020). More thorough research is required to understand how auditors interact with increasingly complex information systems, particularly with regard to guaranteeing audit reliability and integrity (Abdul Ghani et al., 2022; Siew et al., 2020).

Additionally, organizational influence to technological change and adapting existing workflows to integrate CAATTs is another element that the Big 4 firms have to navigate in these markets. Prior research found that auditing costs, resources, expertise, and management support influence CAATTs' use (Ahmi & Kent, 2012). Performance expectations, organizational and technical infrastructure support are other key factors in determining whether auditors will use CAATTs (Janvrin et al., 2008). But even as technology adoption is advancing, a deliberate effort is still crucial to preserve the delicate equilibrium between automated procedures and the auditor's crucial professional judgement (Ghani, 2016). While technological advancements significantly impact the auditing field, there is a noticeable lack of focus on the necessity for audit firms to embrace new audit tools and develop long-term strategies for adapting to these technological changes (Sahut et al., 2013). The aforementioned gap underscores the necessity of acquiring a more sophisticated comprehension of the dynamic function of technology in auditing and its wider ramifications on the field.

Despite the fact that the use of CAATTs lowers the audit costs and at the same time positively impacts the audit quality and productivity of the auditors, CAATTs are not fully utilized in developing countries (Siew et al., 2020). This highlights a gap in understanding the barriers to CAATTs implementation in these regions. Moreover, regulatory and compliance factors in Malaysia may also have a hand in the adoption of CAATTs. In order to fully profit from technical developments in auditing, adjustments in regulatory legislation, educational frameworks, and organizational culture are required

(AASB, 2006; AOB & SSM, 2017; Ismail & Zainol Abidin, 2009; MIA, 2009; Premkumar, 2003).

2.7 Summary

The comprehensive literature review delves into the evolution and impact of technology in the audit industry, with a focus on the adoption and acceptance of CAATTs. It traces the history and implications of the Industrial Revolutions, emphasizing the transformative effects of IR 4.0 on various sectors, including auditing. The review highlights the significant role of technology in the modern auditing era, exploring imperatives for technological transformations driven by various reasons. It can be grasped that the use of CAATTs bring along numerous benefits to the audit field and surely has its play in ensuring that audit outcome is maintained at its peak.

There are a number of significant research gaps in the area of CAATTs adoption, especially when considering the Big 4 audit firms in Malaysia. CAATTs have been shown to improve audit productivity, quality, and efficiency, but Siew et al. (2020) pointed out that there is still a need for more research because of how little they are used in developing nations like Malaysia. As such, this study explores the context of CAATTs adoption, with an emphasis on factors that influence the CAATTs within Malaysian Big 4 audit firms. This study seeks to advance knowledge of the dynamics of technology adoption in auditing within the Malaysian context, offering insightful information for both theoretical and practical uses in the field of audit technology. The next section discusses the theoretical concept employed in this study.

CHAPTER 3: CONCEPTUAL FRAMEWORK

3.1 Introduction

To study CAATTs adoption within the Malaysian Big 4 context, with an emphasis on factors that influence the CAATTs adoption in Malaysian Big 4 audit firms, this study adopts the Technology, Organization, and Environment (TOE) framework. This chapter begins with an overview of the theories utilised to study technology adoption, followed by the presentation of the emergence of TOE framework and finally the descriptions of TOE framework, in line with this study.

3.2 Technology Adoption Theories

There are numerous key theories in the field of technology adoption that shed light on how and why technology is adopted in different situations. Several key theories have found widespread application in various sectors of technology adoption, such as auditing and the use of CAATTs. For instance, the Diffusion of Innovation (DOI) theory by Rogers (1995); the Technology Acceptance Model (TAM) by Davis (1989); the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2013); and the Technology, Organization and Environment (TOE) framework by Tornatzky & Fleischer (1990). Technology adoption theories vary depending on the technology innovations and contexts studied.

The DOI theory clarifies the how, why, and rate at which novel concepts and innovations proliferate. Based on their willingness to accept new technology, adopters are divided into five groups, namely, the innovators, early adopters, early majority, late majority, and laggards (Rogers, 1995). On the other hand, TAM is primarily focused on understanding user acceptance of technology, specifically emphasizing perceived usefulness and perceived ease of use as the key factors influencing technology adoption (Davis, 1989). Furthermore, UTAUT integrates elements from various technology adoption theories to create a comprehensive model. It includes multiple factors such as

performance expectancy, effort expectancy, social influence, and facilitating conditions respectively (Venkatesh et al., 2013).

3.3 Technology, Organization and Environmental (TOE) Framework

Beyond the individual perspective, the TOE framework as reflected in *Figure 3.1* considers the organization as a whole (Tornatzky et al., 1990). This is in contrast to the approaches used in previous studies on technology adoption in general, or specifically CAATTs, such as the use of UTAUT (Abdul Ghani et al., 2022; Bierstaker et al., 2014; Curtis & Payne, 2008; Dowling, 2008; Ferri et al., 2021; Janvrin et al., 2008; Owino; & Musuva, 2021; Rosli et al., 2012) or the use of TAM (Kim et al., 2009; Shihab et al., 2017; Widuri et al., 2016).

The TOE framework originates from the DOI theory that focuses on individual and organizational levels of technology adoption. Innovation, time, communication channels, and social systems make up the DOI theory's primary components. Relative advantage, complexity, compatibility, trialability, and observability are factors that affect how quickly innovations are adopted (Rogers, 1983). In response to Rogers, Tornatzky and Klien (1982) conducted a meta-analysis study and identified the top ten innovation traits that have been extensively studied are relative advantage, complexity, compatibility, cost, profitability, communicability, divisibility, social acceptance, trialability, and observability. However, it was found that adoption was inversely related to complexity, with only compatibility and relative advantage being consistently significant and positively associated with adoption. These are seen to be lacking in previous studies using the UTAUT or TAM (Curtis & Payne, 2008; Janvrin et al., 2008).

While both the DOI theory and TOE framework share similar concepts, the TOE framework is distinct with its inclusion of the environmental context, which the DOI theory does not account for. Oliveira and Martins (2011) argue that the TOE framework offers a more comprehensive explanation for intra-firm innovation adoption due to this

inclusion. Additionally, Tornatzky et al. (1990)'s TOE framework rarely negotiates for a fixed model and therefore its components have undergone continual modification by many researchers, leading to its broader use and increased theoretical validity (Alamgir Hossain & Quaddus, 2011; Awa et al., 2017).

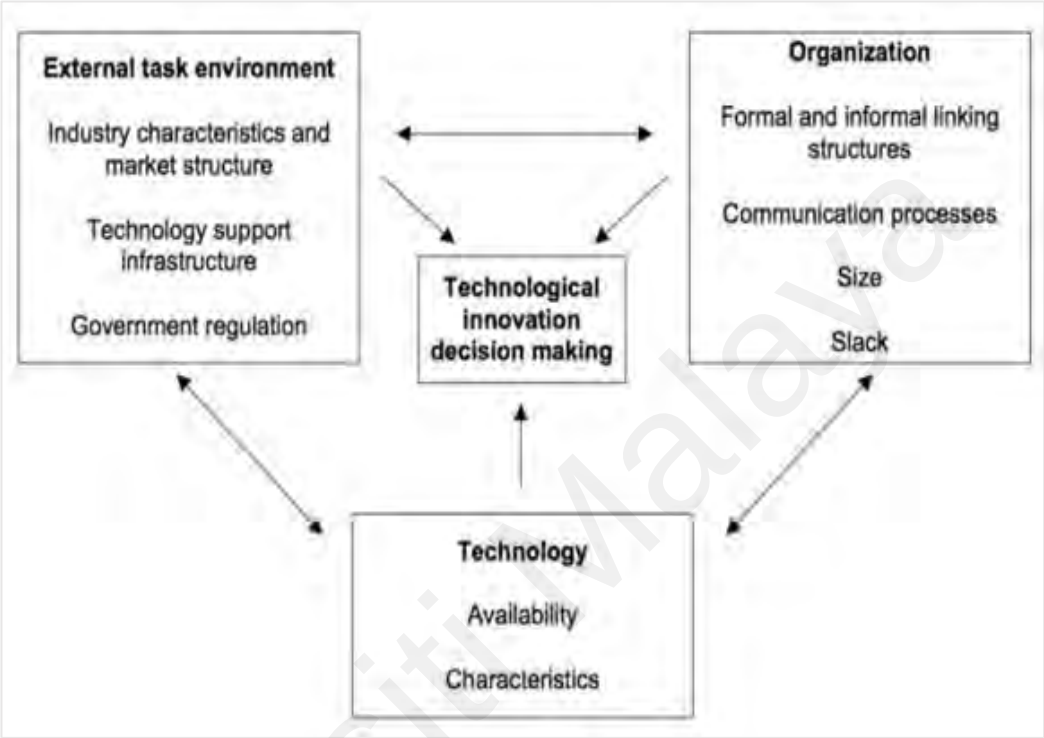

Figure 3.1: TOE framework

Source: Tornatzky et al. (1990)

This study examines the TOE framework's applicability in Malaysian Big 4 audit firms, analysing CAATTs adoption based on the theoretical and empirical foundation provided by earlier studies. It is appropriate to utilize this framework as it goes beyond the technological paradigm to include organizational and environmental factors (Venkatesh & Bala, 2012), offering a multidimensional viewpoint that is ideally suited to the exploratory character of a qualitative research (Verma & Bhattacharyya, 2017). The three aspects of the TOE framework, namely the technological, organizational, and environmental contexts, are subsequently discussed.

3.3.1 Technological Context

In the CAATTs adoption context, technology refers to the software and hardware utilised in the auditing process (Aviantib, 2019; David et al., 2010). This includes internal and external technological variables influencing individual, organization, and industry innovation adoption (Huang et al., 2004; Troshani et al., 2011). The technological attributes that influence adoption are the five innovation attributes by Rogers (1983) and other attributes by other researchers (Ahmi & Kent, 2012; Alamgir Hossain & Quaddus, 2011; Awa et al., 2015; Oliveira & Martins, 2010; Rosli et al., 2012).

Adopters frequently assess an innovation's qualities based on its potential gains and barriers. Gains include higher levels of service reliability, efficiency, and quality, while barriers include complexity, compatibility, and legacy systems. Prior to firms implementing CAATTs, it is necessary to consider attributes like cost-benefits, risk, and availability of the technology to be adopted (Oliveira & Martins, 2010; Rogers, 1983). While complexity has been found to have a negative correlation with technology adoption in organizations, it has also been found to be a significant factor in determining its adoption in organizations (Verma & Bhattacharyya, 2017).

Nevertheless, the decision on whether to adopt and use a technology is based on both its perception and its need. This brings rise to the task-fit factor because organizations may choose not to use CAATTs if it does not meet their audit job requirements, even though it is considered valuable cutting-edge (Rosli et al., 2012). Although the study emphasized the task-fit aspect, research on how effectively CAATTs satisfy particular audit work needs in various organizational contexts, particularly in audit firms of different sizes such as the Big 4, is lacking.

Technology infrastructure and accessibility are another important aspect within the technological aspect. The possession of such infrastructure has a significant impact on the uptake and efficient use of technology. Effective technology adoption demands

appropriate investments in the IT infrastructure as well as associated labour (Verma & Bhattacharyya, 2017). Further research is needed within the context of Malaysian CAATTs (Aviantib, 2019; David et al., 2010).

3.3.2 Organizational Context

According to Tornatzky et al. (1990), the organizational context refers to internal organizational traits including size, scope, structure, and communication methods that may influence adoption. The TOE framework helps understand the tangible and intangible aspects within the organizational context. An organizational environment that supports and reinforces corporate values is a critical determinant of adoption (Ahmi et al., 2014; Premkumar, 2003; Troshani et al., 2011). Troshani et al. (2011) found that adoption in highly centralised organizations can be aided by senior management's decision to adopt despite opposition from lower levels. However, other organizational characteristics are more frequently noted in the literature, such as organizational size (Ahmi & Kent, 2012; Janvrin et al., 2008), organizational support (Ahmi & Kent, 2012; Rosli et al., 2012), and encouragement from management (Curtis & Payne, 2008).

Larger firms are more likely to adopt innovations due to their financial capabilities, while smaller organizations may be more adaptable due to their flexibility and concerns about adaptation (Troshani et al., 2011). Larger firms have economies of scale and resilience to bear the risks (Zhu et al., 2004) besides having more financial and human resources to ensure successful use of technology (Bierstaker et al., 2014). Perceived costs is an important aspect of organizational readiness that needs to be considered in the adoption of any technology (Iacovou et al., 1995). A reduced intent to adopt technology results from perceived higher costs (Verma & Bhattacharyya, 2017).

Within the organizational perspective of the TOE framework, the human personnel context, specifically individual differences such as attitude, perspectives, and motivation, are also found to have an impact towards the adoption of technology. The

organizational focus on CAATTs adoption is beneficial as it involves the entire company rather than just one auditor. Firms' strategic focus and organizational level innovation adoption are highly dependent on the peculiarity of individuals. It is found that a positive attitude leads to the motivation of technology adoption. There is a dearth of study on the influence of human variations on organizational focus and innovation adoption, especially as it relates to the strategic focus on CAATTs adoption (Awa et al., 2015).

These prior reviews imply that, even though specific organizational traits are frequently mentioned in the literature respectively as influencing technology adoption, more thorough research is required to consider a wide range of variables, including individual variations within organizations, particularly for specific technologies like CAATTs.

3.3.3 Environmental Context

The environmental context refers to the overall conditions in which a company operates. Research has used attributes like competitors, industry dynamics, governmental and external influences (Tornatzky et al., 1990; Widuri et al., 2016). Environmental factors are essential for encouraging the adoption of technology, as successful adoptions can encourage others to consider it (Troshani et al., 2011).

The TOE framework indicates that organizations must manage their external environment, which includes but is not limited to market and industry structure, competitors, governmental and regulatory bodies' requirements, as well as external pressure (Tornatzky et al., 1990). Firm managers may experience pressure as an increasing number of businesses and other firms in the sector, whether competitors or business partners, adopt a technology. Consequently, these managers might feel compelled to implement the said technology, to maintain their competitive edge (Verma & Bhattacharyya, 2017).

Additionally, auditing the customer's system is essential to ensure business activities are conducted correctly and reports are generated accurately. Prior literature states that as client size increases and their systems become more complex with larger volumes of data, the technology used by audit firms will become increasingly necessary (Rosli et al., 2012).

While Tornatzky et al. (1990) and Widuri et al. (2016) discuss environmental influences, there is a gap in understanding how specific environmental dynamics, such as society and external aspects uniquely affect technology adoption, especially in the audit field. Additionally, the impact of regulatory and professional bodies on technology adoption strategies in audit firms, particularly in countries like Malaysia, is not extensively explored.

3.4 Summary

The transformation of the TOE framework since its inception has resulted in the development of many attributes that enhances its applicability. According to Tornatzky et al. (1990), the three aspects of the framework present both opportunities and constraints for technological innovation. Hence, this study is based on the conceptual framework as shown in *Figure 3.2*, built on the theoretical basis and supported by empirical evidence from the TOE model by Tornatzky et al. (1990) and previous studies' modifications (Alamgir Hossain & Quaddus, 2011; Awa et al., 2017; Oliveira & Martins, 2010, 2011; Rosli et al., 2012; Venkatesh & Bala, 2012; Verma & Bhattacharyya, 2017). The gaps that exist suggest avenues for future research, emphasizing the need for a more nuanced understanding of technology adoption within the TOE framework, especially in relation to specific technologies like CAATTs. The framework in *Figure 3.2* supports the research objectives of this study by illustrating how each component of the TOE framework interacts and influences CAATTs adoption.

