The Application of Sociotechnical Theories in Information Systems Research

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To my daughters, Tadiwa and Osayanmon, I dedicate this book to you.

CHAPTER 1

INTRODUCTION

Introduction

Information systems (IS) researchers have gradually moved from the tradition of following the interpretive approach to a more rigour-oriented, dynamic approach by applying sociotechnical theories as lenses for data analysis. This has been of significant value, as it makes it less challenging to justify the rigour of qualitative research in IS. In over two decades, two things have been achieved and are well documented in literature: (1) the theories are well described and explained, including critique and support; and (2) the theories have been well embraced and are increasingly being applied in IS studies. Despite these efforts, a fundamental gap exists, which is the way theories can be applied in IS studies. This is primarily the aspect that is found to be challenging and pushes some researchers, including postgraduates, away from the complexity of using the theories. This book provides a guide for each of the theories it focuses on activity theory (AT), actor-network theory (ANT), contingency theory (CT), the diffusion of innovation (DOI) theory, structuration theory (ST), and the technology acceptance model (TAM).

I would like to begin by clarifying two important terms used in the chapters of this book: information systems and technology (IS/IT) and information technology (IT) solutions mean the same thing in the context of this book; also, environment and organisation mean the same thing. Thus, the terms are interchangeably used in the book.

The introductory chapter is divided into four sections: the introductory section, followed by a synopsis of the problem the book tries to address, presented in the second section. The third and fourth sections provide brief introductions to the information systems (IS) discipline and IS research. These sections highlight the significance of qualitative data and the essentiality of the data source, as detailed in Chapters 3 and 4. In the fifth section, six sociotechnical theories that are the focal point of this book are

introduced. The theories are extensively and comprehensively covered in the last ten Chapters of the book.

The Goal and Synopsis of the Problem

Many challenges are implicitly associated with over-reliance on an interpretivist approach for the analysis and interpretation of qualitative data in IS studies. This is the main reason many IS researchers struggle to justify the rigour of their studies. It gets worse because the data sets are often small, compared to quantitative studies. The emergence of sociotechnical theories has been significant in improving rigour and justification in IS research. Within the last two decades, six of the theories have been applied more than 5 million times in IS studies. In that period, last two decades, two things have been achieved and are well documented in literature: (1) the theories are well described and explained, including critique and support; and (2) the theories have been well embraced and are increasingly applied in IS studies.

Despite these efforts, a fundamental gap exists, which is the way the theories, can be applied in IS studies. The challenges emerge from two different perspectives; namely, why, and how the theories are applied in IS research. Some of the challenges emanate from the lack of know-how. This discourages postgraduate students from selecting a theory, even though it would have been most appropriate for their studies. This is primarily because some aspects of theories are challenging and complex. Therefore, some researchers including postgraduates push back, applying the theories. This book provides a guide for each of the theories that have the highest rate of selection and are focused on by IS scholars. The theories are activity theory (AT), actor-network theory (ANT), contingency theory (CT), the diffusion of innovation (DOI) theory, structuration theory (ST), and the technology acceptance model (TAM).

For each of the theories, this book proposes a model that holistically guides data analysis from an interpretivist perspective. Through the models, a better understanding can be gained of the components of each theory and how they can be applied as lenses in the activities of the phenomena being studied. This includes the process of data collection in qualitative research and how its challenges can be avoided. The Chapters in the book reveal and discuss how the theories are used as lenses to guide data analysis and interpretation from a qualitative research perspective in IS. Another contribution of the book is in its plausible explanation: the strength of the theories lies in how to connect human actions with the different aspects of

technology solutions, including the interaction and relationships that happen during the development, implementation, management, and use of information technology (IT) solutions. Subsequently, this draws the attention of both IS practitioners and academics, particularly emerging researchers, and postgraduate students, to the usefulness of applying sociotechnical theories in IS research.

Information Systems

Neither this Chapter nor the book intends to redefine IS as a discipline. I only describe it based on my experience that IS is an academic discipline which constitutes two fundamental embodiments – information and systems – which are of pivotal importance to society and scholarly domains. Information is from the Latin word of *information-*. In the Oxford English dictionary, it is defined as knowledge acquired through experience or study, knowledge of specific and timely events or situations. Simplistically, a system consists of organised components that have relationships which go through integrated processes of different elements. The field of IS is a sociotechnical organisational system that is designed to gather, store, process, and distribute information (Ritchie, 1991). IS are made up of four main components: task, people, structure (or roles), and technology. None of the components operates in a vacuum; they influence one another to produce results or enhance usefulness. How, when, and why the components influence each other is determined through research.

