A Method for Selecting Sociotechnical Theories in Information Systems Research

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Abstract: Information systems (IS) researchers are progressively employing sociotechnical theories to underpin, particularly, qualitative studies. Subsequently, work has been conducted on how to apply the theories. Despite the increasing popularity and academic efforts, challenges persist, which sometimes hamper the research sequence. This study focuses on the seven commonly applied theories in IS research, which are activity theory (AT), actor-network theory (ANT), contingency theory (CT), diffusion of innovation (DOI), grounded theory (GT), structuration theory (ST), and technology acceptance model (TAM). Based on the comprehension of the theories, the study proposes a three-step approach to ease the selection of sociotechnical theories for IS research. This includes the complementarity of the theories in research. Additionally, it highlights the vocabulary used within the theories, which contributes to the confusion and challenges encountered by researchers, particularly emerging researchers and postgraduate students. The three-step approach increases rigour in qualitative research and advances the application of sociotechnical theories in IS research.

Keywords: Sociotechnical Theories, Activity Theory, Actor-Network Theory, Contingency Theory, Diffusion of Innovation, Grounded Theory, Structuration Theory, and Technology Acceptance Model.

1. Introduction

Humans create or employ information technology (IT) and information systems (IS) solutions, and they function together as a system. As the system operates, relationships are formed and interactions occur, making it complex. To gain meaning in the processes and activities beyond the conventional interpretivist approach, sociotechnical theories are applied. Primarily, sociotechnical theory provides interconnectedness between human actions and technological capabilities, which is holistic. Tsang and Ellsaesser (2011) deduced that theories are essentially employed to facilitate knowledge in the process of extracting findings. In the process, it adds rigour in producing formidable scholarly contributions.

Applying the theories can be viewed from three standpoints: behaviourist, cognitive constructivist, and social constructivist (Gregor, 2006). Explicitly, Iyamu (2024) states that applying sociotechnical theories in IS research guides and helps to give meaning to humans' experiences, feelings, thoughts, and knowledge, including explaining what, when, why, and how factors influence actors or agents in the phenomenon being studied.

Due to its growing popularity and importance, Mkhomazi and Iyamu (2013) focused on the importance of selecting appropriate theories and how they could provide a systematic method in data analysis in IS studies. This was enhanced by Iyamu (2021; 2024), which attempted to provide a guide for the use of six theories in IS research. Despite the efforts and attempts by these and other authors, challenges remain, and it is increasingly affecting some researchers in IS in selecting theories to underpin their studies. The sociotechnical theories by themselves are a challenge as they do not have a formula, and it is not guided by distinct views and boundaries (Lawrence, 2010). Iyamu (2024) responded by explaining that researchers often have different opinions and interpretations, which should be guided using a formulaic approach.

The challenges are influenced by various factors. Mkhomazi and Iyamu (2013) suggested that the challenges are either because the theories are not of the IS field or some aspects of the theories could be seen to overlap. Sawyer and Jarrahi (2014) argued that selecting theories to underpin IS studies remains challenging. Osanloo and Grant (2016) attribute the challenges to the articulation of the rationale for selecting theories. Sekgweleo et al. (2017) suggest that the influencing factors are not understood.

Some of the challenges remain because it is difficult to find literature that provides procedural steps and attributes that constitute selecting the most appropriate sociotechnical theories in IS research. This study upholds this as a gap and proposes a solution. Thus, the study poses a question: What are the steps and attributes that aid the selection of sociotechnical theories in IS research? In answering the question, a literature review was conducted to scholarly affirm the gap and challenges in selecting sociotechnical theories to underpin IS research. The literature focuses on the most applied theories IS field. Sekgweleo et al. (2017) argued that

activity theory (AT), actor-network theory (ANT), contingency theory (CT), diffusion of innovation (DOI), Structuration Theory (ST), and technology acceptance model (TAM) are the most used theories applied in the IS field.

The paper is organisation into five main sections. In the second section, the study is problematised. A literature review is presented in the section that follows. It includes a summarisation of the concepts and vocabulary of the sociotechnical theories. In the fourth section, a three-step approach that can be used in selecting sociotechnical theories in IS research is proposed. The conclusion is summarised in the last section.

