A theoretical framework based on activity theory and structuration theory

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Abstract

The last two decades have witnessed a surge of sociotechnical theories used to examine information systems (IS) research, attributable, to increase rigor. It, therefore, necessitates innovative ways and usefulness in applying the theories in IS research. Inevitably, it leads to complementarity of some of the theories, whereby, activity theory (AT) and actor-network theory (ANT), and structuration theory (ST) and ANT have been combined in IS studies, in recent years. Despite the efforts, there is a need for complementarity of more theories, to cover extended scopes and increase rigor in the phenomenon being studied. This paper proposes a theoretical framework that combines AT and ST, for data analysis and interpretation of findings in IS research. The paper advances the application of sociotechnical theories to underpin IS research through a theoretical framework that combines AT and ST's dimension of change.

Keywords: activity theory, information systems research, structuration theory, theoretical framework

Introduction

Increasingly, sociotechnical theories are employed in information systems (IS) research, to examine why things happen in the way that they (Iyamu, 2021), between humans, technology, and social structures. Some of the sociotechnical theories are activity theory (AT) (Engeström, 1987), actor-network theory (ANT) (Callon, 1986; Latour, 1991; Law, 1992), contingency theory (CT) (Donaldson, 2001; Feidler, 1964), diffusion of innovation (DOI) (Rogers, 1995), structuration theory (ST) (Giddens 1984), and technology acceptance model (TAM) (Davis, 1989). Two fundamental things that must be taken into cognizance. First, some of the theories are from other disciplines such as philosophy and sociology, increasingly employed to underpin research and practice, particularly in interpretive studies in the IS field (Walsham, 2006). Second, the theories vary in their focus, strengths, and weaknesses.

Simplistically, we highlight the focus of each theory mentioned above. AT focuses on human activities, where it argues that "social" and "material" are redundant, and that there is no difference in social context and use of technology (Karanasios, 2018). ANT is concerned with shifting negotiation (Callon, 1986), and the conscious and unconscious creation of actor-network (Iyamu, 2021). In CT, there is no one or the best way to manage, and the design of an organization's subsystems must 'fit' with the environment (Reinking, 2012; Feidler, 1964). DOI is centred on the notion that diffusion entails different stages, which are embedded in a process that unfold over time (Jemine & Guillaume, 2022; Rogers, 1995). Recursive action of humans using structure to produce and reproduce (Giddens, 1984). The TAM assumes a mediating and deterministic role, in predicting users' acceptance or rejection of a system (Acikgoz & Vega, 2022; Davis, 1989). Consequently, it is sometimes difficult to employ a single theory in IS research, especially in a broad scope.

Complementarily applying two theories to examine a phenomenon being studied is something that is not often found within IS research (Atkinson & Brooks, 2003). Nehemia-Maletzky, Iyamu and Shaanika (2018) emphasized that one theory may not necessarily be enough to underpin a study toward achieving its aim and objectives. In recent years, some of the theories have been complementarily employed as lenses in IS studies. Greenhalgh and Stones (2010) combined ST and ANT to examine the recursive relationship between humans and technology within an environment. Atkinson and Brooks (2003) inducted the use of both theories as StructurANTion. Nehemia-Maletzky et al. (2018) proposed a model for the complementary use of AT and ANT in IS research. There seems to be no study where AT and ST have been combined in IS research. Even where two theories have been used, it does not depict the steps or how they can be complementarily applied (Nyandiere, Ateya & Kamuzora, 2015), as covered in this paper.

Two theories can be used complimentarily in IS research primarily because of the unique focus of each theory, however, the approach comes with challenges (Iyamu, 2021), such as understanding where one of the theories starts and ends (Nehemia-Maletzky et al., 2018). These challenges can be approached by knowing the tenets of each theory and understanding their strengths and weaknesses. The objective of this paper is to construct a framework that combines AT and the dimension of social change. This paper presents a theoretical framework that can be used for data analysis and interpretation of the findings from the analysis., based on the objective of the study. The theoretical framework is a complementarity of AT and the dimension of social change (DS) of the ST.

The paper is organized into four main sections. The first section introduces the paper. In the second section, the concept of sociotechnical underpinning studies in IS field is discussed. This includes a comprehensive review of literature relating to AT and DS of ST, respectively. The third presents a theoretical framework that combines AT and DS. Finally, a conclusion is drawn.