In practice, people often change the IT solutions that they make use of by consciously or unconsciously modifying the properties through their interaction with the solutions. This happens even when a technology is stable and functions appropriately. Thus, the stability of IT solutions and their application are only provisional. Consequently, because of the rapid evolution of IT solutions, which stems from the fact that different elements are continuously developed, existing functions fail, and repairs are needed, new materials are invented, new standards are set, and users modify the artefact and/or its content for new and different uses. Thus, an understanding of how and why things evolve is key to findings in IS research. As has been seen or experienced for many years, there is increasing interest and the use of sociotechnical theories as lenses to examine and gain a better understanding of how and why things happen in the way that they do, in the development and implementation of IT solutions.

IS research is multifaceted and interdisciplinary, and is concerned with the study of the impacts and effects of information and systems on the behaviour of actors, agents, and organisations (Galliers, Markus & Newell, 2006). Hevner et al. (2004) explain how research in IS is used to create fresh solutions for both human and organisational capabilities. The solutions are constructs in the form of models, frameworks, and methods (March & Smith, 1995). In addition, research is conducted for innovation and contribution to knowledge. Essentially, research is vested in data and the analysis of the data.

The analysis of data is aimed to answer research questions and provide insights into solving problems. A research problem is not necessarily something that is broken. It could be enhancement, demonstration of knowledgeability, revelation of the unforeseen, or empirical confirmation of situations or circumstances. Data analysis is therefore a systematic approach which employs logical reasoning or techniques to describe, evaluate, and interpret data to find meanings that alter the ontological position before the research was conducted, and conclusively contribute to knowledge. Also, analysis is aimed to evaluate and examine sets of data, and to gain insights and an understanding of why and how systems' components interact, interconnect, interrelate, and influence each other in the process. Substantially, this is often a complex exercise; therefore, it requires symmetric, asymmetric, and isometric logical interventions to achieve the aim and objectives of the research.

Information Systems Research

The reliance on IS makes it critical to understand the various ways in which IT solutions can be used to support and enable organisations' operations. However, the selection, development, and implementation of IT solutions are not as simple as they are sometimes proclaimed, hence the existence of continuous challenges and the subsequent need for research. Owing to their complexities, from both technical and non-technical perspectives, organisations and researchers employ a more innovative approach, such as the use of theories, to underpin IS studies. Also, the use of theories adds rigour, which improves the reliability, credibility, and legitimacy of the study. According to Rose and Scheepers (2001), theories contribute significantly to the development of the IS discipline because they help to gain a better understanding of human interactions with technologies and have a meaningful impact on the environment.

The interactions and relationships that occur among actors in the activities of IS are often unpredictable and sometimes unstructured, which makes it subjective. However, subjectivism in a qualitative study does not necessarily make the examination and understanding of IT solutions easy. Qualitative studies in IS primarily focus on actors' relationships and interactions, from the perspective of subjectivism. Callon (1986) defines an actor as being both a human and a non-human entity. According to Myers and Avison (2002: 70), 'qualitative research methods were developed in the social sciences to enable researchers to study social and cultural phenomena'. The primary purpose of qualitative research is to understand a phenomenon as it is seen by respondents within contexts and over some time. Purposefully, this is achieved by studying the respondents' views in the context of their natural settings. The outcomes from qualitative research are subject to the meanings which people give to them in real-life situations and contexts (Yin, 2010). However, the meaning that individuals and groups give to or associate with events has never been easy for researchers and practitioners, without analysing or interpreting them.

Data analysis is critical in empirical studies, in that it entails the unpacking of data into perspectives (Bryman, 2012). An analysis is a process of making sense of the data that was gathered within context and the relevance of the phenomena being studied. The relevance of data is determined by the research questions and objectives. Increasingly, sociotechnical theories are employed to guide data analysis in an interpretivist study. There are two main components of theory: relevance and context. Relevance is symbolically representative of real-life issues or challenges. Context is deterministic of scope and boundaries. The components are viewed from different elements such as: (1) some theories are more complex than others; (2) one or a combination of theories can be applied in research; (3) theories add rigour and quality to research; and (4) theories serve important purposes in that they shape the outcome of the research.