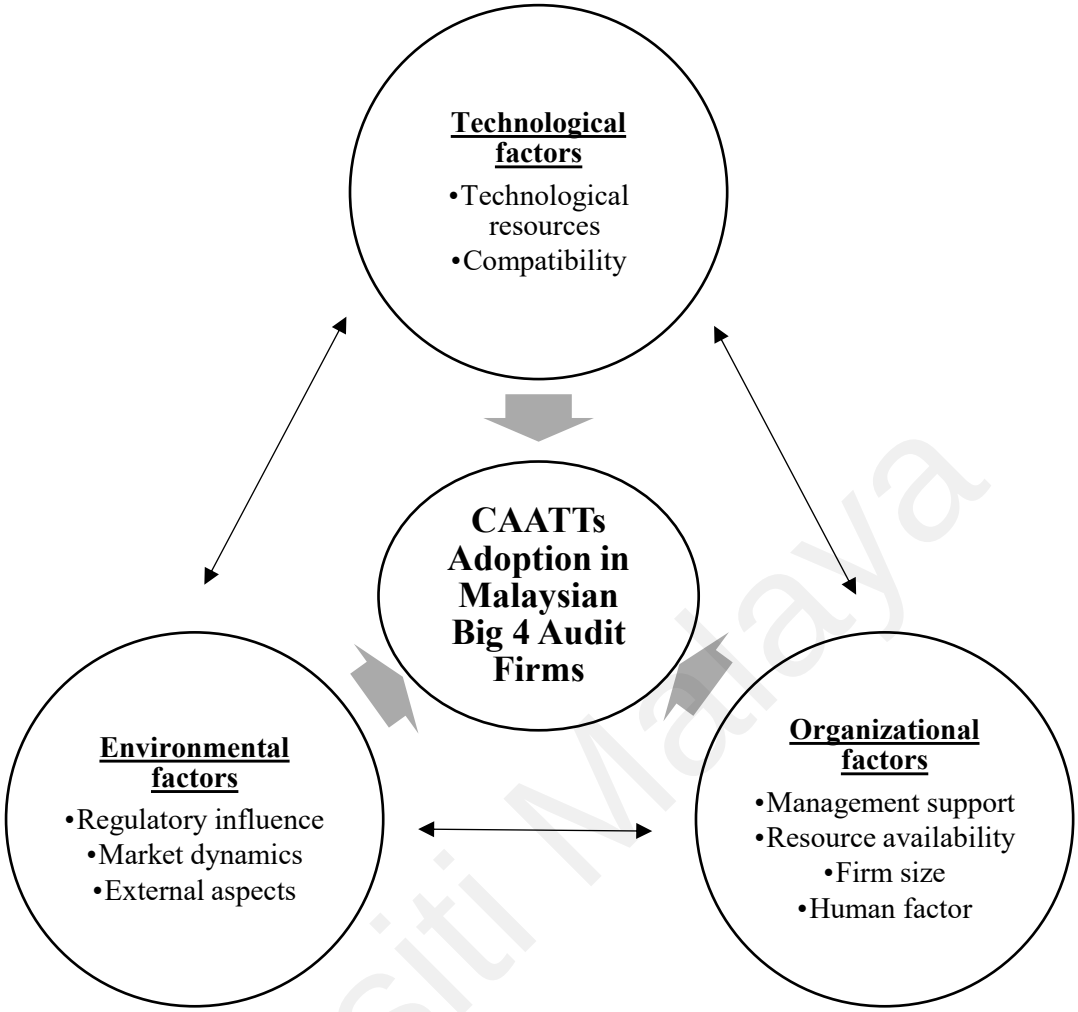

Figure 3.2: Proposed TOE conceptual framework

Source: Developed for this research

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

This chapter lays out the overall research methodology and procedures undertaken in this study. It begins with an overview of the qualitative method employed in gaining insights into CAATTs adoption in the Malaysian Big 4 audit firms. This chapter continues with the presentation of the philosophical assumptions, research design and ethical considerations. Finally, the data collection and data analysis methods undertaken within the qualitative approach are described.

4.2 Qualitative Approach

Aligned with the research objectives mentioned in the first chapter, a qualitative methodological approach was devised and implemented to delve deeper into the adoption of CAATTs within the Big 4 audit firms in Malaysia. Qualitative research refers to a broad range of theoretical perspectives and research methodologies, including ethnography, grounded theory, case studies, content analysis, historical research, and action research (Creswell, 2009). A qualitative research approach is elucidated as a systematic and subjective method of describing or comprehending life events to further make sense of them. This depth of understanding is especially beneficial in fields where human experience and interpretation are essential (Delgado-Hito & Romero-García, 2021).

Qualitative research involves the process known as induction, which entails gathering data on a particular topic of study from which the researcher develops various conceptions and theories. A qualitative approach is ideal for this study as it offers a thorough investigation of the participants experiences, gathers and analyses non-numerical data, and attempts to extract meaning from it, in contrast to a quantitative strategy (Mohajan, 2018). This type of study allows the observation and understanding on how the auditors observe and interprets events relating to CAATTs adoption along

with their beliefs and perceptions on the subject matter, reflecting current and real-time conditions. Furthermore, this study is classified as an exploratory study, allowing for the investigation of complex and evolving processes, as well as the examination of emerging patterns and topics (Miles & Huberman, 1994) on CAATTs.

A qualitative study also does not adhere to a predetermined participant count or sample size, unlike a quantitative research that necessitates a statistical determination of sample size to ensure adequate power in demonstrating that the observed effect can be attributed to the intervention (Sargeant, 2012). As such, the concept of saturation is used in this study to describe the point in data gathering when no new themes, issues, or insights are found and the data obtained on CAATTs starts to repeat, indicating that a sufficient sample size has been achieved and that further data collecting will only lead to redundancy (Bradshaw et al., 2017; Hennink & Kaiser, 2022).

There have been several studies conducted previously on CAATTs that employed the quantitative methods of collecting data (Ahmi & Kent, 2012; Al-Okaily et al., 2022; Siew et al., 2020; Thottoli et al., 2022), and only limited studies that indeed applied the qualitative methodology, reflecting other countries and contexts (Ahmi et al., 2016; Debreceny et al., 2005; Widuri et al., 2016). Hence, employing a qualitative research method is not only suitable for providing a more in-depth analysis to achieve this study's objective, but it also has the potential to contribute to the existing body of knowledge by improving the analysis of the CAATTs adoption in Malaysian Big 4 firms.

Overall, a qualitative study is appropriate as the experiences of the auditors are considered necessary to gain an understanding of the types of CAATTs in practice and the adoption factors in Malaysian Big 4 audit firms. By gathering detailed insights from auditors at various levels, this study can identify the necessary steps to bridge gaps and enhance the adoption of CAATTs.

4.3 Philosophical Underpinning

Conventionally, a research study is guided by one or more research paradigms, which are the fundamental philosophical views that researchers have about reality and truth in general, and the research problem specifically (Dawadi & Giri, 2021). Thus, a research paradigm is a philosophical stance regarding the nature of reality, the world, and the methods to approach and comprehend it (Maxwell, 2005). Researchers using a qualitative approach make certain philosophical assumptions in their studies (Creswell, 2009). It is crucial for researchers to better understand competing research paradigms and their philosophical underpinnings (Scotland, 2012), given that philosophical assumptions guide the research process (Boswell & Babchuk, 2023). The components of research paradigms are ontology, epistemology, and methodology, reflecting the philosophical stance used by researchers (Bleiker et al., 2019; Boswell & Babchuk, 2023; Creswell, 2009; Cuthbertson et al., 2020; Delgado-Hito & Romero-García, 2021; Maxwell, 2005; Scotland, 2012; Spencer et al., 2020).

The study of ontology examines the nature of reality. Ontology is explored in terms of views regarding the existence of "universal truth" and objectivity within the framework of a qualitative study (Cuthbertson et al., 2020; Spencer et al., 2020). This perspective suggests that reality is subjective and socially constructed. Qualitative researchers hold that different people can have different perspectives of the same reality and that these perspectives can coexist. Researchers should take a stance on their perceptions, opinions, and beliefs about reality and its mechanisms (Scotland, 2012), as their approach to the ontological perspectives determines the methodological decision making (Bleiker et al., 2019; Boswell & Babchuk, 2023).

Meanwhile, epistemology is the study of the process of knowing and how it can be known (Cuthbertson et al., 2020; Spencer et al., 2020). In the study of the social world, epistemology is frequently referred to as subjectivist. Subjectivist epistemology views

study subjects more as "actors" who contribute to the creation of reality rather than mere subjects to be tested. This perspective is often embraced by qualitative research, which recognises that individual viewpoints, experiences, and interpretations shape knowledge (Bleiker et al., 2019). Ontology is a prerequisite for epistemology, and for the research to be coherent, the researcher's ontological stance must be connected to the epistemological approach, which in turn informs the research's methodology and tools (Bleiker et al., 2019; Dawadi & Giri, 2021).

Methodology is the study of the research process (Cuthbertson et al., 2020). A naturalistic inquiry approach is frequently used in qualitative research, with an emphasis on studying phenomena in their natural environments. According to Scotland (2012), methodology is the strategy or plan of action that underlies the specific choice and use of methods. It reflects the why, what, from where, when, and how of the data collection and analysis.

These three components form a paradigm with their own characteristics. Every research is underpinned by differing assumptions about reality and the knowledge that can be generated through its methodology and methods. The researcher's presumptions about the nature of the phenomena's reality (ontology) will particularly impact how information can be gathered about the phenomenon (epistemology), which in turn affects the technique of the investigation (methodology) (Kant, 2014; Shah & Al-Bargi, 2013). Researchers must comprehend these philosophical presumptions and how they fit into particular research paradigms to explain their methodology, defend methodological decisions, and evaluate data within a convincing theoretical framework (Scotland, 2012).

In this research, reality is viewed as a symbolic discourse as the researcher sees the world comprising human actors who make sense of their reality through processes of social interaction and experiences, made possible through the shared meanings and normalcy they attach to people, things, and situations. Since this study aims to develop

an understanding of the use and adoption of CAATTs in the Malaysian Big 4 audit firms, by obtaining information from various actors of different hierarchical levels, subjective meanings with multiple realities might emerge. In such a situation, the reality of CAATTs implementation and adoption might be situated in the meanings and norms developed through the social interactions among the actors in the organizations. Therefore, this study assumes that there are multiple realities or truths in the thoughts of the actors in these firms and can only be known through the employment of a qualitative research approach (Ryan et al., 2002).

4.4 Research Design

Research design is a plan that guides the researcher in the process of collecting, analysing, and interpreting observations. It links the data collected and the conclusion drawn to the initial question of the study (Creswell, 2009; Scotland, 2012). According to Flick et al. (2004), the methods used to accomplish the research objectives of a study can be summed up as research designs. With the intention of achieving the research objectives, linkages are drawn between theoretical frameworks, questions, research, presentation aims, and the tactics and resources employed.

Qualitative research uses an analytical framework, a network of related ideas and classifications, to understand underlying processes, focusing on descriptions and in-depth knowledge of social problems, unlike quantitative methods like questionnaires, which rely on numbers (Gill et al., 2008). Additionally, qualitative research aims to increase understanding of the meaning and aspects of a person's life experiences and their social environment (Fossey et al., 2002).

As such, the qualitative method is appropriate as the experiences of auditors are considered necessary in this study to gain an understanding of the adoption of CAATTs within Malaysian Big 4 firms. The following sections will provide a more detailed elaboration.

4.5 Data Collection

Similar to other research methodologies, qualitative research also draws on a variety of techniques for data collection. In general, the methods employed to gather data under the qualitative approach include interviews, observations, focus groups, and document review (Asenahabi, 2019; Delgado-Hito & Romero-García, 2021).

In contrast to the outcomes of a quantitative approach, which are in numerical values, a qualitative research design produces a large amount of descriptive data expressed in terms of language. The data from qualitative research are examined inductively and come in the form of text produced during the study (Mohajan, 2018). There are different ways of making record of the data collected via qualitative means, such as taking handwritten notes, audio or video recordings, maintaining field notes, memos, and transcription (Lin, 2009; Sutton & Austin, 2015).

The most reasonable approach to gather data for this study, as applied, is through conducting semi-structured interviews. The main objective of this data collection method is to collect auditors' perception on CAATTs adoption within the context of Malaysian Big 4 audit firm. Conducting semi-structured interviews allows for subjective and flexible response, as well as spontaneity during the interview (De Santis & D'Onza, 2021).

Data were collected over a period of 8 months, from April 2023 to November 2023. The ensuing subsections provide specifics and a discussion of the methods employed in this study.

4.5.1 Semi-structured Interview

Interviews are conducted to examine people's perspectives, experiences, worldviews, and motivations about particular issues (Gill et al., 2008). They can be categorised into structured, semi-structured, and unstructured interviews (Alamri, 2019; Creswell, 2009; Gill et al., 2008; Minhat, 2015). In this study, semi-structured, one-on-one interviews

were used to conduct the in-depth interviews, which included a series of questions deemed useful for comparing and contrasting.

Semi- structured interviews allow for subjective and flexible responses, as well as spontaneity during the interview, unlike the conduct of structured and unstructured interviews (De Santis & D'Onza, 2021). Semi- structured interviews are more like natural conversations, permitting participants to express themselves in their own words and encouraging them to share their insights, experiences, and perspectives comfortably. Furthermore, the flexibility of this approach enables the discovery and expansion of data that participants value but that the researcher may not have initially deemed relevant (Gill et al., 2008; Mohajan, 2018).

Semi-structured interviews comprise a number of fundamental questions that help define the core topics while also allowing the researcher and participant to stray from the topic at hand to delve deeper into a related specific idea or response (Gill et al., 2008; Jamshed, 2014). This approach also enables the interviewer to develop follow-up questions based on the interviewees response or conversation (Elhami, 2022).

In this study, the semi-structured interviews included open-ended questions and were conducted in-depth to elicit the views and opinions from participants related to the adoption of CAATTs. Given the informal and open-ended nature of the interview, it provided the opportunity for the interviewees to reveal more about the subject matter from their experiences and observations. Every interaction between the interviewees and interviewer was distinct, resulting in a diverse array of responses that are both unique and of different quality. Consequently, a larger set of more reliable and comparable qualitative data was gathered for the analysis of this study.

For this study, the interviews were conducted in-person and through online platforms such as Microsoft Teams and Google Meet. This approach allowed the leverage of conferencing tools to facilitate real-time and in person interactions. Online platforms

expand the reach of research participants, enabling the researcher to connect with individuals across geographical boundaries, fostering interaction between the interviewer and interviewees in their familiar and comfortable environments, and promoting flexibility in scheduling, greater openness, and convenience.

The interviews lasted approximately 30 to 60 minutes and were recorded with the permission of the interviewees, then further transcribed. According to Elhami (2022), transcription of the conversation is required for data analysis in a qualitative research. Nevertheless, it is crucial to obtain the consent of the participants for recording. In the even no consent is obtained, note taking, field notes and observation records become pivotal (Fossey et al., 2002; Mohajan, 2018).

In this study, the initial intention was to record all interviews conducted for accurate data analysis. However, some participants expressed reluctance due to privacy concerns. To address their preferences, no recordings were made; instead, detailed and thorough notes were taken to keep records and subsequently analyse the responses gathered. Notes were made during the online and in-person interviews. This approach allows for a comprehensive analysis of the information, with more focused interview segments fully transcribed for in-depth study, as mentioned by Fossey et al. (2002).

During the interview, the respondents were provided with opportunity to independently express their perspectives, and questions arising from the discussions were used to further delve into their thoughts and probe the matter. The semi-structured interviews began with discussing the type and purposes of CAATTs used by the auditors. As the interview progressed, further depth was gained by inquiring about CAATTs adoption through the perception of auditors on factors motivating or hindering the adoption of CAATTs in the Big 4 audit firms in Malaysia.

The interview questions were meticulously formulated based on the research questions, prior research, and the TOE framework to ensure comprehensive coverage of each attribute. Structuring the interview questions around the key attributes of the TOE dimension aimed to capture a holistic view of the factors influencing CAATTs adoption. Some examples include, technological context questions exploring the availability and complexity of CAATTs, such as, 'Do you find audit software/ application challenging to use?', 'Does it affect your usage?'; organizational context questions exploring management support, like, 'What does your firm do towards encouraging the adoption of technology?', 'Does your firm provide any type of training or other support?'; and the environmental context questions addressing external pressures, such as, 'In your opinion, how does regulatory requirement/ professional bodies affect the decision to adopt audit technologies?'.

This approach comprehensively covered technological, organizational, and environmental aspects, enabling a thorough exploration of the challenges and drivers of CAATTs adoption in Malaysian Big 4 audit firms. The interview guide, shown in *Appendix A*, reflects the appropriate linkages between each TOE attribute and the questions asked. However, the questions were not asked in a predetermined order; instead, the order followed the natural progression of topics during the interview sessions.