2. Problematising Sociotechnical Theories in IS Research

Theories consist of the ideas, concepts and principles that are organised and related to describe and explain a particular phenomenon (Yahaya et al., 2019). These ideas and concepts are logically arranged in a conceptual framework to display how they are related in a research study (Mensah et al., 2020). The theories developed from tested and published knowledge are summarised and integrated to form theoretical frameworks. Kivunja (2018) explains that theories are theoretical frameworks that provide lenses that help to provide a structure on how to examine, analyse data and interpret findings. Theories provide explanations of how things work based on evidence. Hence, the theoretical frameworks help to simplify and make sense of complex phenomena (Jones & Abes, 2011).

Theories are broad, comprehensive and difficult to put into practice (Cairney, 2012). For a researcher to use a theory, the researcher needs to understand the vocabulary of the theory, its weaknesses and strengths, including its previous use (Holmström, 2005). Without such understanding, applying a theory becomes a challenge. However, Sekgweleo et al. (2017) state that the selection and application of a theory do not solely depend on the knowledge and understanding of the researcher. The research problem and the aim of the study also contribute to the selection and application of an appropriate theory.

Fundamentally, sociotechnical theories contribute to IS research in four ways, primarily, by helping to: (1) associate meanings with what is experienced, observed, and felt; (2) guide explanation of relationships that exist between entities within context (social system and activity systems, and environment); (3) provide propositions and link influencing factors and attributes including their effects; and (4) intended to improve our understanding of computing as they apply to the world. Also, using a theory in research enhances the robustness and rigour of the findings of the study (Stewart & Klein, 2016). Thus, IS field increasingly relies on the use of these theoretical frameworks borrowed from other disciplines (Lynch et al, 2020). Because of that, the adaptation and use of theories in IS studies become difficult and controversial (Rose et al., 2005).

3. Sociotechnical Theories in IS Research

From the literature, over thirty sociotechnical theories exist and have been applied in IS studies (Wu et al., 2022; Hanafizadeh et al., 2020). This study focuses on the sociotechnical theories most applied in IS studies. According to Iyamu (2021), seven sociotechnical theories have been applied in IS research over 50,000 times in peer-reviewed materials in the last two decades. These are AT, ANT, CT, DOI, GT, ST, and TAM.

Activity theory provides a socio-cultural and socio-historical lens through which human activity can be analysed. The theory focuses on the hierarchical structure of the activity, which is made up of activity, action, and operation (Kaptelinin & Nardi,1997). A central concept of AT is the consciousness of the subject when carrying out activities. Schmidt (2022) noted that in AT, activity and consciousness are dynamically and inextricably interrelated. Consciousness is the enactment of our capacity for attention, intention, memory, learning, reasoning, speech, reflection and imagination (Kaptelinin & Nardi, 2006, p.6). Congruently, Engeström and Sannino (2021) assert that activity systems are increasingly interconnected and interdependent. According to Kaptelinin and Nardi (1997), in IS, AT provides a conceptual framework for describing the structure, development, and context of computer-supported activities.

Actor-network theory is concerned with the creation and maintenance of networks consisting of human and non-human actors. In ANT, an actor can be anything human and non-human, provided it is granted to be the source of an action and can make a difference (Latour, 1997). ANT does not deploy any distinction between human and non-human agents; rather, they are treated equally in building networks. Also, actors and networks are inseparable. Bueger and Stockbruegger (2017) explain that agency is realised through networks and in association with other actants. Also, a network can be part of other networks, resulting in actors and network heterogeneity (Iyamu, 2021). Translation is another important tenet of ANT. It focuses on the transformation of

activity from one stage to another (Callon, 1986) and the negotiation of meaning within a network (Iyamu, 2021). These aspects of ANT described here are critical and help to deduce certain manifestations in the development, implementation, and practice of governance of IT solutions.