The use of theories in IS tradition began around the mid-1990s. Since then, interest from various quarters of IS has grown significantly (Mueller & Urbach, 2013). The theories are employed to facilitate knowledge in the process of extracting findings. In the process, it has helped produce high-quality scholarly contributions (Tsang & Ellsaesser, 2011). Also, it helps to advance an understanding through an explicit explanation of the phenomenon being studied. Another issue of pivotal importance is that the use of theories increasingly adds legitimacy to findings and conclusions reached in IS studies.

Sociotechnical theories are vital in IS research in that they guide and give meaning to humans' experiences, feelings, thoughts, and knowledgeability. They guide the explanation of what, when, why, and how factors influence actors or agents in the phenomenon being studied. Consequently, they add rigour, which helps to shape the outcome of the study. On the one hand, they virtually extend the boundaries of the known and unknown of existing knowledge. On the other hand, they bring about challenges from the angle that a good theory is not necessarily a useful theory in a study. The rhetorical question that immediately follows is, what makes a theory useful in a study?

IS researchers formulate and use various criteria to evaluate the usefulness of theories in the discipline. The usefulness of sociotechnical theory in IS research depends on the nature of the phenomenon being studied, which is based on the research problem or the objectives. There are four fundamental elements: (1) the context of the study; the theory is purposely applied to give meaning to circumstantial incidents and events; (2) resonance with the objectives to be able to guide the data analysis towards answering the research questions; (3) ability to assist in the explanation of the findings that corroborate with the actions and interaction of the actors or agents within the context of the research objectives; and (4) ability to stimulate the development of a theoretical concept (framework or model) in the form of new knowledge.

There is emphasis on the use of theories from two main angles: (1) as a manner of speaking, which implicitly means research language; and (2) as a way of thinking, which implies unprecedented or a beyond-the-norm type of approach or end. Both elements are amplified in the use of theories as lenses. First, as a manner of speaking, it helps to follow the traces of relationships and interactions that happen between actors. Second, as a way of thinking, it is an integral part of research, primarily because it is used to gain a deeper and better understanding of what happens, how things happen, and why things happen in the way that they do. It is based on this premise that it helps to reach findings, explain the findings, give meaning to findings, and draw conclusions.

There are many theories, and they exist in the areas of psychology, sociology, organisation, economy, and systems (technical). This book focuses on social and technical (sociotechnical) theories that have increasingly been applied in IS research over the last two decades. Specifically, this book concentrates on the most popular sociotechnical theories in IS research, which are AT, ANT, CT, DOI theory, TAM, and

ST. As presented in Chapter 11, AT has been applied over 3 million times, followed by DOI, ANT, and ST. The last of the top six are CT and TAM, which have been applied in IS studies over 60,000 and 70,000 times, respectively.

A lens is an aspect of a theory that converges on a particular perspective through which analysis can be conducted to examine and explain a phenomenon. It thus, specifically, focuses on links, traces, patterns, relationships, and interactions between actors in the development, implementation or management of IT solutions. Based on the objectives of the study, a lens is used to view a given situation to explain the worldview explicitly or implicitly. It is thus used to explain the constituent elements and the interrelations in findings.

Sociotechnical Theories for IS Research

The sociotechnical theories emphasise social contexts from different angles and offer various types of meanings and explanations. The theories bring fresh perspectives into IS research. The theories are applied to facilitate and examine the interactions and relationships that exist between actors or agents and between people and technology. This includes the networks which the actors form under conscious and unconscious circumstances while developing, implementing, using, or managing IT solutions for organisations' purposes. Thus, the use of the interpretivist approach by itself may not be exhaustive enough in the analysis of qualitative data that can be so complex in IS research. The multifaceted nature of qualitative data rationalises, in addition, the increasing use of sociotechnical theories in the field of IS.

The remainder of this book is structured into 13 Chapters. In Chapter 2, the application of the theories is problematised. Chapter 3 covers the types and sources of qualitative data. The Chapter that follows provides a detailed discussion on collecting qualitative data, focusing on the use of semi-structured as a technique. Chapters 5–10 sequentially cover applying AT; ANT; CT; DOI; ST; and TAM, respectively. Chapter 11 provides a guide on how to select a theory for IS research. In Chapters 12, 13, and 14, AT and ST, AT and ANT, and ST and ANT are combined, respectively.