4.5.2 Selection of Interview Participants

To ensure that participants selected could contribute effectively to this study, it was vital to undertake the right selection process. Thus, in relation to this study's research questions and to enhance the adequacy and quality of the information collected, purposive sampling was employed. The participants of this study are auditors of various levels from the Malaysian Big 4 audit firms, reflecting a purposeful sample of individuals who have the necessary understanding and familiarity (Bradshaw et al., 2017) with the CAATTs phenomenon under study. Participants were selected based on this study's objectives, as

well as their consent and willingness to participate. Through the purposive sampling technique, various points of view on the research topic are represented by individuals possessing relevant knowledge or skills (Fossey et al., 2002).

In the initial stages of this research, it was imperative to approach potential participants with consideration and courtesy. The process began with preparing a list of targeted participants and then reaching out to them with a proposal to participate in this study. A combination of personal connections and snowball sampling was used to obtain interview subjects. Several participants were acquaintances of the researcher, while others were recruited through snowballing, where initial interviewees assisted in identifying additional potential participants (Fossey et al., 2002). The initial contact was made through direct messages, explaining the purpose and nature of this research. Comprehensive details of the study, including its objectives, scope, and potential influence, were disclosed. Any questions or concerns raised by participants were promptly and thoroughly addressed. Upon their acceptance and consent to participate, a mutually convenient time and date were arranged for the interview, accommodating the participants' availability and preferences.

The interview began with participants providing a brief overview of their current roles, their prior career histories, and their journey within the audit field, specifically in the Malaysian Big 4 audit industry. This allowed for a comprehensive overview of their professional paths and set the groundwork for a more in-depth investigation of how their roles relate to the subject matter. As the interview progressed, the conversation transitioned to focus on CAATTs. Aligning the conversation with the main topic and participants' experiences with sophisticated CAATTs indicated the depth of the interview.

4.5.2.1 Interview Participants Selection Criteria

A total of 17 interviews were conducted with external auditors of various levels in the Malaysian Big 4 audit firms for this study. The auditors were selected based on several criteria to ensure they could provide the necessary information to meet the research objectives. The meticulous selection process significantly contributed to enhancing the study's applicability, relevance, and comprehensiveness.

Firstly, the participants must be currently employed by one of the Big 4 audit firms, i.e., PwC, KPMG, EY, or Deloitte within the Malaysian landscape. This ensures that participants possess a shared professional context and exposure to similar organizational structures and practices, guaranteeing that the insights gathered are relevant to the business practises, technology implementation, and regulatory framework of Malaysia.

Moreover, participants should hold a position directly related to auditing within the firm. This includes roles such as Audit Associates, Audit Senior Associates, Audit Managers, Audit Principals, or Audit Partners. By including auditors across these diverse roles, this research aims to capture a comprehensive understanding of how CAATTs adoption varies across hierarchical levels. This inclusion criteria reflects diversity in experience, ranging from those new to the profession to seasoned professionals. It acknowledges that auditors at various levels may encounter different opportunities and challenges in incorporating CAATTs into audit processes. The diversity ensures a range of viewpoints, considering how CAATTs usage is changing and how it affects auditors at different phases of their careers.

Furthermore, it is crucial for participants to be actively engaged in audit practices within their respective firms. Hence, a minimum of six months of experience in audit practises within a Big 4 firm is required for participation. This ensures that auditors have successfully completed the initial learning curve, likely encountered various aspects of audit processes, and gained sufficient exposure to the complexities of audit work and the

workings of the firm. Essentially, the auditors possess direct knowledge of audit techniques and insights, making their viewpoints highly pertinent to the aim and objectives of this study.

By adhering to these criteria, this research was able to gather nuanced insights from a diverse group of auditors within the Malaysian Big 4 audit firms, contributing to a more thorough understanding of CAATTs usage and adoption in the audit industry.

4.5.2.2 Interview Participants Information

As interviews were the sole technique for gathering data and may be subject to bias, interviews were conducted with auditors at various hierarchical level. The participants were chosen based on the predetermined criteria to ensure their suitability and reliability. A total of 17 interviews were conducted with external auditors of various levels in the Malaysian Big 4 audit firms for this study. The participants included a mix of genders and positions ranging from Audit Associates to Audit Senior Managers, with experience levels ranging from over a year to over twelve years. *Appendix B* provides the demographic information for the participants selected and interviewed.

The participants provided a wide range of information and data from the interviews conducted. The most experienced participants, being M1 and M2, with over 10 years of experience, offered strategic insights into the long-term trends and broader perceptions of CAATTs adoption. This perspective contrasts with the more operational viewpoints of participants with fewer years in the field, who tend to emphasize immediate, day-to-day practicalities of CAATTs integration.

By including a diverse range of participants across different hierarchical levels, this study was able to gather a comprehensive and multidimensional understanding of CAATTs usage and adoption. This diversity in perspectives reduces potential bias and mitigates the risk of skewed or unrepresented data, thereby enhancing the validity and

reliability of the study and providing a holistic view of CAATTs adoption in Malaysian Big 4 audit firms.

4.6 Ethical Consideration

Ethical consideration plays a paramount role in the conduct of any research, particularly in qualitative studies, where the concern becomes more salient due to the comprehensive nature of the study process (Mohd Arifin, 2018). Several ethical principles were considered in this study, including ethics review and approval, informed consent, voluntary participation as well as privacy and confidentiality.

First and foremost, the research methodology, research design, and ethical consideration for this study underwent a review and approval by the ethics committee. Ethical approval was sought and granted by the University of Malaya Research Ethics Committee (UMREC). This review ensured that the study adhered to ethical standards and guidelines. Ethical approval was granted by the institution prior to the commencement of this research.

Upon receiving permission from the ethics committee, potential participants were approached individually to ensure informed consent was obtained from each participant. This signified their voluntary agreement to participate after understanding the nature of the research. Participants were given a comprehensive explanation of the study's purpose, data collection process, potential benefits and risks, the approximate length of the interview, and the type of information required. According to Gill et al. (2008), providing participants with an overview of what to expect from the interview boosts the likelihood of honesty, which is a crucial aspect of the informed consent process.

Participants were also advised that their involvement was strictly voluntary and free from any coercion or pressure. They were under no obligations to answer any questions and could decline to participate or withdraw from the study at any moment,

without repercussions, if they experience any discomfort or inconvenience during the interview, as a result of the questions asked or the interviewer's behaviour.

Most importantly, the participants' privacy and confidentiality were strictly maintained throughout the conduct of this study. They were assured of ethical practices such as data confidentiality and identity anonymity prior to the interview. The primary purpose of maintaining confidentiality is to safeguard study subjects from harm (Kaiser, 2009). Specifically, participants' confidentiality and anonymity were maintained by withholding their names and identities, replacing them with unique identifiers throughout the data collection, analysis, and reporting process. The data gathered was stored in a secure location. Protecting the confidentiality and privacy of participants reinforces trust and empowers informed involvement. Additionally, to preserve the confidentiality of the involved firms, any participant-provided information that could potentially reveal the identity of the firms was also assigned unique identifiers. This approach ensured anonymity while handling sensitive data.

By adhering to the above-mentioned ethical consideration, a responsible and respectful study was conducted in a secure and ethical environment. This not only contributed valuable and impactful insights but also prioritised the rights and well-being of the participants involved in this qualitative research on CAATTs adoption in Malaysian Big 4 firms.

4.7 Data Analysis

In qualitative research, the data analysis process begins alongside data collection and theoretical development. This shapes the data collection and helps the researcher to organize the entire study as well as provide alternative explanations for the research issues. Data analysis functions to examine, categorize, tabulate, test or otherwise recombine various pieces of evidence to fit the findings and within the proposed theoretical framework (Maxwell, 2005; Miles & Huberman, 1994).

In most cases involving qualitative research, the researcher ends up with a considerable amount of data generated from various sources such as interview transcripts, observations, documentary reviews and field notes (Asenahabi, 2019; Delgado-Hito & Romero-García, 2021). Through data analysis, the gathered data can be filtered, helping the researcher to identify and focus on the most relevant and significant parts of the dataset. This does not mean discarding data arbitrarily but rather having a more focused dataset that allows researchers to begin identifying patterns, trends, and relationships within the data. At its core, these insights provide a deeper understanding of the subject being studied and form the basis of data analysis.

The vast raw data obtained in this study, gathered through semi-structured interviews with the respondents were organized, classified, and analysed using thematic analysis. This analysis methodology is widely used in qualitative research (Braun & Clarke, 2006; Lugli & Bertacchini, 2022; Rao & Tilt, 2021; Sharma & Dahlstrand, 2023; Turner et al., 2023), as it generates themes, patterns, understandings, and perspectives through fieldwork and analysis (Braun & Clarke, 2012). According to Braun and Clarke (2012), thematic analysis is a process for systematically identifying, categorizing, and providing insights into patterns of meaning or themes within data collection. This model was selected based on its capacity to analyse the intricate data collected in a manner that would yield significant insights for subsequent analysis. The abundant data gathered were processed into comprehensible narrative descriptions with primary patterns and categories.

Thematic analysis involves several phases to systematically analyse and interpret qualitative data. The data analysis begins with familiarisation with the data. First and foremost, to prevent the transcriber's subjective interpretation, the interview audio recordings were transcribed verbatim properly and accurately into electronic format via Microsoft Words and Excel to become textual data. The transcripts were further organized

and read several times by the researcher to identity key issues and major themes. For field notes from interviews conducted without audit recordings, the familiarisation involved organizing them systematically and meticulously reviewing them multiple times, noting down initial thoughts and questions that arose during those interviews. According to Braun and Clarke (2012), to gain a comprehensive understanding of the gathered data and highlight potential areas of interest, the researcher must read and reread the transcripts multiple times.

The second phase involved the identification of repeated patterns or theme across the data. This study managed the data to find and create themes using Microsoft Excel rather than any qualitative data analysis software like Nvivo. The transcripts, field notes and documents obtained were coded into key themes based on Tornatzky et al. (1990)'s TOE framework. According to Braun and Clarke (2006), a theme is an important component of the data that connects to the research questions and indicates a degree of relevance or patterning in the dataset. This analysis includes coding the data by dividing the text into smaller units such as into sentences or paragraphs, and assigning one or more code to each unit. The codes are based on concepts or main ideas from the interviews conducted, as proposed by Creswell (2009). Compressing or combining codes that share similar features or are consistent to reflect and express a meaningful and coherent pattern in the data is the main technique for developing themes and subthemes, which are the subcomponents of a theme (Braun & Clarke, 2012). In this study, the researcher identified themes focused on the use of CAATTs, their usage context, and factors influencing the adoption of CAATTs in the Big 4 firms.

The researcher then compared the themes to the compiled data extracts to determine how well the theme fits the entire data, ensuring its relevance. Visual tools such as maps, highlighters, and sticky notes were used to identify and link patterns and

common themes within the data. As themes were analysed, the data was formed into tables, figures, and diagrams to form meaning and answer the research questions.

To aid in the exposition of the analysis results and demonstrate the authors' interpretation of the data gathered, excerpts from the interviews were correlated with each theme during the explanation. Once the data was coded and themes were formed, the findings were reported based on the types of CAATTs in use and the adoption factors related to the technological, organizational, and environmental attributes in the audit firms. Connecting observations to theoretical frameworks is essential in qualitative research. This involves considering the wider implications of extrapolating research findings to theory, reflecting on how the study's findings relate to current theoretical models, and recognising the study's theoretical contributions (Lillis, 2008).

In summary, the data on the subjects were succinctly, coherently, logically, non-repetitively, and engagingly described in the analysis that was written up once the themes were thoroughly established. The technological, organizational, and environmental influence on the audit firm’s approach to CAATTs adoption, as well as the barriers and motivations for integration, were identified using the TOE framework. The researcher expresses the significance, underlying assumptions, and implications of each theme in the final analysis to construct an overarching narrative with several themes relevant to the problem (Braun & Clarke, 2006).

4.8 Summary

The research method explained in this chapter guided the conduct of this study. This rational, methodological approach involved several steps, beginning with gathering information to answer the questions posed in this study, followed by examining the collected data, and then analysing and describing the results. A summary of the research process is reflected in *Figure 4.1*.

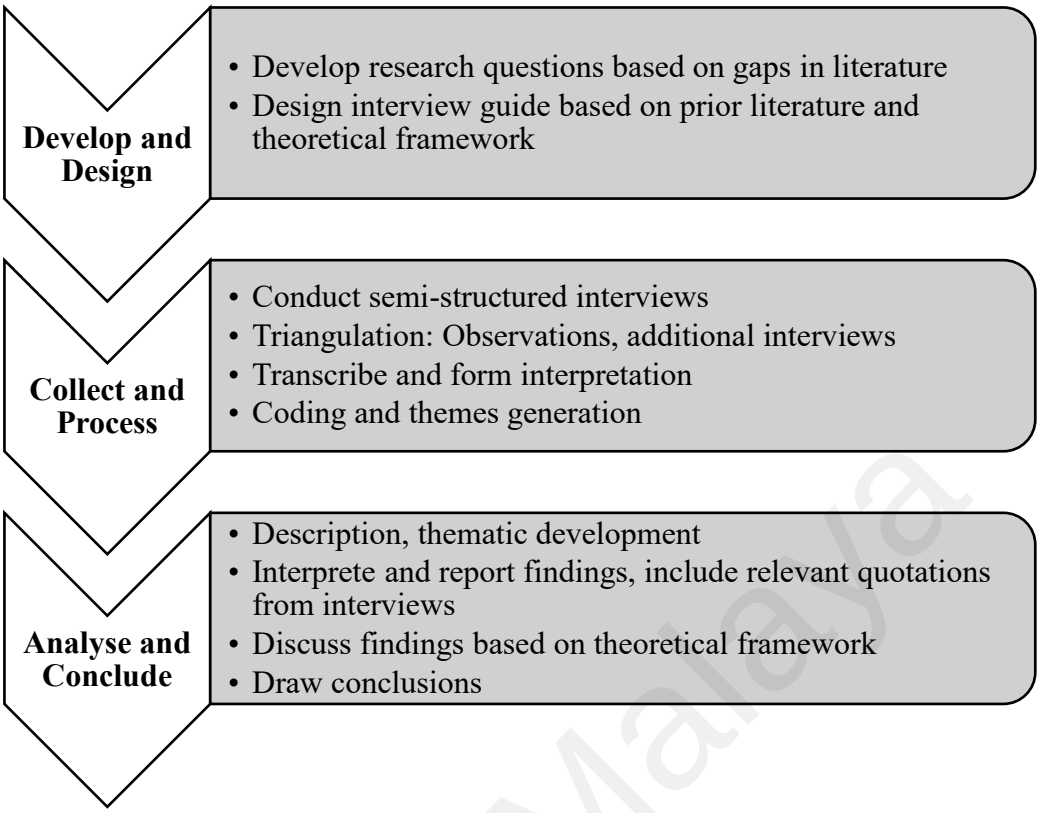

Figure 4.1: Qualitative research process employed

Source: Developed for this research

CHAPTER 5: FINDINGS

5.1 Introduction

This chapter presents the findings of this study based on the semi-structured interviews conducted with auditors from various levels within the Malaysian Big 4 firms. The findings are organized into several sections to address the research questions, providing a foundation for the in-depth discussion and analysis in the following chapter.

5.2 Background

The Malaysia Big 4 firms, namely Deloitte, EY, KPMG, and PwC, are regarded as pillars of trust and expertise, dominating the financial audit market. Each member firm, while operating under a common brand and adhering to global standards, maintains its own financial performance, legal obligations, ownership, and management structures, ensuring operational independence. In order to uphold professional standards and prevent conflicts of interest, this independence is essential.

The Malaysian Big 4 firms are the leading players in the industry due to their greater market share, substantial resources, and industry experience; and may serve as a stand-in for higher quality services. Because of these qualities, they are able to hold more authority and prestige in the field hierarchy. The firms continuously push boundaries, adjust to changing market conditions, and offer priceless insights that influence the financial landscape. Majority of the interviews concurred that their firms' global presence ensures that they always maintain a competitive advantage in the market and a portray of commitment to provide the best services to their clients.

This context is crucial for interpreting the findings related to CAATTs adoption, as it highlights the unique challenges and strategies employed by each firm, which will be further analysed in the next chapter.