Contingency theory is concerned with fit and that there is no best way (Betts, 2003). The theory is entrenched in studying organisations' behaviours, which manifest from how contingent factors such as technology, culture, and the external environment are designed to function (Islam & Hu, 2012). In CT, each organisational structure is unique to its environment and, therefore, cannot be applied to another organisation (Petrovska & Berzins, 2020). "The effectiveness and operation of each organisation are purely dependent on the fit and match of the variables such as technology, environmental volatility, the size of the organisation, features of the organisation structure and its information systems" (Islam & Hu, 2012, p.5159). Thus, the theory is suitable for analysing subsystems such as IS/IT solutions, including how they are developed and implemented. Petrovska and Berzins (2020) suggest that examining subsystems helps to respond to and improve organisational situations that arise within its environment.

Grounded theory focuses on generating a theory that is grounded in data, which is shaped by the views of the participants (Turner & Astin, 2021). Miner (2015) describes GT as a theory that focuses on qualitative research that aims to develop a systematic, limited-domain theory about observed phenomena. Turner and Astin (2021) assert that GT is both a methodology and a method used in qualitative studies. As a methodology, GT provides a process for the emergent discovery of conceptual theory from empirical data (Holton, 2009). As a method, GT provides a systematic method that shapes the data to be collected and provides strategies for analysing it (Charmaz & Thornberg, 2021).

The theory allows the researcher to interact with the collected data and analyse the data to determine additional data to be collected for a deep understanding of the phenomenon. Charmaz and Thornberg (2021) explain that with GT, the data focus emerges during the research process rather than being determined before the inquiry begins. Thus, the research focus keeps evolving as the researcher understands what is important to the participants from the data collection and analysis process (Turner & Astin, 2021). GT is applied in information systems research to guide the development of theories about the application of technologies in organisations. According to Holton (2009), GT studies are not conducted to test hypotheses but to generate theories that directly capture and explain processes, actions or interactions involving real-life social phenomena.

Diffusion of innovation aims to understand how people decide to adopt or not adopt an innovation. Innovation is something which is regarded to be new by potential adopters (Dearing & Cox, 2018; Kaminski, 2011). In DoI, the adoption of each innovation is influenced by five characteristics: relative advantages, complexity, compatibility, observability, and trialability and emphasis on the criticality of communication channels and time, in diffusing innovation within a social system (Rogers, 2003). Call and Herber (2022) asserted that DoI theory is applied in information systems to understand why some technological innovations gain rapid, widespread acceptance while others with comparable advantages take much longer or will never be adopted at all.

Structuration theory focuses on social systems, within which the theory keenly magnifies structure, agency, and reproduction (Giddens, 1984). Social systems represent the recurrent, empirically observable, and situated doings of human actors (Englund et al., 2020). In ST, agents represent both technical and non-technical artefacts, and structures are the rules and resources (Iyamu, 2021). Larsson (2012) explains that agents act within a structure that simultaneously constrains and enables their activities, the structure itself is dependent on the human activity that it governs. These are key factors that influence the development, implementation, or practice of IS solutions. Thus, from these perspectives of structure, constraints, and enablement including an understanding of the roles of agency and reproduction, many IS researchers are lured to select the theory.

The technology acceptance model focuses on the perception, predicting, and explaining acceptance of IT/IS solutions by their users in organisations (Aburbeian et al., 2022; Davis,1989). TAM provides a useful analytic framework for the use and adoption of technology through the variables of perceived usefulness, perceived ease of use, and use intention (Han & Sa, 2022, p. 405). Davis (1989) explains that a user's attitude towards the system is a major determinant of whether the user will use or reject the system. In TAM, the user's attitude towards the system is influenced by two constructs: perceived usefulness and perceived ease of use. Davis (1989, p. 320) defines "perceived usefulness as the degree to which a person believes that using a particular system would enhance his or her job performance, whereas perceived ease of use refers to the degree to which a person believes that using a particular system would be free of effort".

4. Selecting the Most Appropriate Theory

The guide for selecting the most appropriate theory is a three-step approach. Step number one is to identify the attributes of the objective or phenomenon being studied. In the second step, an understanding of each theory's capability (the strengths and weaknesses) is gained. The first (attributes of the research objectives) and second (strengths and weaknesses of the theories) steps are mapped, and weights are associated with the mapping to determine the most appropriate theory in the third step.