Sociotechnical theories

The last decade has witnessed a surge of theories used to examine IS studies (Dwivedi et al., 2019). Sociotechnical theories are used to support the data analysis and interpretation process which is conducted subjectively. This enhances rigor in IS research that commonly employs the interpretive approach for data analysis (Walsham, 2006; 1995), which is because reality is constructed on individual perception and interpretation that is regarded to be subjective (Cuthbertson, Robb, & Blair, 2019). Based on the aim of the research, a sociotechnical theory is selected. Separately, AT and ST have been selected to underpin IS studies for many years. Also separately, the two theories are discussed in the remainder of this section.

However, the interpretive approach has a shortcoming because it does not have a formula and is not guided by clear rules and activities (Lawrence, 2010). Iyamu (2021) further claims that underpinning theories guides data collection to data analysis. AT and DS are complementarily used based on the aim and objectives of the study. Similarly, in contributing to the use of sociotechnical theories for IS research, Nehemia-Maletzky et al. (2018) proposed the complementary use of AT and ANT to guide qualitative data analysis. The complementary use of AT and DS in a theoretical framework can be used to underpin any study if it fits the scope and objective. The theoretical framework (Figure 4) presented in this paper represents a formula in that it provides step-by-step guidelines for data analysis and interpretation of the findings.

Activity Theory

Activity theory (AT) is a social theory that was developed by Lev Vygotsky, Alexei Leont'ev and Luria

from Moscow State University (Bhattacherjee, Davis & Hikmet, 2013). The theory emphasizes human interactions within a social setting (Goncalves, Correira & Cavique, 2017), and it is referred to as a framework that outlines the interpretation and analysis of human activity (Bhattacherjee, Davis, & Hikmet, 2013). Activity in the theory refers to purposeful activity with repeated actions that contribute towards the achievement of its goals (Leont'ev, 1981).

Activity in AT does not mean the same as in the English vocabulary. In AT, activity denotes a high-level term that implies more significance and meaning (Hasan & Kazlauskas, 2014). Primarily, the theory attempts to comprehend how relationships consciously influence action in an activity (Kaptelinin & Nardi, 2006), which makes it appropriate for conducting analyses to gain insight into why things happen in the way that they do (Iyamu, 2021).

Thus, the main principle of AT is about the undertaking of human efforts, referred to as activity, which entails six components as shown in Figure 1. According to Karanasios (2018: 136), "activities are object-oriented, meaning that the most important element of the activity is the object upon which the subject acts to achieve a desired outcome". The object is the driving force and motivation for an action to be conducted, which establishes an activity. Bhattacherjee, Davis and Hikmet (2013), define activity as a structure of actions, influenced by intentional interaction between subject and object (Carvalho, et al., 2015). The subject (human) undertakes a structure of activities to resolve an issue (object), using tools (instruments) to achieve a desired outcome (Kuutti, 1995).
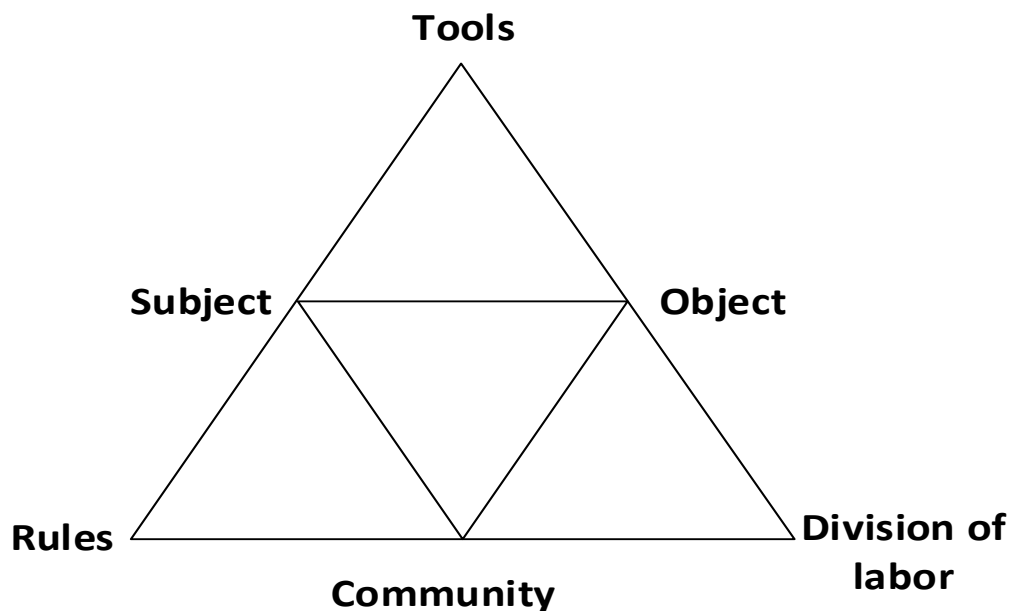