Activity Theory

AT was developed in the twentieth century for psychological purposes, which has since evolved and is being applied in IS studies (Yamagata-Lynch, 2010). The theory focuses on human activities within a socio-environment. It holds that the elements of activities are not fixed and can change as circumstances change over time or within space (Kaptelinin & Nardi, 2006). Engeström et al. (1999) explain how human activity is composed of three levels: activity, action, and operation. In this context, an activity comprises of actions, and each action endorses operations. Through this composition, AT is used to investigate human-associated engagement or events that are understood as activities in a specific social setting. Activities evolve in a non-linear way. This makes AT a useful theory for explanation and in gaining a deeper understanding of the logic behind human actions in carrying out an activity.

Also, the theory helps to trace and examine how each activity is performed through group or individual actions or chains of actions that are related to one another towards achieving a specific goal or objective (Nardi, 1996). In AT, actions are conscious, and consciousness is a basic principle of AT in seeking to understand actions and outcomes (Kaptelinin & Nardi, 2006). Consciousness is described by Kaptelinin and Nardi (2006: 9) as 'the enactment of our capacity for attention, intention, memory, learning, reasoning, speech, reflection and imagination'. AT consists of six components: (1) tools, (2) subject, (3) object, (4) rules, (5) community, and (6) division of labour, a subject and an object mediated by a tool (Engeström et al., 1999). The components are comprehensively discussed in Chapter 5. In IS, AT is often used to account for history and is particularly useful as a lens in qualitative studies where methodologies such as ethnography and case study are followed. It guides analysis to find patterns of actions in interactions and relationships, describing phenomena and presenting phenomena through a built-in language and rhetoric.

Actor-Network Theory

ANT is a social theory that is embedded within science and technology. The core elements of ANT are the actor, network, and translation (Callon, 1986), others are black box, irreversibility, and immutable mobile. In ANT, actors are both human and non-human (Callon, 1991). Neither actor nor network can exist separately or independently of each other; the relationship happens in a recursive process through which the network matures or becomes stable

(Heeks & Stanforth, 2015). Translation is the process of movement from one stage to another and it entails negotiations between the actors involved. There are four stages in translation referred to as moments of translation (Callon, 1986). Many IS studies have benefited from the use of moments of translation as a lens for the analysis and interpretation of qualitative data. ANT provides a lens to view how technology and social factors shape each other, which are often applied in the development, implementation, or management of IT solutions.

ANT is concerned with the existence of social and technical factors, and the creation and maintenance of networks of human and non-human actors, which, in the case of IS, includes people, organisations, software, and hardware (Walsham, 1997). In ANT, the constituents of the network are constantly shifting, including the relationships between actors (Callon, 1986). This is vital in investigating the complexity that often exists in the relationship and interaction between actors in networks (Heeks & Stanforth, 2015). In IS research, ANT is vital in four main ways – investigating how: (1) networks come into being (Callon, 1986); (2) associations or relationships exist; (3) actors are enrolled into a network (Doolin & Lowe, 2002); and (4) a network or networks become stable. It is thus useful in investigating social and technical factors that are involved in the development, implementation, and maintenance of IT solutions in an environment.

Contingency Theory

CT originates from organisational theory (Galbraith, 1973). However, it also derives from systems concepts, based on the notion that organisations comprise a multitude of subsystems whose interrelationships must be recognised (Reinking, 2012: 726). It describes the relationship between contextual factors, such as technology, the environment, and organisational structures, including the variables (Opitz, Krüp & Kolbe, 2014). Lin and Wang (2012) explain how relevant factors influence IT solutions and are perceived fit by denoting internal and external contingencies. The theory provides four variables – environment, strategy, structure, and performance – that are increasingly used in IS research (Blanton, Watson & Moody, 1992).

The theory is based on two fundamental principles. First, there is no best way to organise or manage an organisation influenced by uncharacteristic internal and external factors. Thus, each situation should be seen as unique

and require distinctiveness to achieve optimal functionality (McGrandle, 2017). This makes the theory most appropriate in examining the various best ways of constructing effective and efficient IT solutions. Second, any specific method that an organisation employs to organise or manage its activities is not equally effective (Van de Ven, Ganco & Hinings, 2013). This means that the optimal course of action is contingent on internal and external factors.