"I think in general there is a significant difference between Big 4 and any other firms, especially in terms of the reputation, resources, expertise, reach, investments, and other aspects. It surely gives them a competitive edge."– M2

It was gathered from the interviews that despite their fame, the Big 4 have encountered numerous challenges and disputes caused from the financial scandals over the years, the 2007-2008 financial crisis as well as the recent COVID-19 outbreak, which has had a significant impact on the overall operation and processes of the audit services of the Big 4 firms respectively. The aforementioned events resulted in legal actions against the firms, which exposed shortcomings in audit procedures and raised questions about the effectiveness of financial oversight, and the ability of audits to detect and address financial irregularities in particular, even when auditors show reasonable professional scepticism (ACCA, 2023c; Deloitte, 2020). Additionally, because financial transactions are complicated and the corporate environment is always changing, auditors face challenges in assessing risk and producing accurate and reliable financial reports, as explained by SA7:

"The world is constantly changing, the technology existing is always evolving, so everyone has to move in line accordingly, to make sure that we, the auditors can provide accurate and relevant services."

The Big 4 firms face relentless pressure to enhance their audits, driving them to invest in cutting-edge technology, strengthen training and development initiatives, and fortify internal controls. Rapid technological advancements hold the potential to transform the field, creating opportunities for increased efficiency and innovation. Consequently, these firms must continually adapt to stay ahead of industry standards and uphold their reputation for excellence.

5.3 The Evolution of Technology in Audit

The audit industry's technological journey is believed to be a dynamic and ongoing process influenced by numerous elements. In the context of Malaysian audits, the use of technology has evolved significantly over time. To gauge the technological preparedness of the Big 4 firms, particularly regarding the adoption of CAATTs, participants were asked for their perceptions of these advancements, in relation to the first research question.

It was gathered from the interviews that during the era of traditional audit services, CAATTs were comparatively restricted to basic tool integration, primarily employed for routine tasks such as data entry and computations. Over time, Generalised Audit Software (GAS) was gradually introduced to the audit sector, enabling auditors to efficiently undertake data analysis and automate repetitive processes. This automation eventually paved the way for the development of platforms for continuous auditing.

"CAATTs have existed quite some time ago to my knowledge and it has gradually evolved as time passed, in line with the revolution of technology everywhere, changing how things are done."– SA6

"Once upon a time CAATTs were just capable of basic tasks like data entry and repetitive tasks. But as technology advances, we began using AI and machine learning. Now, these tools handle the heavy lifting, analysing data and automating processes. It is amazing to see how much more efficient and thorough our audits have become." – M2

The data collected from the interviews aligns with the discovery from ACCA (2023b), which highlights that, unlike traditional auditing, which relies heavily on manual processes, continuous auditing utilizes technological advancements such as automation, AI, ML, and RPA. These technologies significantly change the methods of data collection and analysis in auditing.

Deeper insights can be gained by data analytics (DA), and this realisation grew significantly around the 2000s. DA technologies have enhanced risk identification and fraud detection capabilities by extracting important insights from large datasets. Auditors can analyse vast amounts of data, including financial transactions, customer behaviour, and market trends, to gain a better understanding of client operations and any associated risks, as highlighted by AA6:

"Data analytics helps us dig deeper into numbers and find important information more quickly and accurately, it just makes our work easier and more effective."

In the current modern day, cloud computing, AI, DA and ML algorithms have been heavily incorporated into auditing tools and procedures. By automating tasks like document examination, data analysis, and anomaly identification, AI is completely transforming the audit process. Additionally, ML algorithms are being used to construct predictive models that identify patterns and potential hazards, increasing the efficacy and efficiency of audits. This allows auditors to focus more on challenging professional judgment-based work.

The year 2020 marked a dramatic acceleration in the adoption of digital technologies, enabling audit firms to implement cloud-based software, virtual communication tools, and remote audit methods in response to the shift in work environment. The COVID-19 pandemic presented unprecedented difficulties for auditors, including complex financial reporting, uncertainty about future financial performance, and disruptions to business operations. Consequently, the pandemic expedited the use of digitalised tools and methods for remote auditing. AI, DA, and cloud-based collaboration tools became indispensable for audit teams working in remote environments. As AA5 indicated:

"The use of CAATTs is actually very important to facilitate uninterrupted audit processes. One real life scenario is of course the recent pandemic. Thanks to technology, most audits were conducted remotely, which ensured the continuity of business while maintaining communication between audit team and clients. Remote audit allowed us to continue working."

This is supported by information shared by SA4:

"I believe before the pandemic a lot of things were still very manual. There is a major change that the firm is looking into since then to improve. For example, is the (system name) that is the old system. Now, the firm is coming up with another new system (Software Indigo) that actually uses cloud, so everyone is working at a real-time situation. The difference is there; the whole engagement team will now be looking at the situation right away, when all the working papers are updated immediately."

Technology has changed over time and continues to do so within Malaysian auditing. Innovation has made it possible for audit procedures to be digitalised, enabling audit automation, improved risk management, audit team collaboration, better audit progress tracking and task execution, reduced administrative time, and increased overall efficiency. These advancements are significantly transforming the auditing landscape, making processes more accurate and reliable. One auditor noted the transformation:

"CAATTs have indeed evolved and become more sophisticated. Last time, auditors relied on computers to automate simple tasks, but now we have more than that. Now we have various tools in the market from customised software, to digitalised audit management, and communication tools. All ensures audit to be done pretty seamlessly."– M2

5.4 CAATTs Adoption in the Big 4

Interestingly, participants noted that technology adoption and its existence are two rather distinct concepts. The mere existence of technology does not ensure its adoption. In other words, technology adoption and its existence are separate yet interconnected phenomena. CAATTs have been around for a while and are becoming increasingly sophisticated, but their adoption remains relatively limited in Malaysia. Adoption goes beyond mere existence; it is a deliberate choice made by the Malaysian Big 4 audit firms to actively incorporate CAATTs into their audit processes. Firms can now expand their infrastructure of audit related tools thanks to the presence of CAATTs as part of the technical base.

"I think just because technology is available doesn't mean it's being used or adopted. There are uncountable technologies in the market, but you can't say you are adopting them just because it exists. To adopt, there is a need of usage." – SA2

The existence of CAATTs offers a basic foundation for the Big 4 firms, setting a baseline for available tools and capabilities. Owing to the varied spectrum of technologies currently available in the market, the Big 4 firms use a range of CAATTs, from simple tools that automate fundamental audit tasks to sophisticated data analytics or cloud-based tools that can analyse massive dataset and identify potential risks.

Generally, CAATTs are understood as various technologies used to perform audit processes, leading to the audit task completion. Basic inquiries about CAATTs were posed at the initial stage of the interview before delving into a more comprehensive discussion on the subject. First and foremost, all participants were asked if they are familiar with CAATTs. It was found that all participants were aware of the existence of CAATTs and understood what CAATTs is all about. Despite their inability to articulate what CAATTs is specifically, all of them effectively communicated a general understanding of the subject matter, drawing from their knowledge and expertise in the field. Supported by the information shared by AA1:

"CAATTs are the use of technology and software to enhance and simplify the audit process."

Another take on CAATTs by SA3 is as stated below.

"I would say CAATTs are the powerful assistants for auditors. They are smart tools or software that help auditors do their job more effectively and with greater accuracy. In other words, I would say it is like having a reliable assistant that allows auditors to focus on critical tasks while CAATTs handle the tedious data-related work in the background."

It was also gathered that the Big 4's CAATTs implementation runs deep into the audit processes, enabling auditors to carry out most tasks using these tools. This includes, but is not limited to planning the audit before the start of the audit engagement, performing audit processes such as sampling and testing, determining materiality, evaluating risk, reviewing audit work done, generating reports, and so forth. AA5 provided explanations as follows:

"Through the use of AI and RPA, you can just insert the whole file, for example the whole invoice file provided by client and then the tool will automatically sort out like the invoice number and then the lump sum of the amount. You just let it run itself and you will get the results whether there's exception or not. So, this is more towards improving the efficiency because normally to perform vouching, we need to see by three-way matching. This is one way to reduce manual tasks."

Another associate (AA4) provided further information on how CAATTs are being used.

"CAATTs are used in analysing journal entries, testing account balances, assist in generating audit reports. The technology enables us to cross-reference across several documents and working papers easily."

While the context of CAATTs runs deep within most audit-related work, the use of CAATTs varies between junior and senior auditors. Junior auditors work on more routine tasks such as conducting pre-established audit procedures, performing basic testing and analysis, and dealing with smaller sections of audit files, using CAATTs sparingly. In contrast, as seniority increases, auditors take on more complex tasks and are expected to possess a more advanced understanding of CAATTs. Senior auditors are involved in the interpretation of results, integrating findings into the larger audit context, making crucial audit decisions, and creating audit reports. In addition to closely monitoring and reviewing the work of the junior auditors, they also play a significant role in offering direction when needed. M1 described:

"When an audit working paper is completed, the preparer signs off on it. And the superiors such as senior associates, managers or partners reviews the audit work performed and provides feedback before finalizing the audit and coming up with the audited financial statements."

Within the Big 4 firms, superiors are well-positioned and vital in fostering the development of proficiency among junior auditors in the effective use of audit tools and techniques. They achieve this by reviewing the work of juniors, providing constructive feedback for improvement and further refinement of their skills, as well as offering constant support and direction while conducting audits using CAATTs.

Today's auditors need to be knowledgeable about various tools and methods to test the functionality of client's computerised systems and to further collect and assess data stored in computerised records. This expertise is essential for identifying potential risks and providing valuable insights that can enhance the overall audit process.

5.4.1 Diversity of CAATTs Utilization

The Big 4 firms use a variety of CAATTs to address the complexity and evolving nature of audits. To gather insights on the sources of CAATTs and address the first research question of this study, participants were asked to describe their utilization of computerized tools and techniques in their practice.

The most frequently used tool in the Big 4 firms is the audit analytics platform, also known as the audit software, which comprises of electronic audit working papers. This tool is an integral element of the audit and is used for majority of the audit work, including conducting all the audit testing and reporting, organizing, and storing audit evidence, procedures, and findings. These platforms typically include spreadsheets, PDFs, electronic documents, and other digital formats. The application of such functionality involves using data analytics and techniques to perform substantive audit procedures, identify patterns, anomalies, and trends in large volumes of financial data, enhancing the audit's effectiveness and depth. Each Big 4 firm has its own audit analytical platform, namely being Red, Orange, Yellow, Green, Blue, Indigo and Violet respectively. Based on AA4's insights:

"Usually, we will use a platform called (Software Green and Blue). So, we use that to perform most of our audit work. It has a lot of functions and ensures audit approach is consistent throughout."

Each Big 4 possesses its respective audit software, which comprises powerful analytical spreadsheet tools designed to facilitate a variety of audit tasks. Their software offers sophisticated, tailored features and interfaces for auditors, surpassing Excel's general-purpose capabilities. This results in more meaningful findings, identification of risks, and in-depth insights. Participants elaborated that there is a notable distinction between the audit software used by the Big 4 firms in general and regular Excel.

"I do concur that there's certain similarities between (Software Violet) and Microsoft Excel in general. Looking at it specifically, there is quite a contrast. The audit software has functions like data sampling and testing, deeper analysis, risk assessment, fraud detection, and reporting templates. It is also designed to ensure compliance with the audit regulation and standards, which is not possible with the normal Microsoft Excel."– SA5

"So, when we are doing the analytical procedure, the tools we have now enables us to integrate, like last time we just use manual methods and we see the trend and how is it like for certain accounts. But now with these, they are trying to use the tools to integrate all accounts together and then it comes up with a result for us to analyse it as a brief. We can also drill in further, in detail, compared to previously doing it manually and just comparing one account to another. It really saves our time and it is really beneficial for us."– AA5

Furthermore, the Big 4 employ online collaboration and management tools that facilitate smooth teamwork within the audit team. These platforms are either integrated with the audit software or used independently. Having a good management system in place contributes to the seamless conduct of audit, ensuring their timely completion without any drawbacks. The result is more engaging team interaction, which includes more focused and insightful discussions on the findings, risks, and insights.

This study found that it is crucial for all participating auditors to be aware of the ongoing audit processes and have access to standardised information to ensure a smooth audit process is undertaken. This shared awareness and access significantly reduce the risk of errors and miscommunication. Supporting her perception further, SA4 provided an example of scenario that may take place, in the absence of CAATTs, emphasizing its importance:

"If let's say we don't have such a tool that the whole engagement team is using the same, there might be different opinions. I would say like for example, if we are talking about the risk level of some account balances, if there are no common tools that we are using, there might be different opinions. I might think this account balances are under a higher risk. But maybe another team member would think it is under a lower risk. So, there would be some discrepancies of opinions. But now everyone is on the same page."

5.4.2 In-house vs Commercial Tools

The Big 4 firms strike a balance between using in-house developed CAATTs and commercially available tools. The predominantly used audit analytical software (Red, Orange, Yellow, Green, Blue, Indigo and Violet) are built-to-suit computerised audit software, customised in-house, and developed globally. In-house tools offer the advantage of customization to specific need and methodologies, as well as seamless integration with existing workflows within each firms respectively. This is supported by the need of specialised tools to handle the intricate and multidimensional nature of modern auditing, ensuring a standardized approach to auditing practices that align with regulatory environments, accounting standards, and industry-specific nuances. Supported by the information shared by AA2 on her firm's exercise:

"My firm uses in-house software (Software Yellow) to practically do most tasks in the audit process. It is used globally, allowing a consistent audit irrespective of complexity and location. What we use here is the same with what is being used in US."

Interestingly, it was found that one of the Big 4 firm incorporates their audit platform with a cloud-based solution centre that provides the latest and most relevant research and technical information. This platform keeps the audit teams updated with the newest developments in accounting, auditing, and industry-specific details. SA1 mentioned:

"We have this worldwide used platform (Software Red) for research in accounting and financial reporting. If we have any queries, we can just get the information from that platform. It is integrated with Software Yellow, which provides easy access."

Alongside the primary in-house audit software used to carry out audit procedures, the Big 4 firms complement their technology package with commercially available tools and techniques. These tools foster communication among audit team members and clients. For instance, emails via Microsoft Outlook enable the exchange of documents and provide updates, instant messaging platforms like Microsoft Teams facilitate communication, as well as video conferencing tools such as Zoom and Microsoft Teams allow for remote, real-time interactions. Other Microsoft Office Suite applications, such as Word, Excel, and PowerPoint, are used for audit report generation, management letters and confirmations, and other documentation stages of the audit processes.

The advancement of technology has indeed made it possible for many different tasks to be carried out using a single application. The in-house applications used within the Big 4 firms also integrates communication and management functionalities to enhance the overall audit efficiency and effectiveness. These applications assist the auditors in managing and tracking the daily execution of audit activities, disseminating a centralised plan to audit team members worldwide, and providing a round-the-clock view of the audit's progress in one convenient location. AA6 explained:

"The software simplifies audit engagement tracking for seniors and partners, allowing them to track audit work progress with just a click. They can also leave comments or feedback concurrently throughout the engagement, saving time and effort."

In practice, the Malaysian Big 4 employs a hybrid approach, leveraging a blend of in-house and commercially available CAATTs to optimize their audit capabilities. This approach ensures that the auditors can efficiently address the complexities of modern auditing while maintaining high standards of accuracy and compliance.

5.5 Financial Resources

In examining the factors influencing CAATs adoption in Malaysian Big 4 audit firms, possessing financial capabilities were found to be somewhat important. Successful implementation and adoption of any technology, including CAATTs, require financial resources for acquisition, integration, updates, and maintenance. The various software and platforms implemented by the Big 4 are not inexpensive, highlighting the necessity of adequate financial capacity to keep up with technological advancements over time.

"If the firms do not provide the infrastructure such as laptops and the software, auditors are not going to go out of their way to incur that expense on their own account to further acquire and utilize it."– AA1

Effective cost management requires the firm to have sufficient financial resources, particularly when taking into account the expenses associated with hiring and training new auditors. The majority of the interviewees concurred that their firms do make technological investments to provide access to the latest tools, ensuring a smooth conduct of audit. AA1 further added:

"I think it is safe to say Big 4 are highly likely to possess the necessary resources. They have been in the market for years now, allowing them to sustain and improve operation efficiency."