4.1 Step # 1: Research Objective Attributes

A research objective is a statement or statements that provide specific and realistic goals that the study intends to achieve (Nayak & Singh, 2021). The statements are derived from the research aim, which is a broad statement that captures the main purpose of conducting the study (Thomas & Hodges, 2010). According to Khoo (2012), research objectives should be concise and achievable within the set timeline. Research objectives help to guide the development of the entire study (Farrugia et al., 2010). Hence, Monrroy et al. (2022) state that research objectives need to be aligned with the research title and problem. Research objectives consist of attributes, which are the verbs and nouns within the research statements. For this study, the attributes (the factors that constitute) of the IS theories are identified in Table 1.

Table 1: Theory focuses and attributes

Element	Description
Technology (Artefacts)	An artefact is a man-made object with a specific purpose, consisting of a make plan, a use plan and a capacity specification (Weigand et al., 2020). An artefact is a tool that is passive and governed by people. The artefacts influence the implementation, management and government of IT solutions (Mutasa & Iyamu, 2023). Artefacts can be technical and non-technical.
Interaction	An interaction is a transaction between two or more entities towards fulfilling a task or achieving an objective within an environment. The interaction between entities is shaped by the relationships that exist between humans, technology and processes (Hornbaek & Oulasvirta, 2017). Iyamu (2019) identifies different interactions such as human-to-human, human-to-process, human-to-technology, process-to-process, process-to-technology, and technology-to-technology.
Interconnection	Interconnection is defined as a connection between two or more components or people that influence or affect one another. The components include people, technology and processes. During the interconnections, the components are dependent on each other. Hence, it is crucial to identify all the required components and their role towards achieving the objectives of the study. In that way, it allows the recognition of the influence of each component that has on a system (Iyamu, 2021).
Negotiation	The development of IT solutions requires a process of negotiation between actors (Iyamu, 2021). The negotiation entails an in-depth interaction of the actors, which results in the negotiations being shifted towards determining a common goal.
Relationship	A relationship is constituted by connection, communication and collaboration. Relationship constitutes the power to influence and control entities, and enact planning and decision-making processes (Beritelli, & Laesser, 2011). Also, relationship influences the allocation of tasks, roles, and responsibilities (Iyamu, 2017). The relationships formed based on power are shaped by organisational rules and regulations.
Rules	Rules are a set of policies and regulations that govern actors in the activities they perform (Dennehy & Conboy, 2017) over a period and within a specific environment. According to (Tessier & Zahedi, 2022), rules help to define processes that need to be followed and manage relationships and interactions between actors (Wang et al., 2020).
Structure	In IS theories, structure refers to rules and resources which help shape a social system (Giddens, 1979). Humans need rules and resources to be able to achieve an activity at hand (McPhee & Canary, 2016). Structure refers to the organisations and relationships of components in a computing environment. It depicts the power and flow of information in an organisation.

4.2 Step #2: The Theories' Capabilities

Every theory has a focus, which represents features that uniquely set it apart from other theories. Based on the focus, each theory inherently has weaknesses. Reinking (2012) shared that each theory has some inherent weakness that needs to be considered before its application. According to Iyamu (2024), from the perspective of naturalism and realism, disadvantages come with every theory's advantages. Thus, the theory's strengths and weaknesses are simultaneous, as one cannot exist without the other. On the other hand, a researcher often supplements a theory's weakness by selecting a second theory. Nehemia and Iyamu (2023) explained that the complementary use of theories is attributed to the difference in their focus, strengths and weaknesses.

When selecting a theory, one must understand its focus, strengths, and weaknesses. This is important to enable a correct representation of the theory's focus during its application. The study's comprehensiveness is undermined without understanding the theory's strengths and weaknesses (Tarhini et al., 2015). When a researcher does not understand the theory's weaknesses and strengths, it limits the researcher's capability to use the theory's lenses extensively to guide the study. Truex et al. (2006) explain that not understanding the theory's weaknesses and strengths leads to misinterpretation of the underlying notions about the nature of reality and how knowledge is acquired, which is implicit in the theory. The weaknesses and strengths of the most used theories in IS studies are presented in Table 2.