Diffusion of Innovation

DOI theory seeks to explain how and why including the rate at which a new idea or technology is dispersed in an environment. Vitally, this helps to reveal factors of influence in assessing the likelihood of success or failure in the development or implementation of IT solutions. Rogers (2003) argues that diffusion is the process of disseminating an innovation within a social system. In DOI, four components – innovation, communication channel, time, and social system influence the spread of a new idea in an environment. According to Nemutanzhla and Iyamu (2011: 244), the 'DOI theory communicates technological innovation through specific networks, over time, among members of society'. Individuals and groups possess different degrees of willingness to adopt or not to adopt innovations, which are influenced by factors including time (Rogers, 2003). The theory is thus concerned with how a new technological idea, artefact, technique, or a new use of an old one, migrates from one point (creation) to another (use).

Diffusion refers to the process by which innovations are spread among the members of a social system over time (in organisations). In contrast, adoption is a decision to implement innovations based on knowledge and persuasion of individuals within a given system (e.g., organisations or enterprises) (see Rogers, 1995). The theory can be used at both macro and micro levels to assess or evaluate the adoption of innovation. Diffusion is at the macro level. It concerns the dissemination of an innovation, while the micro level is the adoption stage where an individual or group decides to accept or reject the innovative technology solution. The DOI process consists of five components: (1) knowledge, the first step in the process where awareness is required; (2) persuasion, a point at which a prospective adopter shows interest in the new technology; (3) decision, based on certain factors an adopter decides; (4) implementation, operationalisation of the innovation; and (5) confirmation, finalisation of the entire process.

Structuration Theory

ST is a social theory that focuses on the reproduction of social systems through interaction between agents and structures (Giddens, 1984). In ST, agents are both technical and non-technical artefacts, and structures are rules and resources (Iyamu & Roode, 2012). The theory holds that human actions are enabled and constrained by structures but emphasises that these structures are the result of previous actions (Orlikowski, 1992). In structuration, structure is only manifested in the structural properties of social systems and consists of the rules and resources that human agents use in their everyday interactions. These rules and resources do not exist independently of human action, nor are they material entities. Giddens (1984) describes them as 'traces in the mind' and argues that they exist only through the actions of human beings. According to Loureiro-Koechlin (2008), the agents in an organisation learn how to exercise their power as is expected in the social system they are in.

Agents create structures, which in turn enable and constrain their actions and interactions, referred to as duality of structure, the aspect of the theory that is mostly used as a lens in IS studies (Jones & Karsten, 2008). The duality of structure consists of three dimensions, namely, structure, modality, and interaction (Giddens, 1984). The interaction between agents and structures is linked through modality, interpretive scheme, facility, and norm. Signification is established by human agents based on the interpretative schemes through which the meaning of communication is affirmed. Human agents dominate using facilities that are then used to exercise power. The theory is applied as a lens in many IS studies, primarily to guide analysis, particularly from the perspective of qualitative methods (Jones & Karsten, 2008).

Technology Acceptance Model

TAM is a theory that models how users get to a point where they accept or reject a technology solution. TAM is intended to explain the determinants which influence the acceptance and rejection of systems within an organisation (Davis et al., 1989). TAM assumes that beliefs about usefulness and ease of use are always the primary determinants of the adoption of information technologies in organisations. The theory suggests that these two determinants serve as the basis for attitudes towards using a particular system which, in turn, determines the intention to use, and generates the actual usage behaviour (Venkatesh et al., 2003). Thus, the

model is suitable for examining the factors which cause people to accept or reject IT solutions in organisations.

TAM provides the basis for examining the impact of external variables on internal beliefs, attitudes, and intentions (Davis, 1989). The use of TAM in IS studies helps to reveal valuable insights into why and how IT solutions are accepted or rejected by users in an environment. In TAM, there are two main determinants of technology acceptance: perceived usefulness and perceived ease of use (Wallace & Sheetz, 2014). Perceived usefulness and ease of use are influenced by external factors based on the characteristics of the technology.