Figure 1: The Activity System Model (Engeström, 1987)

Consciousness is defined as the display of a human being's capacity for attention, recollection, learning, analysis, consideration, and imagination (Kaptelinin & Nardi, 2006); and AT is based on human consciousness and the interpretation of consciousness (Hasan et al., 2017). Thus, an activity is only undertaken by an actor with consciousness, a human being who acts on an object (Karanasios, 2018). Before an action is performed, it is planned in consciousness within a model (Moawad, Liu, El-Helly, 2013). An object, on the other hand, can be anything that poses a problem or point of interest for the activity, and this object justifies the establishment of an activity (Spinuzzi, 2011).

The object can be anything tangible, intangible, or a human being (Kaptelinin & Nardi, 2006). A subject can initiate an activity to alter an object, and to achieve its objective; tools are used as mediators for the activity. Hasan and Pfaff (2012), describe a tool as anything tangible or intangible, used to mediate an activity between a subject and an object. Tangible tools can refer to items such as machines and instruments, whilst intangible tools can refer to procedures, languages, or a law. Without tools, subjects will not be able to achieve their objectives towards the object. The community and circumstances surrounding the study will determine the kind of tools to be used, and these tools can range from processes, rules, signs, instruments, technology, and laws of an organization (Er, Kay, & Lawrence, 2010).

AT considers social elements such as the community, rules, and the division of labor, which all have a bearing on an activity (Engeström, 1987). A community is an establishment of a group or individuals that share the same interest through the object that interacts with the subject (Karanasios, 2018) because of the common objective, an activity is created by the participants in the community (Foot, 2001). Rules refer to the norms and processes that control the activities within a community (Engeström, 1987), where these rules and norms can positively or negatively affect the activity (Moawad, Liu, El-Helly, 2013).

In addition, these rules and norms can be explicit or implicit, defining what is acceptable or not (Karanasios, 2018). Activity is initiated to achieve an output, and according to Karanasios (2018), an output is a result of labor and a group of labor, which are divided by roles and hierarchical structures through the division of labor. According to Siemonova (2017), the division of labor is the roles and responsibilities of people in a community. Division of labor in AT is perceived as the categorized roles and responsibilities of an individual partaking in an activity (Nehemia-Maletzky et al., 2018). In addition, the division of labor dictates the division of power and status within a community (Tobin, Milne & Plakitsi, 2013).

In AT, an activity has a structure that defines how the activity happens at three concurrent hierarchical levels (Kaptelinin & Nardi, 2006). These levels of multiple actions are intended to transform an object (Bhattacherjee, Davis, & Hikmet, 2013). The first hierarchical level is the purposeful activity, followed by the purposeful action, and lastly the supporting operations (Leont'ev, 1981). The hierarchy of activity is shown in Figure 2 below.
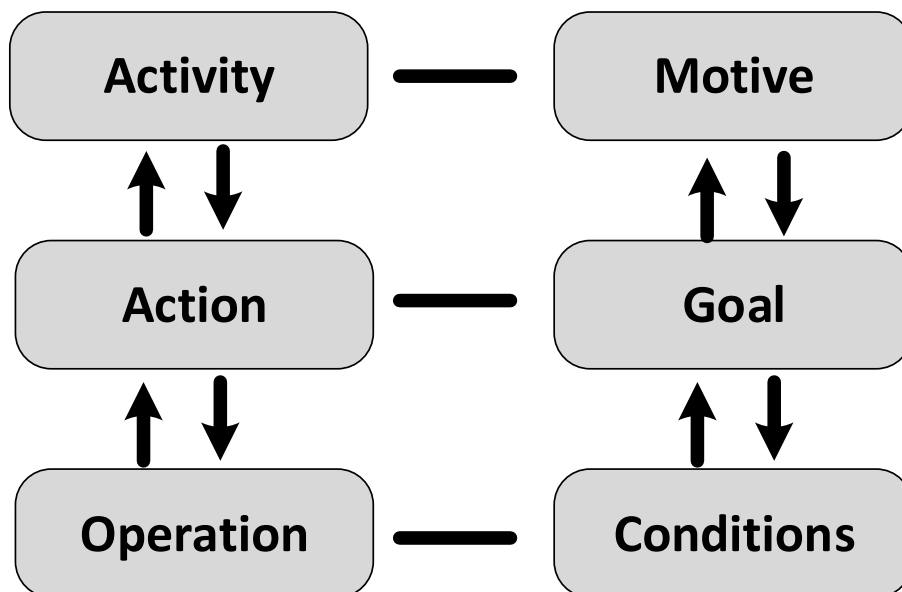

Figure 2: The activity hierarchy (Leontiev, 1981)

The top level of the hierarchy refers to activities established by a subject that has a motive directed to an object (Carvalho et al., 2015). The motive of the subject is to transform or attain an output from the object. In the second level, activity is accomplished by a series of actions even though some actions are not related to the motive (Devan & Squire, 2012).