The key concern at hand is how these Big 4 firms effectively utilize their available resources. These resources are allocated not only towards the CAATTs acquisition, adoption, and maintenance, including software, hardware, and licenses, but also towards additional infrastructure like talent hiring and retention, and investment in training and ongoing skills support for the auditors. All of these are necessary to leverage CAATTs effectively. Several participants believe that the high expenses related to maintaining auditor turnover, such as hiring, training, and loss of productivity, may actually limit the

budget available for investing in new computerised tools and techniques. This, in return, slows down the adoption process as whole. SA6 elaborated:

"Constant changes in auditors, when one resigns and then a new person onboards, causes a lack in continuity and then they need time to become proficient in using CAATTs and to understand the firm's processes, which does slow down the audit."

Through the interview conducted, it was gathered that auditors believe the Big 4 generate substantial financial resources to accommodate the expenses associated with adopting CAATTs. SA7 elaborated that the Big 4 are generally well-established, operating internationally and providing services to clients of various sizes. Their wide range of customers generates sizable cash streams that support their stable finances.

"Putting it bluntly I think money is not an issue for the big firms, if anything it is how they utilize the money they have to improve the operations is what matters."– SA7

The Big 4 firms invest in state-of-the-art tools, software, and infrastructure because to a certain extent they understand the importance of technology to the audit process. Adopting CAATTs is one way to improve the efficacy and efficiency of audits.

5.6 Skills and Training Requirement

Skilled auditors who can operate the tools and technology and, in essence, possess data analytics capabilities to interpret audit outcomes and make informed decisions, are crucial. Big 4 firms hire people with accounting and auditing backgrounds in addition to those with excellent analytical and technological skills. All participants agreed that for increased CAATTs adoption, skilled auditors with relevant IT skills are pivotal, though the skill levels may vary from one auditor to another. AA2 mentioned having the right human resources is crucial for firms to effectively utilize technology, as technology without proper experts to maintain it undermines the purpose of having such infrastructure. A few other perspectives on this matter includes the following:

"Understanding the software, features, and capabilities of the tools, as well as knowing how to utilize them effectively is crucial. Firms need auditors with skills."- AA1

"If you have the tools, but no manpower (auditors) to operate on it, it defeats the purpose of such technology." – AA5

It is crucial for auditors to possess a solid understanding of the technological aspect of CAATTs to leverage the tools effectively. In the Big 4, new associate level auditors are initially given simpler assignments to gradually advance their technological proficiency bit by bit. As they gain experience, they will likely take on increasingly difficult duties. AA1 explained on the current practice at his firm whereby the associate auditors are given smaller tasks that requires the use of CAATTs:

"Yes, I have used CAATTs in some of my recent engagements. I mainly worked with basic data extraction tools and sampling procedure. It is safe to say that I would rate my literacy as average in both as there is still much more to learn."

Fresh graduates' technological competence is noted to be lower to that of more senior auditors due to the difference in experience and exposure to CAATTs. A lower technological competence may result from less practical experience. Over their career years, seasoned auditors have encountered and utilised a variety of technology tools, which raises their level of technological proficiency. Additionally, lack of exposure among recent graduates is associated with the fact that they are not exposed to sophisticated audit techniques and technologies in depth while in school. Auditors without early exposure face difficulties using software during their initial work period, which affects the use of audit software, as shared by a senior auditor (SA1) who explained:

"The (Software Yellow) is not something that we have learnt in university, and it is even different than that in use by the non-Big 4 firms during my internship. So, it was somewhat

challenging and complex when I first learnt about it and there were times I did things manually. I slowly started learning it."

When considering skill development, auditor individuality cannot be overlooked. The effectiveness and efficiency of audit operations can be significantly impacted by the auditor's approach and mindset about technology. The auditors are aware that the introduction of CAATTs has significantly changed the audit profession. This change must be embraced by recognising the value that technology offers to their work. Insights indicate that concerns regarding the apparent difficulty or time commitment of implementing CAATTs may exist among auditors. Auditors face pressure in the fast-moving audit field and often seek easier tasks through easy-to-use systems, as mentioned by AA6:

"If the system is very complicated to be used and is easier to do things manually, it decreases the motivation to even use the systems."

The investment by the Big 4 in various tools and efforts to implement CAATTs in auditors' daily use is also said to depend on the auditor's positive attitudes, which promote openness to change, excitement for learning, and willingness to experiment with new tools and procedures. A positive attitude among auditors significantly improves their performance if they take initiative and seek learning opportunities.

It is agreed that staying abreast of the ever-changing technology can be challenging. Acclimation to new technology is a learning process, therefore each person may face certain challenges in understanding the principles and functionalities. An associate (AA5) offered the following justification:

"I think, if you want to start off any technology, not only CAATTs, there is a learning stage. So, I believe that everyone needs the time to adapt. If you ask whether it is easy or hard, I think there is sure a hard time for everyone to adapt to it, but then, if and when

one is already familiar with it, I think it may be a lot easier to use because since we already know how it functions."

To achieve the position of comfort and familiarity, auditors may require exposure and orientation to ensure their adeptness in handling the technology. Supported by the information provided by SA5:

"Personally, I feel CAATTs can seem pretty daunting at first, especially if you are not used to handling it. That may be the case for the associates I think as they may not have any clue on how it works. The trick is to give yourself some time, take it slow and don't be afraid to seek help if needed. Once you get the hang of it, audit is a lot easier."

To ensure auditors can enhance their skills and knowledge in various audit areas, including the adoption and utilization of new CAATTS, the Big 4 firms provide support in the form of trainings that covers various aspects of the audit systems in use. Some trainings are mandatory, while others are optional. SA9 expressed that to further motivate the upskilling, the firm provides recognition such as digital badges or certificates upon completion of certain trainings or skills development courses or events.

"(Firm name) does provide training, for the software we use, the standards, and skills improvement and sometimes there are even motivational talks and events conducted. Which is all very helpful honestly."– SA9

When a new auditor joins the team, they receive training on the use of audit software as part of their onboarding and professional development programme. The focus is generally on increasing their familiarity with the tools and comprehending their fundamental features.

Probing further into auditors' technical skills, one interesting finding is that auditors often perceive themselves as technologically competent but, in reality, lack actual IT knowledge. Auditors may believe they know how to use technology but face

challenges in actual use, demonstrating a lack of competency and skills. When this happens, it disrupts the audit process, as the work quality may not meet the required standards due to the lack of competency, as explained:

"Senior auditors may have more experience than juniors, but this does not guarantee expertise in systems and tools. There may be a digital gap between older and younger generations with technology knowledge."– AA2

It was further gathered that CAATTs adoption requires not only skilled auditors but also associated IT personnel to ensure effective tools and technology usage and maintenance. Aspects such as installation, configuration, troubleshooting, and maintaining the tools and technology implemented are crucial for ensuring the effective deployment and utilization within the firms.

"Not only investing heavily to improve the tools, but support to use so that we are able to reach out to them (IT team) when we need help; I think this one is very important from our (auditor) perspective."– SA4

"The IT expertise is necessary because it is them who understand the ins and outs of the technology adopted, the software and hardware, make sure that everything is set up properly and that support is provided whenever it is needed."– SA5

The successful adoption and utilization of CAATTs in the Big 4 firms hinge on both the technological proficiency of auditors and the support of skilled IT personnel. Continuous training and collaborative efforts between auditors and IT experts are highly essential. Additionally, having a positive attitude towards technology is somewhat influential within CAATTs adoption, helping to maximize the effectiveness and efficiency of audit processes.

5.7 Client Expectations

There is a certain client expectation associated with the Big 4's adoption and use of CAATTs. Participants were asked to provide insights into how these expectations shape CAATTs adoption. They revealed that these expectations stem from the rising complexity of business processes, escalating data volumes, and the need for improved efficiency and quality in auditing, although they have little direct influence on CAATTs adoption. Nevertheless, it was noted that expectations may vary based on the size and nature of the client organization. Larger clients with intricate financial and operational data systems expect firms to have robust tools that can deliver deeper insights quickly and effectively without sacrificing audit quality. Conversely, smaller organizations anticipate that using these tools will help create a more affordable audit process tailored to their specific needs.

"In my opinion most of the Big 4 clients are well-established companies with systems in place, making it crucial for us to have compatible and effective systems, for seamless audits. Non-supported system formats require additional effort and resources, making audits more challenging."– AA2

It was further gathered from the interviews that the Big 4 firms audit not only multinational organizations with relatively large investments in technology but also certain small and medium-sized companies that still work in a very manual way or merely use basic accounting software. This may dissuade the efficient use of CAATTs, as the client's manual data must be transformed into a compatible format with the audit software. Two senior associates said:

"The audit software we use is the same for all sized clients. Every client gets the same audit procedure."– SA2

"We still have clients that require us to audit their book accounts, meaning to say they will bring their books up to our office and we will audit from the manual documents, which requires more time and effort."– SA4

Client expectations for the Big 4 firms' usage of CAATTs centre on themes of efficiency, accuracy, insights, communication, compliance, cost-effectiveness, and security. Ensuring that CAATTs is compatible with the objectives and requirements of the client's audit allows it to integrate seamlessly into existing workflows with minimal disturbance. However, auditors indeed adopt the CAATTs because they believe it is practical, supporting a value-driven audit process. To live up to those expectations, as expressed by SA8:

"The logic of using technology in audits is to make our lives easier and because it is just more practical to be more in line with the technology advancements. In my opinion, client perspectives have very little impact on the decision to use technology."

Hence, while larger clients drive the demand for robust tools, the Big 4 adopt CAATTs primarily for their practicality and alignment with technological advancements in a rapidly evolving landscape.

5.8 Psychological Aspect

While CAATTs adoption in Big 4 focuses on the technical aspect and the requirement for financial resources, the psychological component such as learning adaptation, individual differences, and digital weariness significantly affects the process. Participants mentioned that these aspects play an important role in CAATTs adoption and cannot be neglected.

Given that the work pace at Big 4 moves relatively fast, auditors are somewhat forced to adapt to the tools quite rapidly. Particularly during busy times, auditors could have multiple engagements at once with a higher workload, which forces them to work more quickly and certainly with accuracy. If new auditors were to learn about the systems

during these times, it would be challenging and hard on them. However, it was established that the use of CAATTs may be challenging and complicated, not limited for first timers but also for others, resulting in an overload of information that can lead to stress and exhaustion. Excessive levels of burnout and stress at work have psychological effects that impacts the auditors' general health. Additionally, some auditors find it difficult to keep up with the rapid growth of evolving technology, which causes anxiety and subsequently reluctance to change. The adoption of technology is impeded by a stressful work environment, as auditors may be resistant to increased pressure. SA6 elaborated:

"The fast pace working environment in Big 4's does result in burnout at times, resulting in reduced work efficiency especially if we are tasked with challenging work, reducing our motivation as a whole."

Findings also indicated that the age-factor reduces the motivation to adopt CAATTs, as older auditors may be hesitant to embrace challenging systems. They did not learn such technology in university, and the more sophisticated the applications and software used, the more complex becomes for them. Participants felt that younger auditors are more receptive to using CAATTs or even any technology for that matter.

"I think it an agreed notion that the junior auditors are more tech-savvy and hence open to explore it, regardless it be challenging."– AA2

CAATTs adoption is driven by auditors' intrinsic motivation, which stems from their personal fulfilment and interests, and is a major factor in determining their eagerness to learn and experiment with new technology respectively. The need to embrace and adjust to CAATT in a tough work environment increases stress levels among auditors. Diverse auditors have different learning styles and progress at different rates when it comes to embracing technology, as SA8 explained.

"It is easier for people of the technology generation to pick up and learn new stuff and I think it may be more challenging for the old school generation." – SA8

Participants emphasized that Big 4 could foster effective communication about the benefits of CAATTs adoption through comprehensive training programmes, coupled with motivation and support by peers and management. This recommendation emphasises the importance of conducting thorough training programmes to equip their staff with the necessary skills, while also providing clear and detailed information about the benefits of CAATTs. AA1 highlighted that strong moral support and dedication are crucial aspects of change management, as they motivate auditors to embrace new technologies.

"With good and the right support from the top management, we are motivated to be more open to adopting CAATTs, learning new things and willing to explore their potential benefits of new systems."

By doing so, employee participation in the adoption of CAATTs is reinforced by regular feedback on progress and a continuous improvement culture, providing an inspiring feedback loop. Additionally, offering opportunities for professional growth and skill development through the use of technology increases employee motivation, as they perceive the acquisition of valuable skills as a means of achieving both personal and professional development.

5.9 Societal Expectations

Unarguably, the Big 4 firms have a strong reputation and brand in the auditing sector. This reputation gives them a competitive edge and attracts clients seeking top-notch audits, generating societal expectations for their performance. This extends to their use of technology in audits, as they are expected to leverage the latest tools available to stay ahead of every development in the audit landscape.

Given that CAATTs improves audit efficiency, accuracy, and effectiveness, society expects the Big 4 to be innovative in their embrace and assimilation of technologies. This expectation creates pressure within the Big 4 to stay aligned with the technological innovations. A manager (M1) explained as follows:

"I think people expect the Big 4 firms to use the latest technology as they think it somehow improves the quality of audit. Issues like the Enron fraud may not take place or even the 1MDB scandal may have come to light earlier."

While the expectation exists, it was gathered that societal expectations have little influence on CAATTs adoption in the Malaysian Big 4 firms. CAATTs adoption is primarily driven by practicality and the aim to make conducting audits easier.

The Big 4's capacity to be at the forefront of the industry and their ability to meet social expectations ultimately exhibit clear values by upholding public trust and accountability in their auditing methods, which is highly valued by the public. Thus, in turn, builds their brand and subsequently creates a more reliable auditing system.

5.10 Regulatory Requirement

Regulations and professional body support are needful for sensitizing technological innovations. Regulatory requirements do have an impact on CAATT adoption, but not as significantly compared to other factors. Malaysia has guidelines for using CAATTs in audits but does not explicitly enforce or mandate them. AA2 mentioned that the support received by Malaysian Big 4 firms is insubstantial for a developing economy.

"In my opinion, firms will pay more attention to the regulations by higher authority and that would compel them to enforce such official policy or regulation on the adoption of technology."– AA2

That perception was shared by another two participants who agreed that regulations does not directly promote the adoption of technology in the audit profession. It was gathered that they provide audit firms with an indirect incentive to adopt and incorporate cutting-edge technologies to comply with the regulatory bodies' strict standards. For instance, the aftereffects of the scandals and crises over the years have emphasised the importance of effective risk management and internal controls. Regulatory bodies, recognizing the potential of technology in improving audit quality, efficiency, and effectiveness, have encouraged the adoption of data analytics and other advanced technologies. This encouragement has motivated the audit firms to invest in technological solutions to meet regulatory expectations. The use of CAATTs has not been mandated or made compulsory within the Malaysian auditing profession, which means the decision to adopt CAATTs is left to the discretion of the firms.

On the contrary, certain participants do not share the same opinion. They argue that currently, Big 4 auditors use computerised tools and techniques for practicality and necessity, not in line with any regulatory requirements. SA2 explained:

"I don't think we have been asked to use any methods particularly, we use those methods currently, we are doing it, as a method of improving the audit only. I don't think they have any role to ensure CAATTs are being implemented."

When probed further, majority of the participants suggested that local regulatory bodies could provide more training, software, continuous monitoring, and technology controls, and potentially even mandate the use of CAATTs, as this may positively influence the adoption of CAATTs in the future. They believe that such measures would not only improve the effectiveness of audits but also ensure a higher standard of consistency across the industry.

5.11 Future Direction on CAATTs Adoption

Similar to the progression of other technologies, CAATTs undergo continual development and changes over time. These improvements frequently involve integrating AI, more advanced DA, incorporating new features and functionalities, or improving automation to meet the evolving demands of the audit profession and other requirements. Regular updates and enhancements are essential to keep these tools relevant. These advancements aim to increase the overall efficiency and accuracy of the audit process as a whole. Supported by information provided by SA4:

"Previously, we used to use this (system name), but now they are implementing and training this new cloud-based system (Software Indigo) that enables synchronization and allowing us to work in a 'real- time situation'."