Qualitative studies increasingly rely on sociotechnical theories to guide analysis and illuminate findings. In some studies, theories are used to guide the design of research questions, interpret qualitative data, and propose explanations for the insights of the influencing factor. The theories are used to provide meanings beyond an interpretivist approach. In addition, they help to provide an understanding of complex things, data, and circumstances such as the relationship between social systems and technology solutions by underpinning: (1) how technologies are developed and implemented; (2) why social systems work in the way that they do; and (3) why humans interact in certain ways.

As briefly presented above, different lenses can be employed to examine these circumstances in the various phenomena. This affirms that there is no one way to examine and understand how and why certain problems exist or why some IT solutions behave in the way that they do. Theories are used to underpin studies, to provide insights, and, therefore, to add rigour. Sociotechnical theories are vital in IS research, in that they guide and give meaning to human experiences, feelings, thoughts, and knowledgeability. Thus, they extend the boundaries of the known and unknown of existing knowledge.

The selection and application of theories are influenced by various factors primarily because they constitute integrated sets of attributes from different angles: (1) some theories are extreme; (2) one or a combination of theories can be applied in research; (3) theories add to the quality of data and the research rigour; and (4) theories serve important purposes in that they shape the outcome of research. Thus, two or more of the theories could be complementarily used in a study. Such a case requires different levels of analysis, with each theory having its focus. Iyamu and Roode (2012)

employed both actor-network theory and ST to examine the factors which influence IT strategy in a financial institution. The aim was not to compare the two theories but to use them in a complementary fashion. Chapter 11 addresses the need and how theories can be complementarily used in a study.

Conclusion

This is the introductory Chapter. It briefly explains how theories are used to underpin IS studies to explain humans' and technologies' traits, and the interconnectedness between actors in the phenomena being studied. The Chapter introduces why sociotechnical theories should be used to guide the explanation of what, when, why, and how factors influence actors or agents in the phenomenon being studied. Consequently, this rigorously helps to shape the outcome of the study.

The analysis aspect focuses on people's subjectivity as they continue to make use of technology for different reasons. The introductory content indicates that theories can reveal and facilitate the stability of an IT environment and that continuous change in technologies is subject to human actions. Hence, examining human actions and their manifestation is critical, using different sociotechnical theories. As discussed in the remainder of the book, theoretical lenses are intended to assist researchers in gaining a deeper understanding of the phenomena that they study.

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CHAPTER 2

PROBLEMATISING THE APPLICATION OF SOCIOTECHNICAL THEORIES IN INFORMATION SYSTEMS RESEARCH

Introduction

Information systems (IS) researchers have gradually moved from the traditional approach of using interpretive, to a more dynamic approach of using sociotechnical theories as lenses, to guide data analysis. This has been of significant value by making it less challenging to justify the rigour of qualitative research in IS. In over two decades, two things have been achieved and well documented in literature: (1) the theories are well described and explained, including critique and support; and (2) the theories have been embraced and are increasingly being applied in IS studies. Despite these efforts, a fundamental gap exists, which is a guide on how the theories can be applied in IS studies. This is primarily the aspect that is found to be challenging and scares some researchers, including postgraduates, away from the complexity of using the theories. In gaining a deeper understanding of how to apply the theories, it must first be problematised. This chapter problematises the application of six sociotechnical theories: activity theory (AT), actor-network theory (ANT), contingency theory (CT), the diffusion of innovation (DOI) theory, structuration theory (ST), and the technology acceptance model (TAM).

Qualitative Data in IS Research

Qualitative data are based on the views, opinions and experiences of individuals and groups. According to Hatch (2023), qualitative data aims to capture the perspectives that actors use as a basis for their actions in a specific social setting. As a result, there is no uniformity owing to the subjective responses from the respondents and the vastness of existing materials. Thus, the interaction between the researcher and participants leads to an understanding of experiences and the generation of concepts

(Holloway & Galvin, 2023) Fundamentally, this analysis of the data is complex and challenging, using the interpretive approach which has no specific bearing. Some of the challenges result in findings that are contextually embedded and vague, making it difficult to generalise. Lyons and Coyle (2021) explain that generalisation is difficult to attain in qualitative studies as the aim is to produce findings that apply primarily to the participants in a particular context.