Table 2: Strengths and Challenges

Theory	Focus and Strength	Weakness and Challenge
Activity Theory	• Relationships and Interactions • Regulations • Consciousness • Activity levels • Interconnection • People and process • Social-cultural • Internalisation and externalisation	• Subject as living beings only. • Deep cultural and historical background. • Subject being an individual or group of individuals.
Actor-network Theory	• Building Networks • People • Interactions and Relationships • Negotiations • Translation • Follow the actors	• Not considering macro-social structures. • Its stance on moral and political issues. • Symmetrical treatment of humans and non-humans. • Tendency to describe as opposed to explain
Contingency Theory	• Contextualisation • Organisation strategy • Organisational structure • Fit and performance • Change management • Subsystems • Interrelationships	• No unique formula for the measurement of effective performance. • No clear guidance on how to identify the most appropriate management structure
Diffusion of Innovation	• Dissemination • Communication channels • Process and speed • Rejection and Adoption • Relationships and Interaction	• Silent on cultural differences. • A lack of focus on economic factors. • Does not provide a guide on how to address conflicts of interest, and linearity.
Grounded Theory	• Iterative process • Trail of information • Solution grounded in data • Sociotechnical behaviours • Interrelationship • Process and people	• Ambiguity whether research design or method. • Does not provide a guide on when to reach the point of saturation.
Structuration Theory	• Duality • Power and Structure • Interactions and Relationships • People and process • Recursiveness of action	• Structures instantiated only through actions. • No focus on the roles of actors in the production and reproduction of structures.
Technology Acceptance Model	• Technology • People • Interaction • Rules • Processes • Behaviour • Acceptance	• No focus on factors influencing ease of use and usefulness of systems. • More emphasis on ease of use and usefulness variables. • Variables based on perceptions. • A little guidance on how to increase user acceptance

4.3 Step #3: Mapping Attributes With Capability

The third step entails mapping the attributes of the research objectives from Step #1 with the strengths and weaknesses of the theories from Step #2. As shown in Table 3 below, mapping represents a matrix process where the focus of the objectives is classified into rows and the IS theories in columns, indicative of appropriateness. The matrix constitutes cells, which are the interconnection between the rows (objective attributes) and columns (IS theories). Each matrix cell weighs 1 point (marked 'X'), an example in Table 3. To conduct the mapping process, the researcher is guided by the following rules: (1) for each objective attribute, determine whether it's a theory's strength or weakness; (2) for each objective attribute which is a specific theory's strength – insert a cross mark (X) in the respective intersection cell; (3) tally all points allocated for each cell and record the total at the bottom for each respective theory column. The theory with the highest total sum of appropriateness is considered the most suitable to underpin a study.

Table 3: Mapping attributes with capability

Focus	AT	ANT	CT	DOI	GT	ST	TAM
Relationships	X	X					
Regulations		X	**X**				
Interactions			**X**	**X**			
Artefacts/technology				**X**	**X**	**X**	
Interconnection					**X**	**X**	
People					**X**	**X**	**X**
Process						**X**	**X**
Negotiations							**X**
Rules							
Structure							
Total	**2**	**2**	**2**	**2**	**3**	**4**	**3**

In the case of different theories having the same highest total, it appears that more than one theory could be suitable. This is often attributed to the proximity of theories' strengths. Unfortunately, when only one theory is required, then opt for the theory that encompasses most of the objective attributes as a strength.

5. Conclusion

The three-step approach proposed in this paper enables research contributions from two perspectives, primarily. First, it improves the rigour of research from a qualitative standpoint. This includes addressing inconsistencies in conducting qualitative research. Secondly, it advances the use of sociotechnical theories to underpin IS research. This increases multidisciplinary research because many of the theories are rooted in sociology and philosophy. This study highlights the critical challenges, such as the difficulty in identifying and distinguishing the vocabularies used in the theories. This is a specific area where many postgraduates and those new to applying sociotechnical are mostly challenged. The proposed guide has the potential to advance interest and use of the theories by IS postgraduate students. The guide provides a step-by-step guide that can be employed by researchers to improve the consistency and rigour of their studies.

Ethics Declaration

No ethics clearance was required for this research.

AI Declaration

No artificial intelligence tools were used in this paper.

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