The continuous improvement of computerised tools and techniques is crucial to address the existing limitations of the current CAATTs. Recognizing that no technology is flawless, ongoing enhancements are essential to meet the evolving needs and challenges of the auditing profession. Eight participants described the challenges they face when the audit software crashes or becomes unresponsive, delaying the audit process overall, making it more difficult to complete crucial tasks on time, and possibly compromising the quality and accuracy of the audit findings. Some excerpts are as follows:

"*When a file size is big, or when we input a large amount of data, it starts to hang. Also, there may be constant updates which requires us to close all the tabs and only then proceed with the update, which is quite troublesome."– SA1*

"(Software name) does helps in linking one file to another, allowing us to create numerous sub-files, interlinking one task or working paper to another. But if there are a little too many sub-files, the system starts to hang."– AA1

"I think there is some improvement that can be made to overcome the lagging problem, to make it better."– SA3

A stronger audit strategy is supported by investing in and adopting the tools and techniques to improve the current limitations and anticipate and fulfil market demands. In light of the widespread and constant evolving nature of technology, audits at the Big 4 are propelled by innovation, which also makes the lives of the auditors easier, better, and more efficient. Keeping pace with technological advancements is crucial for maintaining competitiveness and delivering high quality audits.

Intriguingly, a participant (AA3) emphasised the significant importance of keeping up with the rapid pace of the ever-evolving technology. Having the right technology keeps the audit process effective and efficient as it provides the latest guideline in response to the changing demands of the industry, while fostering a culture of innovation.

"It is crucial that the tools get updated because technology evolve almost every other day, right. So, they can't use the old reference; as well as to maintain the integrity of the cyber security extensively." – AA3

While it is difficult to forecast how CAATTs will develop in the auditing industry over the years to come, it is somewhat evident in the technological direction the industry should be moving. The dynamic nature of technology and the shifting demands of the accounting and auditing industries make such estimates crucial. By completing routine operations more quickly, accurately, and efficiently, CAATTs allows human auditors to concentrate on more strategic, analytical, and judgment-based facets of their jobs.

5.12 Summary

This chapter has presented the findings from interviews with Big 4 auditors, structured to address the research questions on CAATTs use and the factors influencing their adoption. The evolution of auditing methods highlights the need for significant financial investment and skilled auditors proficient in these technologies. The adoption of CAATTs varies, influenced by factors such as technological infrastructure, client expectations, regulatory roles, psychological elements, and firm support. It is anticipated that CAATTs' role in auditing will continue to evolve, necessitating regular modifications and enhancements to meet industry demands. These findings are crucial for understanding the current landscape of CAATTs adoption, and it provides a foundation for the subsequent analysis.

The next chapter will delve into a detailed discussion of the findings through the lens of the TOE framework. This discussion will directly address the research questions and objectives of this study, providing deeper insights into CAATTs adoption within the audit industry in Malaysia. The rationale for having Chapter 5 lies in its role as the empirical groundwork that enhances the theoretical and practical analysis in Chapter 6.

CHAPTER 6: DISCUSSION AND CONCLUSION

6.1 Introduction

This final chapter discusses the findings presented in the previous chapter, in connection to the literature review and theoretical framework discussed in the preceding chapters. It addresses the research questions and culminates a conclusion. The discussion explores the findings on CAATTs adoption in the Malaysian Big 4 audit firms, providing a deeper understanding of the factors driving and hindering this adoption through the TOE framework by Tornatzky & Fleischer (1990). Specifically, this chapter examines how technological, organizational, and environmental factors interact and affect the adoption of CAATTs, thereby contributing to both theoretical understanding and practical implementations within the auditing sector. The data analysis involved classifying the findings into the three components of the TOE framework to provide a comprehensive analysis and conclusion.

6.1 Big 4 CAATTs Adoption Context

The first research question of this study aims to identify the various CAATTs and its use from the perspectives of the Big 4 auditors in Malaysia. CAATTs have become increasingly important with the advancement in technology and information systems, allowing auditors to fulfil their responsibilities effectively and efficiently (Ghani, 2016).

Interestingly, all participants (100%) were aware of the existence of CAATTs. This is in contrast with Ahmi and Kent (2012)'s study, which found that some external auditors were unaware of audit software's existence. This increased awareness indicates a significant shift in the adoption of technology in auditing over the past decade.

This study found that Malaysian Big 4 primarily use internally developed software, tailored to their specific needs, alongside commercially available options. This aligns with Liew et al. (2022), who noted that Big 4 firms globally have been creating in-house smart audit technologies to handle big data and data analytics. These custom solutions are

more advanced than typical Excel spreadsheets, offering functionalities for testing, sampling, fraud risk evaluation, journal entries examination, and assessing internal control effectiveness. These tools help ensure accurate and reliable data analysis and reporting.

Table 6.1 below categorizes the CAATTs used by the Malaysian Big 4 audit firms based on type and function, as identified from the interviews conducted.

Table 6.1: Context of CAATTs used by the Big 4 audit firms

CAATTs	**Context**
Audit Management Tools	- Audit planning and documentation - Workpaper management - Task assignments - Issues tracking - Monitor progress of audit engagements
Auditing and Collaboration Tools	- Workflow tracking - Audit work review - Document sharing - Obtain audit confirmations - Communication and collaboration among audit team members
Audit Analytics Software	- Audit planning and strategy - Generate audit working paper - Carry out audit procedures i. Setting materiality level ii. Sort transactions and accounts iii. Testing populations instead of samples iv. Performing substantive audit procedures

Table 6.1: Context of CAATTs used by the Big 4 audit firms, continued

CAATTs	Context
	v. Obtain evidence on control effectiveness vi. Identify journal entries and other transactions to be tested vii. Extracting and analysing large volume of data, patterns, risks, etc. viii. Perform analytical review ix. Reperform procedures x. Risk assessment xi. Conduct audit walkthroughs - Generate audited financial statements - Maintain previous years audit trails

Based on the findings examining the extent of CAATTs use in the Malaysian Big 4 firms, the CAATTs related audit procedures were further categorised and analysed in accordance with the International Standards on Auditing (ISA) published by IAASB (2013); as used by Ahmi and Kent (2012) and Bierstaker et al. (2014). The categorization and analysis of CAATTs related audit procedures are presented in *Table 6.2* below, reflecting the frequency of use reported from the interview. The table provides insights into the adoption and integration of CAATTs in standard audit procedures.

Table 6.2: Context of CAATTs usage in line with ISA

CAATTs related audit procedures	ISA	Frequency of use		
		Frequently	Sometimes	Rarely
Evaluate fraud risk	240	11	3	3
Identify journal entries and other adjustments to be tested	240; 315	17	0	0
Test populations instead of samples	240; 330; 530	17	0	0
Obtain evidence on control effectiveness	330	14	3	0
Check accuracy of electronic files	500	3	13	1
Select sample transactions from key electronic files	500; 530	5	9	3
Analytical procedures	530	17	0	0

The table shows how frequently auditors have reported using particular CAATTs related audit procedures. "Frequently" implies a high usage rate by auditors, with values like 17 indicating that it is a routine feature of most audits. Conversely, "Rarely" denotes that CAATTs is not frequently employed for the particular procedure, as seen with low figures like 1 or 3. When "Sometimes" and "Rarely" columns have no numbers, it means that participants agree it is used often. The difference in frequency of use is associated with auditor hierarchy, where more crucial tasks are undertaken by senior auditors. It is also recognized that CAATTs may be employed in multiple audit procedures, enabling auditors to address various financial reporting and compliance aspects. This allows for a thorough and comprehensive auditing process via CAATTs.

6.2 Big 4 CAATTs Adoption Factors

This section analyses the derived factors covered in the previous chapter on CAATTs adoption in Malaysian Big 4 audit firms, reflecting the three elements of the TOE framework. The proposed framework, initially outlined in *Figure 3.2,* was methodically revised to incorporate insights from the analysis conducted, based on the preceding chapter on factors influencing CAATTs adoption in the Big 4. The adapted framework is comprehensively illustrated in *Figure 6.1* below.

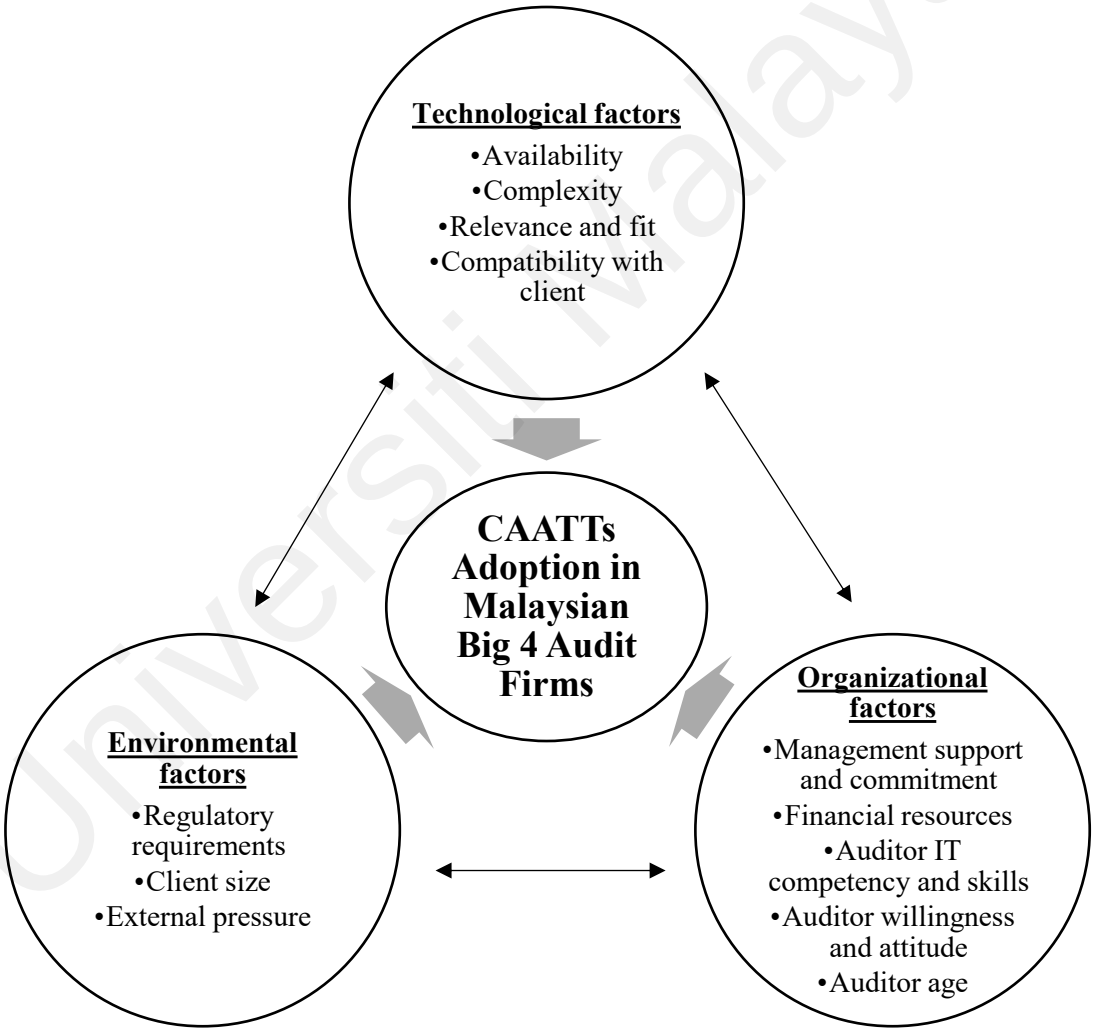

Figure 6.1: Adapted Framework

Source: Developed for this research

The identified factors were categorized according to their degree of impact on the adoption of CAATTs – Highly influential, Somewhat influential, and Less influential, as summarized in *Appendix C*. "Highly influential" factors were defined as those identified by 50% or more of the participants. Factors identified by 30 to 49% of participants were classified as "Somewhat Influential," while those identified by less than 30% of participants were deemed "Less Influential." This method of categorizing and disclosing the frequency of each identified factor aligns with Widuri et al. (2016). Additionally, it was determined that these factors can either have a motivating or hindering effect. Understanding these effects is crucial for effective CAATTs implementation. The following part will provide more detailed discussion accordingly.

Various elements influencing the adoption of CAATTs are highlighted in this study. The availability of the tools, their complexity, relevance, and how well they interface with current audit processes are found to be the most important technological aspects. Furthermore, the degree of interoperability with client systems is considered moderate. From an organizational perspective, management support and auditors' IT proficiency are vital. Age, attitudes of auditors, and financial resources also have a moderate effect. External pressures, client size, and regulatory requirements are found to have less of an impact in the larger environmental context. These insights provide a comprehensive view of the factors at play. These factors will be discussed further in the following section.

6.2.1 Technological Context

Among the four technology-related factors; technology availability, usage complexity, relevance and fit were considered to be highly influential adoption factors across the Big 4 firms in Malaysia.

6.2.1.1 Availability

All participants agreed that the *availability of the tools and technology* is the most crucial factor in the adoption of CAATTs. Without these tools, adoption would not occur. The Malaysian auditing landscape, particularly within the Big 4 firms, mirrors the global scenario, where specialised audit software and Microsoft Office suite are prevalent. These firms often leverage strategic outsourcing to access commercially available tools that are widely used in the market, providing an alternative to in-house technology.

This finding aligns with the research of Verma and Bhattacharyya (2017), conducted under similar conditions in an emerging country, India, which parallels the context of this study in Malaysia. They categorized technology availability under the 'IT assets' umbrella, which includes IT human assets and relationship assets. They further elaborated that physical assets, platforms, databases, and architecture are necessary for technology adoption and are prime examples of technology assets.

Possessing the technology is the first step towards CAATTs adoption, thus proving availability to be relatively crucial. To ensure this can be undertaken seamlessly, firms are expected to possess good financial capability. It was determined that the primary factor influencing whether or not CAATTs are adopted is motivated by the firm's operational characteristics. In this study, the Big 4 firms are said to be making significant investments in the necessary tools to foster CAATTs adoption. Effective technology adoption demands appropriate investments in IT infrastructure and associated labour (Tornatzky et al., 1990; Zhu et al., 2006). This study underscores that a comprehensive technological infrastructure is not only beneficial but extremely necessary for CAATTs adoption. Additionally, firms must prioritize ongoing support and maintenance to ensure the longevity and effectiveness of their technological investments.

6.2.1.2 Complexity

Complexity, according to Rogers (1983) is the difficulty in understanding and using an innovation. This study indicated that auditors are more likely to opt for methods that are easier to complete any audit task, even if that means not utilizing the computerised tools and techniques. Dowling and Leech (2007) found that perceived complexity leads to resistance to technology adoption, resulting in auditors finding ways to circumvent the system or to "go around the system". As such, auditors prefer straightforward, easy-to-use, user-friendly systems. Easy to use indicates a person's belief that technology enhances their job performance (Venkatesh & Bala, 2008). Ease of use is congruent with the TAM proposal by Davis (1989).

People who join the Big 4 practice become part of a profession that is undergoing a fundamental transformation, and change does not come easily. All participants agreed that there are many excellent audit technologies in place today, but despite that, auditors cannot deliver an end-to-end analysis due to the multiplicity of systems and data, especially if the auditors are new to the field. This is due to the unfamiliarity and lack of understanding of the system's functionalities, making them appear more challenging and less user-friendly, resulting in lesser use.

Furthermore, task complexity is also found to be related to auditor motivation. Although auditors may be motivated to use CAATTs, their success may be limited due to its complexity, which results in disorientation of their performance. This supports prior studies that state that task performance is negatively related to task complexity (Liu & Li, 2011). Despite this, performance may also be affected because their knowledge is not sufficiently developed to take advantage of the system's features (Mascha, 2001). Some people love the mental stimulation that difficult jobs bring them and they thrive on them, while others perform better on easier jobs requiring less mental effort. This individual

variability helps explain why some people struggle while others perform well on hard tasks, calling for a more nuanced understanding.

According to a report by KPMG, there is a learning curve involved in the use of technologies to overcome the complex phase faced (KPMG, 2017). The early phases of implementing CAATTs are similar to those of acquiring any other human-acquired skill or knowledge in that they emphasise familiarity and adaptation. There should be a realistic expectation set, as benefits from the tools implemented are not achieved overnight. To reap the benefits, large organizations with intricate systems and a wide range of activities and transactions require patience and dedication. This entails firms making investments in training, supplying sufficient resources, and being prepared to adjust and overcome obstacles as they arise, ensuring auditors can surmount the complexity barrier by receiving the assistance they need to adopt CAATTs.