Literature including professional guides prescribes various ways how to collect qualitative data, (Hatch, 2023; Iyamu, 2018; Iyamu & Shaanika, 2018). In practice, the reality is different from the theoretical academic materials. Sánchez et al. (2021) reported that in the absence of well-designed data collection tools, the results are prone to misinterpretation and misrepresentation. This is the part where many early career researchers and postgraduate students are often challenged, despite stringent theoretical preparedness. This is attributed to unpredicted situations and interaction in subjectivity from both the researcher's and respondents' perspectives. As a result, when the factors begin to manifest during the process of data collection, some postgraduate students do not know how to instantaneously address them in practice. Also, there is often a struggle to neatly fit the findings within the research problem and objectives, which can lead to misleading conclusions. In addition, it is a challenge to justify that there are no biases in the interpretation of the data.

The emergence of sociotechnical theories in IS studies eases these challenges. Sociotechnical theories are used as lenses to guide the analysis of data and the interpretation of the findings while employing subjectivity (Nehemia & Iyamu,2023). This chapter highlights challenges that are commonly encountered in qualitative studies, which should be taken cognisance of when introducing sociotechnical theories, in IS research. Recker (2021) shared that IS postgraduate students are exposed to a wide variety of theories, methods, approaches, and research frameworks from other research traditions, which might be challenging for them to apply.

Despite the rapidly growing use of qualitative methods and the subjective approach, there are challenges. Some challenges are incompleteness, conflicting standpoints, biases, and inconsistency as tabulated in Table 2.1. The challenges must be minimised or eliminated. In practice, this remains problematic, which brings about the significance of sociotechnical theories, as lenses, to provide a guide.

Table 2.1: Challenges in qualitative data

Attribute	Challenge
Incompleteness	Since each response can be true, they are sometimes considered incomplete. This is a common objection to subjectivism in both data collection and analysis, in IS research.
Conflicting standpoint	from participants' responses, one opinion is not more reasonable or plausible than the other. In the context, where there are ideas about right or wrong on the same event, provide less concrete evidence. The differing standpoints are sometimes based on an ontological stance, which does not extend to the analysis of data (Narock, Yoon & March, 2012; Cecez-Kecmanovic, 2011).
Biases	Subjectivism is considered a source of bias in some quarters, primarily, because it introduces misinterpretation of the data during analysis. Consequently, bias imbibes exogenous that leads to a belief and legitimisation of an outcome (Kwak, Holtkamp & Kim, 2019; Curry, Marshall & Kawalek, 2014).
Inconsistency	Analysis of data that is based on only subjective reasoning may lack consistency or reliability because it is influenced by numerous factors and perspectives. In employing subjective reasoning within the qualitative paradigm, often, there is increased inconsistency in the analysis of the data (Hazarika, Chen & Razi, 2021; Arslanturk et al., 2016; Lee & Lee, 2009).

The challenges arising from subjectivism in data analysis presented in Table 2.1 can be resolved or are being addressed through sociotechnical theories. As presented in this book, a researcher can justify gaining a better understanding and motives about his/her research and the outcome. Thus, qualitative research methods introduce subjectivity to the data collection processes, which can be both a strength and a weakness. However, this needs to be steered within a frame, to provide transparent stability, which presents a more acceptable rich and in-depth insights into data analysis, in IS research.

Activity Theory

Activity Theory (AT) is increasingly applied as a lens to guide the analysis and interpretation of data in IS research where IT solutions are assessed and evaluated. The application of AT ranges from development and implementation to management and governance of IT solutions, such as cloud computing, blockchain, digitalisation, and cyber (Renner-Micah et al., 2023; Moche & Iyamu, 2023). This cut across sectors, from banking to healthcare and education (Hurt et al., 2023). Dolata et al. (2023) provide a comprehensive explanation of how AT is used to analyse IS interventions that lead to changes, and how these changes give rise to problems that require innovative solutions. Corroboratively, Adamides (2023) argues the suitability and importance of AT when dealing with policy-making processes related to system innovation and governance of change. Lakay & Mlambo, 2022) explicate transformation, innovation and improvement as the interrelationship link that stems from the associated components of AT. This teaches us why it is crucial to gain a deeper understanding of the theory before embarking on its application.