Although actions from the subject are purposely intended to achieve an output from the object, some of the subjects could initiate activities unconsciously about the motives. The last hierarchical level is referred to as operations, which can be iterative actions established by rules and done unconsciously (Carvalho et al., 2015).

Activities in the hierarchical levels are not solid but can change due to different factors. According to Peachey (2010), a change can occur at the hierarchical level, attributed to a change in an activity that is caused by a change in the subject's motivation or skills. Activity is thus dependent on the subject's motivation and consciousness, which can change. In addition, activity is affected by societal and circumstantial factors in the activity system (Siemonova, 2017), which can be dynamic.

The interaction between the subject and object is not direct but mediated by the tools (Goncalves, Correira, & Cavique, 2017), which can be external or internal tools (Bhattacherjee, Davis, & Hikmet, 2013). In addition, as much as tools are regarded as enablers, they can also be an inhibitor because the capability of the tool can empower or limit an action accordingly (Kuutti, 1995). The community that the subjects belong to influences their activities through rules set in that community (Er, Kay, & Lawrence, 2010), and these rules are a set of conditions that expect conformance, defining how and why subjects may act (Goncalves, Correira, & Cavique, 2017).

Hence, the actions of the subjects are not independent of their community, and the interpretation of actions cannot be separated from the socio-culture of the community (Bhattacherjee, Davis, & Hikmet, 2013). During analysis, a community is used as a lens to comprehend how subjects having different backgrounds produce a solution or new knowledge (Engestrom, 2001). Furthermore, it is used to understand the different perspectives and interactions that take place between the subject and the community (Engestrom, 2001). It is the explicit or implicit rules from the community that governs the subjects (Er, Kay, & Lawrence, 2010). Explicit rules are standardized practices whilst implicit rules are norms or informal practices (Er, Kay, & Lawrence, 2010).

AT has in the last two decades increasingly gained popularity in the field of IS (Ahmad, Akhbariee, & Hafizuddeen, 2013). The theory has been applied in IS studies from various viewpoints to examine activities and episodes. According to Hashim and Jones (2007), AT is used to underpin the complex challenges of human activities in IS studies. Ahmad, Akhbariee and Hafizuddeen (2013) discussed the use of AT to investigate the requirement for Android applications. Shaanika and Iyamu (2015) used AT to determine the factors that influence the development of EA. Makovhololo et al. (2017) employed AT to study and understand the impacts of communication in healthcare systems data analytics. Holen, Hung and Gourneau (2017) adapted AT as a conceptual framework to examine the implementation of a one-to-one laptop initiative in a rural high school. However, AT is short in examining structure, change, and relationship. Thus, the dimension of change is combined with AT to examine the objectives of the study comprehensively and holistically.

Structuration Theory: Dimension of change

Structuration theory (ST) was developed by Anthony Giddens, a British sociologist, to address unusual social problems at the time (Posseborn & Pinsoneault, 2005). ST focuses on an agent (or agency), structure, the recursive interaction, and the relationship that exists between them (Giddens, 1984). It is on this basis

that the theory provides an understanding of how social structures have been established and produced and reproduced through agents' interactions and actions (Vyas et al., 2017).
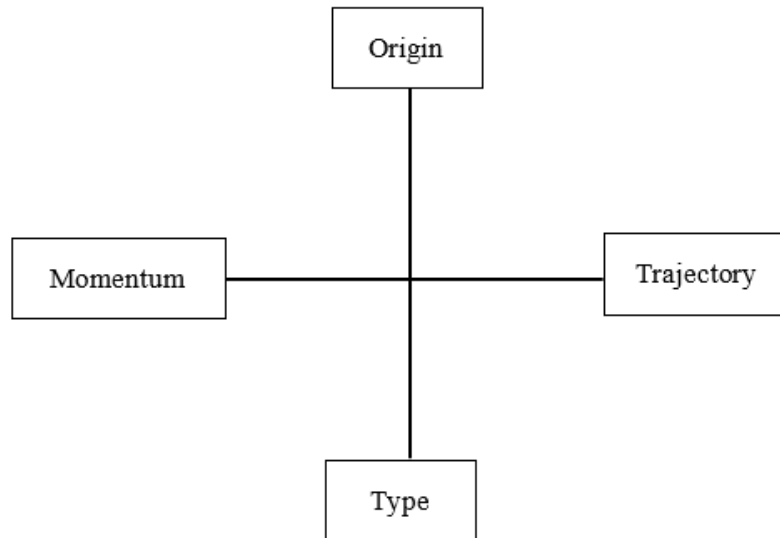