6.2.1.3 Relevance and Fit

Relevance and fit are crucial for CAATTs adoption in the Malaysian Big 4 context. This attribute evaluates the benefit and consistency of CAATTs with auditors' job roles. Findings indicate that Big 4 firms in Malaysia, like their global counterparts, prioritize tools that integrate seamlessly with their existing practices and procedures; consistent with earlier research on the TOE framework revealing fitness to task influences IT adoption (Dedrick & West, 2003).

Relevance and fit factor shape auditors' perceptions of these tools' value and utility, subsequently influencing their decision to incorporate them into audit procedures. This study found that high relevance and fit means that CAATTs are perceived as valuable tools that enhance audit effectiveness and efficiency. When CAATTs are applicable to the specific task, audit processes can be completed more rapidly, leading to increased productivity and improved accuracy. A senior auditor (SA9) from the Big 4 firm illustrated this by stating:

"The audit software we use provides a standardized template for all the working papers and it helps in streamlining the audit process. The templates are complete which includes questions or perspectives that have not been thought of by the auditor."– SA9

Given the Big 4 firms have centralized audit methodologies, they benefit significantly from the standardized templates in their audit software. However, these templates must be routinely evaluated and updated to reflect changes in audit methodology, laws, and best practices. The continuous improvement of CAATTs is essential to address the current limitations. For instance, eight auditors described the challenges with audit software crashes or unresponsiveness, delaying the audit process and affecting task completion timeliness and audit quality.

"As every audit work or process undertaken is in the system, once it freezes, it just causes a hiccup which may affect effectiveness, as that just puts a stop to the audit until the issue is resolved."– AA2

Ensuring that CAATTs investments are relevant and fit for audit processes is crucial. This study highlights a discrepancy noted in prior research regarding the low incidence of work relevance associated with CAATTs, despite Ahmi and Kent (2012) recognizing its potential benefits for external auditors. Notwithstanding the apparent benefits of CAATTs for auditors, this disparity suggests that the relevance of CAATTs in the workplace has not yet been properly acknowledged or integrated. It underscores the need to investigate the underlying causes of this discrepancy and explore solutions to bridge the gap between potential and actual utilisation. According to a white paper by ACL Services, CAATTs should be tailored to specific audit activities and client risk profiles, to be considered relevant and useful to auditors, thus motivating their use. This emphasises the importance of possessing tools that are fit for the appropriate task (Verver, 2014). Addressing these impeding factors is essential to overcome the lack of CAATTs adoption.

6.2.1.4 Compatibility with Client System

Compatibility with client system refers to the extent to which CAATTs aligns with the intended use and client's technology infrastructure. CAATTs adoption may be hindered if the audit tools used are incompatible with the client's system, although standardized audit software often mitigates this issue. Several studies have highlighted compatibility as a crucial factor in determining IT adoption (Premkumar, 2003; Premkumar & Roberts, 1999; Zhu et al., 2006).

TOE literature shows that consumer and trading partner readiness significantly influences IT adoption (Lin & Lin, 2008). This study found that auditors use CAATTs more frequently for clients with sophisticated IT systems that require more analysis. This is consistent with the findings of Braun and Davis (2003), who highlighted the need for suitable techniques to verify the accuracy of computerized data and protect internal control systems.

Additionally, auditing standards like ISA 315 emphasizes the importance of implementing the right technologies for efficient audits (IAASB, 2019). Compatibility with client systems reduces the risk of audit failures and ensures compliance with these requirements. This is crucial for maintaining accuracy and audit reliability.

A study by Al-Okaily et al. (2022), on CAATTs adoption in Jordan, a developing country, concluded that compatibility is essential for successful implementation, especially in environments with complex client systems and sophisticated IT infrastructures. Similarly, this study shows that ensuring CAATTs compatibility with client system is somewhat important. While standardized audit software is used, Malaysia's unique technology landscape necessitates careful consideration of compatibility to ensure seamless integration and effective audit processes.

6.2.2 Organizational Context

Next, we examine the organizational context of CAATTs adoption in the Malaysian Big 4 firms. The TOE framework helps in understanding both tangible and intangible factors within the organizational context. Among the five organizational factors, management support and commitment, as well as auditor IT competency and skills are considered highly influential. In contrast, financial resources, auditor willingness and attitude, and auditor age are somewhat influential. Ali et al. (2022) claim that there is a gap in the literature, as organizational factors have received less focus compared to individual or technological aspect of innovation adoption.

6.2.2.1 Management Support and Commitment

The findings of this study suggest that *management commitment and support* significantly influence the adoption of CAATTs and positively relate to their adoption. Previous studies have shown that management support, often referred to as top management support, promotes CAATTs usage, champions new systems, and legitimizes assimilation through resource allocation (Siew et al., 2020). Premkumar (2003) noted that top management support involves the commitment and resources provided by upper management to encourage technology adoption.

This study confirmed that as CAATTs become increasingly mandatory, encouragement from superiors is forthcoming. Active management supports signals that technology is valued and encouraged. This support includes not only financial resources but also the development of human resources and the promotion of technological competence and proficiency (Ali et al., 2022). A manager from one of the Big 4 firms shared that:

"Our policies are providing each auditor with a laptop when they onboard, which comes with the audit software we use installed in it. Later on, they undertake an orientation or training which gives them an overview of the fundamentals of the software."

Increased management support helps organizations overcome the challenges and complexities involved in technology adoption (Premkumar et al., 1994). While Big 4 firms often focus on the technical aspect and financial aspects of technology adoption, the psychological aspect also plays a significant role in the successful implementation and utilization of CAATTs.

According to ACCA's annual talent-trends survey in accounting and finance globally, mental health and well-being are the second-highest work concern for the future in Malaysia. The data indicated that 65% of Malaysian respondents felt job pressure negatively impacted their mental health. Within the context of Big 4 firms, 70% of respondents agreed that work pressures affected their mental health, and 45% of the total respondents did not believe that Big 4 firms prioritized mental health (ACCA, 2023c). Additionally, the survey highlighted that almost 52% felt overwhelmed by the pace of technological change, and 86% wanted more technology training from their employers.

Work in Big 4 firms has consistently been shown to be particularly intense and demanding, affecting psychological well-being and consequently, performance, regardless of the auditor's position. This highlights the critical role of top management in supporting CAATTs adoption through resource provision, motivation, and support.

This study's findings highlight evident stress and mental health issues across the workforce. Firms should offer training, tools, and encouragement for CAATTs adoption. According to Tornatzky et al. (1990), encouragement can hasten technology acceptance and usage. Management support for CAATTs adoption directly impacts how firms communicate and adopt CAATTs for audit improvements. This element is crucial for maintaining the significance of potential changes by communicating the firm's vision and the value of innovation. As management is the key to accomplishing the firm's objectives, they play a critical role in creating synergy between operations and activities, subsequently motivating the use of CAATTs.

6.2.2.2 Financial resources

With respect to firm *financial resources*, findings reveal that the availability and allocation of financial resources is somewhat crucial to support the adoption of CAATTs. The concept of financial resources aligns with the facilitating condition in UTAUT and available resources in DOI theory. It is perceived that Big 4 firms possess the resources for technology adoption and maintenance (Janvrin et al., 2008; Tarek et al., 2017).

According to the MIA's report on technology adoption by the accounting profession in Malaysia, a significant portion of a firm's annual budget is dedicated to technology adoption, as shown in *Figure 6.2* below. The report highlights the prioritization of technology investment among firms, reflecting the strategic importance placed on digital transformation. It also notes that a large portion of the respondents have allocated part of their annual budget for technology adoption, indicating a widespread recognition of the critical role and strategic commitment to integrating technologies.

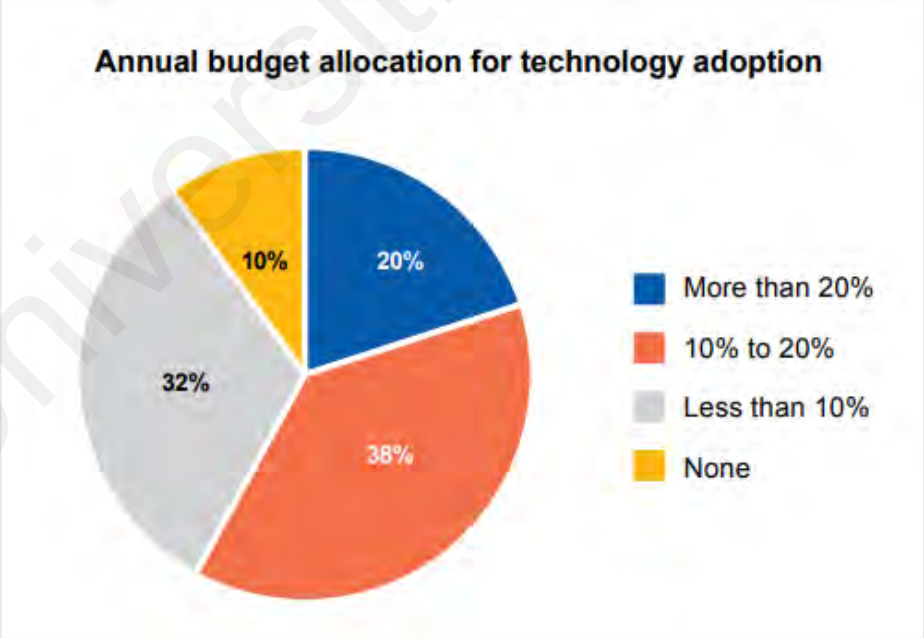

Figure 6.2: Annual budget allocation for technology adoption

Source: MIA (2023)

Furthermore, 72% respondents opted for internal funding as their main source of financing, which aligns with the findings that more than 50% of respondents have allocated 10% or more of their annual budget for technology spending (MIA, 2023). This underscores the critical importance of budget allocation, given the numerous costs and investments involved in technology adoption. Findings of this study indicate that financial resources are essential to cover all the expenses related to the initial setup and implementation, such as purchasing related hardware and software, operating costs including financing of technologically competent human resources with the necessary skills, training, and upskilling costs, and ongoing and maintenance cost of the CAATTs.

The reliance on internal funding highlights the firms' dedication to deeply integrating technology into their operations, ensuring sustainability and control over their technology strategies. For the financial year ending 2023, PwC recorded a global revenue of US$53.1 billion, EY at US$49.4 billion, KPMG at US$2.55 billion and Deloitte at US$64.9 billion (Brownlee, 2023; Deloitte, 2023; EY, 2023b; PwC, 2023). Their operations across multiple nations and industries give them a global presence, which provides substantial financial strength, allowing for significant investments in technology.

The financial support from these firms is not limited, enabling them to continuously enhance CAATTs adoption and integration. This investment yields returns by increasing efficiency and improving the overall quality of audit processes.

6.2.2.3 Auditor IT Competency and Skills

Prior studies say that high IT skills among auditors would lead to increased use of technology (Ali & Essien, 2023; Janvrin et al., 2008). *Auditor IT skills and competency* is found to be a significant factor for adoption of CAATTs, subject to the tools provided by the firms. Higher auditor technological competency is linked to increased organizational adoption (Ismail & Zainol Abidin, 2009). The skills may include, but are not limited to, technical skills, practical skills, analytical skills, and decision-making

skills (Al-Okaily et al., 2022; Ali & Essien, 2023; Thottoli et al., 2022; Widuri et al., 2016). Auditors with strong technological competence are better able to identify opportunities to implement CAATTs and troubleshoot issues, making them more likely to identify suitable opportunities and navigate technical challenges.

It was gathered that Malaysian Big 4 firms face tremendous challenges due to insufficiently skilled auditors, despite having the financial resources, especially during busy periods which requires auditors to work more than they are bound to. Lack of skills to use the systems causes new auditors to face challenges, resulting in a delay in audit work. Research has questioned professional accountants' competency in technology, arguing that undergraduate education and training are inadequate for the dynamic nature of the technology world and its widespread use in business organizations (Chang & Hwang, 2003). To a certain extent, there is a mismatch between auditor CAATTs knowledge and its importance in this study. Auditors are aware of such tools and have a general understanding of their use, but they run into difficulties when putting them to use. Hence, this study emphasizes the importance of competent auditors to prevent mismatches between technology importance and actual knowledge, as mentioned by Ismail and Zainol Abidin (2009); besides confirming Abed (2020) claims that technology competency is a prerequisite for successful adoption of innovations such as CAATTs.

Additionally, according to KPMG (2023), there is a need to solve today's critical gap. As the scope and complexity of audit needs and expectations increase, new skills become essential. The technical proficiency and familiarity with the range of technologies that firms are using are essential for audit teams. Deloitte (2021) reported that the evolving roles of external auditors entail audits requiring a different set of skills, as shown in *Figure 6.3*. Skills are evolving in line with the technological advancements. Participants of this study unanimously agreed that remaining current and possessing suitable skills beyond the traditional audit skillset, especially in the suite of audit tools

and technologies relevant in the industry, is the only viable response to ensure a smooth adoption of CAATTs as a whole.

Rank	External auditors today	External auditors of the future
1	Financial skills	Critical thinking and judgement
2	Critical thinking and judgement	Financial skills
3	Communication skills	Digital and data analytics skills
4	Digital and data analytics skills	Communication skills

Question: In your opinion, which of the following skills do you consider to be the most important for external auditors today/external auditors of the future?
Respondents ranked the importance of 4 factors in order of descending importance.

Figure 6.3: Evolving skills of auditors

Source: Deloitte (2021)

Above all, auditors are to manage their expectations on the extent of the use of the technology, and do not be over reliant on CAATTs, which leaves room for them to overlook potential risks or exceptions that require human judgement. Audit standards such as ISA 200 highlight the importance of an auditor's professional judgement, which must be applied throughout the audit (MIA, 2009). CAATTs has enabled automation of many tasks on a greater scale (Siew et al., 2020), but has resulted in auditors being less reflective and curious in the audit process (Gilbert; et al., 1990) and more mechanical in their way of thinking (Broberg, 2013); hindering the exercise of professional scepticism as auditors. This result suggests that in order for auditors to make decisions based on the information and evidence they have collected, in compliance with SAS No. 142's standards for audit evidence, it is essential that they comprehend how the tools function (AICPA, 2020). Thus, auditor critical thinking and professional judgement are determined to be crucial skills that smoothen the CAATTs adoption and concurrently ensure a good audit outcome can be produced.

6.2.2.4 Auditor Willingness and Attitude

Auditor willingness and attitude is an attribute found to be somewhat influential towards CAATTs adoption, as evidenced by mixed responses from participants. For the purpose of this study, auditor willingness refers to "the ability and attitude of auditors to accept change and experiment with technology." Previous research examined auditor attitude towards using GAS and discovered that the intention to use the audit support system was influenced by these attitudes (Dowling, 2008). TAM suggests that individual intention to use technology depends on user attitude, perceptions, and beliefs (Davis, 1989).

Resistant to change has been a persistent obstacle to effectively integrating CAATTs in the Big 4 settings. Findings of this study revealed that resistance occurs when auditors face difficulties in navigating the tools and hence become reluctant or avoid adopting such tools. The inherent complexities faced and difficulties in changing deeply rooted human behaviours and attitudes contribute to this resistance (Ali & Essien, 2023). Such resistance obstructs CAATTs adoption. Therefore, it is crucial to address behavioural changes to facilitate smoother technology integration.

A positive attitude towards CAATTs increases the likelihood that auditors will seek training and development opportunities to improve their skills. In Malaysia, initiatives such as the MIA Digital Technology Blueprint emphasize the importance of continuous learning and development in digital skills (MIA, 2023). These initiatives aim to foster a positive attitude towards technology among auditors by providing ample training resources and support.

Auditors are more likely to accept CAATTs and overcome initial difficulties if they are eager to learn and adapt to new technology. This openness to learning and adaptability is crucial for effective CAATTs implementation. A positive mindset and attitude can certainly encourage the adoption of CAATTs.

6.2.2.5 Auditor Age

An interesting finding is the relation of the *auditor age* factor to auditor willingness and capabilities, whereby participants felt that younger auditors are more receptive to using CAATTs. A Malaysian study employing the UTAUT theory indicated that younger auditors perceive CAATTs as useful and beneficial for auditing compared to their older counterparts (Abdul Ghani et al., 2022). The age factor, previously underexplored, adds a new dimension to the auditing literature to consider when analysing CAATTs adoption within audit firms using the TOE framework.