Even though its popularity continues to increase in both business and academic domains, the theory is indifferent to challenges and complexity caused by a lack of formal or assessment guides. This could be attributed to the IS artefacts that are not straightforward in their selection, development or implementation. Also, the relationships and interactions formed between the actors when performing IS activities are unpredictable and unstructured, which brings subjective reasoning into the processes (Iyamu, 2020). Subjectivism is a state of reality that is constructed based on an individual or group's perception and interpretation. The challenges are critical because applying the theory significantly influences and shapes the results of the phenomena being studied. This induces one of the contributions of this book in Chapter 5, where a three-phase model approach is proposed to guide: (i) the selection of AT in IS research; (ii) the use of elements for data analysis to ease complexity; and (iii) linking the elements with AT components either in the analysis or interpretation of qualitative data. The approach therefore provides a formal guide that can be followed in selecting and applying AT in IS research.

It is plausible to continue, to emphasise that the theory helps in gaining a better understanding of human-technology interaction, towards identifying factors that influence the success or failure of IT solutions in environments, as argued in the literature. There is an academic duty to explore and be

transparent about the limitations or challenges, to avoid the continuous pitfall by students and emerging researchers. Many articles do not explicitly mention the challenges of the theory. Where the challenges are scantly mentioned, a guide on how to apply the theory remains a gap (Iyamu, 2021). This chapter presents some of the challenges, as shown in Table 2.2. In Chapter 5, a guide is proposed.

Table 2.2: Some pros and cons of AT in IS research

Pros	Cons
It also helps in understanding the outcomes of human-technology interaction and can be used to identify and resolve contradictions, which are considered the driving force behind the transformation of tool-mediated activities (Kamanga & Alexander, 2021).	There is a lack of standardized methods or approaches in applying the AT, as a result, researchers employ an individualistic structure in their use of the theory.
It allows for the identification of interrelationships and contradictions between actors and other elements of an activity system.	Another challenge is the need for access to qualitative data, which can be a significant issue (Long, 2019).
Additionally, Activity Theory can be used as a lens for critical analysis of qualitative data, allowing for the identification of reasons for failure or success in existing situations and as a predictor of success for new projects.	It focuses on the power to make choices and take actions, which removes the influence of external factors and the role of emotions in shaping agency (Xu & Fan, 2022; Feryok, 2012).
The AT provides a holistic view of a complex system or context concerning the social system in which IT solutions are used,	Another limitation is that activity theory may not fully capture the dynamic nature of teacher agency, as it tends to view agency as a stable and individual characteristic (Song & Kim, 2016).

As presented in Table 2.2 and discussed in the literature, AT provides insights into human-technology interaction, but there is a need to highlight the limitations, to influence its selection for data analysis purposes. This helps to propose a guide in Chapter 5. Additionally, the theory does in some instances, need to be used complementarily with other sociotechnical

theories. This is intended to provide a better comprehension of using the theory. In Chapters 12 and 13, AT is combined with structuration theory and actor-network theory, respectively.

Actor-Network Theory

Based on studies which have been conducted over the years, there exist increasing complexities, whether in the development, implementation, management, governance, or use of IT solutions. In the emerging digital world, there exists a growing rate of complications due to emerging technology solutions (Benbya et al., 2020). This is a consequence of not focusing on the balance between the two technical and non-technical factors of IT solutions; rather there is usually an overly focus on the technical aspect. Ibitomi and Iyamu (2020, p.1) alluded that "the challenges could be attributed to lack of evaluation, causing ineffectiveness, inefficiency, and inconsistency in the processes, interactions and activities where IT solutions are applied". ANT has thus been increasingly applied in IS research, to assess and evaluate activities of systems and technologies (Ferratti et al, 2021; Kumar & Tissenbaum, 2022; Wei, 2023).

Applying ANT helps researchers to ask certain implicative questions and guide analysis and interpretation of data to gain deeper insights into what, why, and how IT solutions are deployed, governed, and managed in organisations. The theory is often used in technological studies, to gain a better understanding of how actors consciously or unconsciously form networks, based on the relationships they created and interactions that they established (Vitale, 2023). What is even more important but challenging is how to apply ANT in IS research. So much work has been done about the use of sociotechnical theories in IS research, from both theoretical and practical perspectives, yet, how to apply the theory remains challenging. As presented in Table 2.3, three of the principal areas of challenges are social and technical, differentiating human and non-human actors, and actor's interaction.