Prior studies have included the age factor as a moderating factor to capture the individual adopter characteristic using UTAUT, showing that behavioural intention to IT adoption is strongly moderated by gender, age, and experience (Mahzan & Lymer, 2014; Morris & Venkatesh, 2000). This is quite concerning as according to AOB and SSM (2017), 42% of registered individual auditors in Malaysian major audit firms were 50 years of age or older in 2018, with 36% of this group were over the age of 60. Therefore, effective succession planning that reflects ongoing updates of audit tools, systems, and activities is crucial for guaranteed continuity and sustainability of audit practices. This is primarily because older counterparts struggle with new IT applications (Venkatesh et al., 2013). They prefer systems that are easy to use, consistent with the TAM proposed by Davis (1989), which states that auditor's attitude is driven by perceptions of ease of use, benefits, age and being technology-minded.

In today's changing workforce, age significantly impacts technology adoption decisions (Morris & Venkatesh, 2000). There is a technological gap between younger and older auditors in proficiency with CAATTs. According to ACCA's annual talent-trends survey, younger employees are 'digital natives' and they reported 80% of the generation are very comfortable with technology and pick up new technologies fast (ACCA, 2023c).

Older auditors often resist change as that is a challenge they face when it comes to adopting new technology, hindering the adoption of CAATTs process. An associate noted:

"The seniors are experienced but may not be open to change. They prefer their way and often avoid using computerized tools, especially when more work is required. They prefer to do things their way."– AA1

Despite older auditors' technological limitations, they are significantly knowledgeable in contrast to the younger auditors, which subsequently ensures job completion. However, continuous learning and adapting to the ever-evolving technology are essential to maintain audit effectiveness and accuracy. The rapid pace of technological change necessitates faster learning, as skills become outdated more quickly. Therefore, management support for continuous upskilling and reskilling is crucial to prevent disruption in the audit workforce and to further ensure a smooth adoption of audit tools and technology.

6.2.3 Environmental Context

Looking at the results of the final component of the TOE framework, the environmental context was identified through three less influential factors; namely, regulatory requirements, client size, and external pressure.

6.2.3.1 Regulatory Requirement

Regulatory requirement could positively strengthen the CAATTs adoption in the Big 4 firms. Prior studies suggest that professional and regulatory guidance encourages audit firms to utilise audit software (Ahmi & Kent, 2012; Debreceny et al., 2005). For instance, AICPA mentioned that auditors must use computer-assisted auditing techniques to acquire more thorough evidence (AICPA, 2007). The Australian Auditing Standards Board recommends using CAATTs, especially in a technology-based environment

(AASB, 2006). Countries like the US have made using audit technology mandatory (Widuri et al., 2016). However, these are antecedents in developed economies.

The regulatory environment has been identified as a crucial environmental factor influencing the diffusion of innovation within the TOE framework. Findings of this study indicate that while regulatory requirements do not appear to be a highly influential adoption factor, they can still have an influence on CAATTs adoption. This is because Malaysia does not explicitly mandate CAATTs in audits but adopts standards, such as, but not limited to, ISAs that acknowledge technology's importance, alongside MIA's guidelines and best practices. A manager said:

"We are not compelled to use audit software to carry out audits, we use is because it is the right thing to do because of the developments in technology."

Although the TOE framework emphasizes this factor, this study does not see it as such. This relates to the aftermath of financial crises and scandals over the years. Despite recognizing flaws in audits and the potential for technology to improve audit quality, efficiency, and effectiveness, there has been no mandate by any professional, government, or regulatory body to enforce the implementation of audit tools. This indicates that the decision to implement CAATTs is left to the discretion of the respective firms.

Participants stress the importance of regulatory and professional bodies taking a more active role in motivating, sustaining, and improving CAATTs adoption. Increased involvement from these bodies could drive more consistent and widespread use of advanced audit tools. This is crucial as top management of firms would prioritize responding to policy and regulatory calls, fostering a supportive regulatory environment to enhance innovation diffusion within the firm. According to Mahzan and Lymer (2014), when selecting audit tools, auditors tend to seek advice from professional bodies among other sources.

Conversely, a report by KPMG (2017) suggests that laws and regulations may impede adoption since they specify audit evidence requirements based on manual or traditional audit procedures rather than fully aligning with innovative technology-based approaches. However, no such evidence was gathered from the interviews in this study.

6.2.3.2 Client Size

Another environmental factor established through the findings is *client size*, possessing somewhat little influence. The underlying perception is unaffected by the idea that Big 4 firms often audit large corporations because the software used for auditing clients of all sizes remains largely consistent. Clients generally prioritize the audit's final results over the CAATTs employed. However, larger clients often necessitate more comprehensive audits, limiting the flexibility of audit tools and methodologies, impacting the adaptability of auditing approaches. In contrast, smaller clients may require CAATTs to ensure rigorous reporting due to fewer internal controls and a heightened risk of fraud, errors, and risks.

Widuri et al. (2016) argued that larger audit firms would enhance their technological proficiency to align with clients' complex IT systems to make their technology compatible. However, the findings of this study contradict this assertion, indicating that there is a difference in audit technology used depending on client IT systems, whereby more often than not, it is the bigger-sized clients who have more complex and sophisticated systems in place. That statement only partially reflects the reality of the Big 4 auditing landscape and needs some nuance.

It was gathered that Big 4's apply standardized computerized tools and techniques universally across their client base, regardless of client size. The primary differentiation lies in the extent of effort required, particularly as smaller clients with less sophisticated data systems may demand more labour from the auditors. Thus, the adoption of audit software is driven by the audit firm rather than being influenced by their client size.

6.2.3.3 External Pressure

Within the external pressure factor umbrella, it consists of the expectations of the external parties of the Big 4 audit firms such as clients and society, as well as unprecedented phenomena.

Client expectations have been noted by Iacovou et al. (1995) as pivotal in the adoption of technology. However, participants in this study believe that while client expectations do exist, they have no bearing on the implementation of CAATTs within the Malaysian Big 4 firms. Expectations of clients vary from one client to another. Generally, clients expect firms to keep pace with technological developments, demonstrating flexibility in response to market shifts and offering clients state-of-the-art solutions.

Moreover, public expectations for enhanced audit quality and accountability have escalated as a result of well-publicized audit failures. Such instances include, but are not limited to the Enron and WorldCom, as well as the scandal of 1MDB and Serba Dinamika lawsuits within the Malaysian context (PwC, 2016; WSJ, 2016). These incidents underscored the need for audit practices to leverage technology like CAATTs to mitigate errors, enhance efficiency, and rebuild public trust. This catalysed a shift towards advanced technologies in auditing to meet rising societal expectations for rigorous financial oversight and accountability.

The rapid adoption of remote auditing capabilities further accelerated during the COVID-19 pandemic, demonstrating the critical nature of technology for conducting audits without physical presence. A senior associate (SA5) highlighted this shift:

"The pandemic made it difficult and impossible for us to travel to client sites to conduct audits. This led to an increase in demand for remote audits. Technology is very much needed for remote audits, as it allows auditors to access and analyse client data without having to physically be present on site."

MIA's report on technology adoption by the accounting profession in Malaysia reported technology adoption has been accelerated by several years due to the pandemic. With 42% of respondents indicating an acceleration of technology adoption by more than 50%, and 38% reporting an increase of up to 50% (MIA, 2023), this data substantiates the narrative of this study that remote auditing capabilities have become indispensable. Thus, it reinforces the assertion that the pandemic has driven a considerable shift towards the adoption of advanced technological solutions in auditing practices.

The changing demands and prospects of the auditing world is causing a rise to expectations from society and Big 4 clients, but this does not have a significant motivating effect on CAATTs adoption. This is primarily due to the fact that Malaysian audit firms are adept at making well-informed decisions that balance the potential advantages of technology with real-world implementation and efficacy concerns when assessing digital financial and operational data. These decisions are made based on the practical benefits and suitability to their audit style.

6.3 Contributions of the Study

The study makes several key contributions to the field of auditing and technology. Theoretically, this study extends the understanding of CAATTs adoption in the Big 4 audit firms within the Malaysian context, using the TOE framework. This integration provides a new comprehensive understanding of how technological, organizational, and environmental factors interact to influence the adoption of CAATTs within Malaysian Big 4 audit firms. Premkumar and Roberts (1999), and Zhu et al. (2004) concentrated on the adoption of IT innovations generally; this research specifically extends these ideas to audit tools, highlighting the unique challenges and advantages of CAATTs, thereby offering a refined perspective on its adoption in auditing. While Janvrin et al. (2008) and Tarek et al. (2017) discussed financial resources generally, this research specifically examined their availability and distribution in relation to audit technology adoption in a

developing nation. It highlights how these factors impact CAATTs adoption, offering a nuanced understanding that was previously underexplored.

Additionally, Abdul Ghani et al. (2022) talked about how younger auditors view technology. In contrast to their older counterparts, younger Malaysian auditors are more open to adopting CAATTs, despite facing challenges, as demonstrated by the findings of this research, which adds a new dimension to the adoption process. Particularly in relation to CAATTs, there is an advance in knowledge of how age affects technology adoption decisions. It highlights the technological gap that exists between younger and older auditors. This study highlights the requirement that audit companies maintain a balance in their teams by including both experienced auditors and digital natives. By utilising the advantages of both parties, this strategy promotes a more successful and amicable adoption process. Younger auditors, who are considered "digital natives," are more accustomed to and flexible with new technologies than their older colleagues, who could be reluctant to embrace new tools because of the difficulties they encounter with them. This knowledge is especially important given how the workforce is evolving today. It emphasises the necessity of audit firms' focused approaches in technology adoption initiatives, taking into account auditors' varying degrees of technological familiarity. These findings offer a foundation for policy creation and training programmes for organizations such as the MIA, facilitating a more seamless use of new auditing technologies across various age groups. This strategy can greatly improve the audit industry's flexibility and efficiency.

Another key addition is the identification of resistance to change as a major barrier to the incorporation of CAATTs. This study acknowledges that resistance can impede the adoption of CAATT due to hurdles in utilising new tools and the inherent difficulty in altering deeply ingrained human behaviours and attitudes; underscoring the need for effective management support and strategies in the firms to facilitate the movement

towards advanced auditing technologies. Audit firms may customise training and support programmes to accommodate the different levels of digital literacy; such as developing mentorship programmes whereby tech-savvy auditors help those in need of guidance, or providing more user-friendly and intuitive technologies that make it easier for auditors who are less tech-inclined to use them. Firms should also take these generational disparities into account when assembling teams, striking a balance between the computer expertise of the seasoned auditors and the digital natives.

Beyond the technical and financial elements within the firm, this study also expands on and admits the hard and demanding nature of work in Big 4 firms has a psychological influence on auditors' mental health and well-being, which in turn affects their attitude and how they perform and use technology. The study emphasises how crucial management support is, for providing resources and ongoing inspiration to deal with the demands of CAATTs adoption, as well as a responsibility to foster a culture that embraces technology in addition to allocating funds. Creating a supportive environment, counselling access, and promoting work-life balance are the key initiatives to create a more productive and healthy work environment.

This study fills gaps in the existing literature by focusing on Malaysia, a developing country, thereby adding a unique perspective to the global understanding of auditing technology adoption. It highlights the elements that influence CAATTs adoption in the Malaysian Big 4 firms context, providing valuable insights for professionals in technology, audit firms, and accounting bodies. By emphasizing the viewpoint of a developing nation, this study offers practical information that can encourage the increased use of CAATTs in audit procedures. This could lead to a more developed and technologically sophisticated audit sector in Malaysia, aligning with international audit standards and technological advancements. By focusing on the unique aspects of the Malaysian audit industry, this study enhances the global conversation on audit technology

adoption and offers targeted strategies to enhance technology adoption and improve audit practices, ultimately enriching the broader field of audit technology research.

In conclusion, this study makes several key contributions to the field of auditing and technology, both theoretically and practically. It provides valuable insights into the factors influencing the adoption of CAATTs and offers suggestions for improving their implementation.

6.4 Limitations of the Study

This study, focusing on the adoption of CAATTs in Malaysian Big 4 audit firms, provides a comprehensive analysis of the technological, organizational, and environmental factors influencing the adoption. However, there are certain limitations that need to be acknowledged, which can be viewed as a starting point for the development of additional research.

Firstly, this study is confined to the Malaysian context, with the sample size being auditors in the Malaysian Big 4 audit firms. This may limit its wider application and the generalizability of the findings to other contexts or geographical regions.

Secondly, this study primarily relies on qualitative data, seeking information about auditors, perceptions, and experiences of CAATTs adoption. To comprehend the phenomenon being explored in the context of this study, interpretive research is employed. This study is interpreted based on the TOE framework. However, because interpretation is a subjective process, it depends on the researcher's beliefs, motivations, values, and presumptions.

Additionally, while being rich in detail, one must acknowledge the inherent imperfections of the interview process. Participants may alter their responses to fit social norms or researcher expectations, leading to biased results. The process used to ensure the study's validity, along with strategies for minimising participant and researcher bias, is discussed in Chapter 4.

Lastly, the rapidly evolving nature of technology and auditing standards means that the findings might quickly become outdated, necessitating continual updates and research in this field. Further research could be undertaken at a more precise and granular level scale. For instance, within different firm settings, size, and countries, as well as involving other types of technologies, specifically such as artificial intelligence.

6.5 Suggestions for Future Research

This study attempts to bridge some gaps in the literature on CAATTs audits, such as the paucity of studies utilising the TOE framework and limited evidence from and about developing nations. Additionally, given the limitations and the dynamic nature of both technology and the auditing profession, future research could expand in several directions.

Firstly, complementing the qualitative results of this study with quantitative methods such as survey-based approaches may offer a more thorough understanding of the adoption trends and variables affecting the use of CAATTs in Big 4 audit firms. This could provide a balanced perspective, combining detailed insights with broader statistical validation.

Future research may also dissect the adoption of CAATTs into different subcomponents, such as internally developed and commercially available. This would allow for a deeper analysis of the intricacies of the audit tools currently in use. It would also be pertinent and forward-thinking to look into how new technologies like blockchain and AI may affect auditing procedures and CAATTs in the future. Detailed studies on the use and effectiveness of specific CAATTs tools could provide practical insights for audit practitioners and even tool developers.

Additionally, future research could explore the role of institutional theory, such as Institutional Isomorphism by DiMaggio and Powell (1983) in CAATTs adoption. Investigating how normative, coercive, and mimetic pressures influence the adoption process could provide deeper insights into the factors driving technological integration in

auditing. Comparative studies across different developing nations would enhance understanding of contextual variations and facilitate broader generalizations. This would contribute significantly to the literature on technology adoption in the auditing industry, particularly in diverse economic and regulatory environments.

Furthermore, expanding this study to examine the direct relationship of other key stakeholders on CAATTs will be useful. For instance, investigating the specific role of regulatory bodies. Guidelines for developing policies could be provided by research on the ways that regulatory bodies in various nations affect the adoption and application of CAATTs. Also, within the client context, a distinct perspective through study of technology in auditing may come from knowing how audit firms' clients view and respond to the usage of CAATTs in audits.

To sum up, this multifaceted approach to future research on CAATTs in Malaysian Big 4 audit firms could further the knowledge of technology adoption in auditing and provide insightful information to scholars, practitioners, and policymakers.

6.6 Conclusion

This research focuses on the adoption of Computer Assisted Audit Tools and Techniques (CAATTs) in Malaysian Big 4 audit firms and explores the technological, organizational, and environmental aspects through the TOE framework, providing a holistic view to analyse the various factors influencing this adoption.

The findings reveal that while CAATTs have significantly transformed the audit sector, their full potential remains underutilized in Malaysia. The main causes of this underutilization include a number of factors that have significant influence. Such factors include availability, complexity of the audit tools, and relevance and fit within the technological context; management support and commitment, and auditor IT skills and competency within the organizational context. Other factors are found to have some or little influence on CAATTs adoption.

This research offers valuable insights for audit firms and enhances the understanding of CAATT adoption in the context of Malaysian Big 4 audit firms. It provides a nuanced perspective of the interaction between technology, organization, and environment in this context, enriching the scholarly literature on technology adoption in auditing.

All in all, this study contributes to the understanding of CAATTs adoption in the Malaysian audit sector, offering insights into the complexities and challenges involved. Predictions are hard to make on how technology in audits will evolve in the coming years. Thus, it serves as a foundation for future research and practical recommendations for enhancing CAATTs integration, with the ultimate goal of bridging the gap between current practices and the promising potential of these technologies for the audit profession.

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