Figure 3: The dimension of social change (Giddens, 1984)

Agency and structure are the main tenets of ST, and according to Giddens, agency and structure have an indispensable relationship (Klesel et al., 2015) as they are co-dependent without priority of importance between each other (Meneklis & Douligeris, 2010). Agency refers to the pattern of people's actions, as opposed to a vehicle that is established to fulfil people's intent (Posseborn & Pinsoneault, 2005). Giddens (1989) explains that an agent is a human being who is defined to be knowledgeable, responsive, and acting with a purpose (Sarason, Dean & Dillard, 2006), whilst a structure is rules and resources which help shape a social system (Giddens, 1979). Structure enables and at the same time constrains human actions within a social system (Vyas et al., 2017).

The structure can expedite an activity using tangible resources such as computers, and funds or intangible resources such as knowledge and culture (McPhee & Canary, 2016). Giddens describes resources as the means of exercising authority that can affect transformation (Klesel et al., 2015). The premise of ST is based on the analysis of the establishment and re-establishment of social activity in a social setting (Posseborn & Pinsoneault, 2005).

However, an agent needs rules and resources to be able to execute activities (McPhee & Canary, 2016), even though they execute activities according to the limitations set by the existing structures (McPhee & Canary, 2016). Giddens resonates that no study or analysis of a structure's properties can be executed without the consideration of the agent's knowledgeability (Giddens, 1984).

Structuration is not constant, because social behaviors change over time and must be replicated even though the result stays the same (Rose & Scheepers, 2001). Through this evolution, Giddens notes a process of identifying emergent regularities of social practice and periods of marked societal change (Tungela, Mutudi & Iyamu, 2018). A period is defined as the changes that are sequentially executed through several activities with a defined beginning and end (Giddens, 1984). One of the main tenets of structuration theory is the dimension of social change.

The dimension of social change consists of four components, which are origin, trajectory, momentum, and type, as shown in Figure 3. The components are most suitable for interpreting the dynamism of a phenomenon being studied.

Origin – this is used to address the start of an episode (Giddens, 1984). This component focuses on investigating and evaluating the source of an episode, which can include the historical aspects (Tungela et al., 2018). This helps to gain an insight into how requirements are gathered, leading to the deployment of an IT solution. This includes an understanding of how certain actions are triggered in the development or implementation of the solution.

Type - refers to the description of the kind of episode. This component exposes the influence which change has on an environment, from both negative and positive viewpoints (Giddens, 1984). From the dimension of change perspective, type involves an episode, such as the distinctive roles and responsibilities of actors in deploying a solution.

Momentum - This component refers to the rapidity at which change occurs in an environment (Çam & Kayaoğlu, 2014). From a structuration perspective, Giddens (1984) associates this component with specific episodic forms. This component helps to gain a deeper understanding of how change occurs in the deployment of a solution in an organization.

Trajectory - is about the course or direction of the social change (Boje et al., 2017). This enables focus on the deployment of a solution. Through this component, the collaborative effort of the actors in the deployment of a solution is interpreted and assessed.

Like AT, ST has gained considerable popularity in the field of IS (Puron-cid, 2013). This is because of the theory's benefits of creating critical and reflective thinking in IS research (Ma, 2010). Supporting this argument, Van Veenstra et al. (2014) suggest that the field of IS has used structuration theory to gain a better understanding of the development, deployment, and application of IT artifacts and solutions. Iyamu (2020) used the dimension of social change to guide the analysis in a study to determine the role of e-government in healthcare services.

The theoretical framework

The two socio-technical theories, AT and ST that underpin the study, as discussed above, were combined to form the theoretical framework. According to Varpio et al. (2020), a theoretical framework is based on the use of concepts such as theories to form a building block of a study. As shown in Figure 4, the theoretical framework provides a structured sequential guide for the analysis of data and interpretation of the findings. Thus, the theoretical framework is divided into Phase 1 and Phase 2, for analysis and interpretation, respectively. The process of employing a theoretical framework increases the rigor of the study.
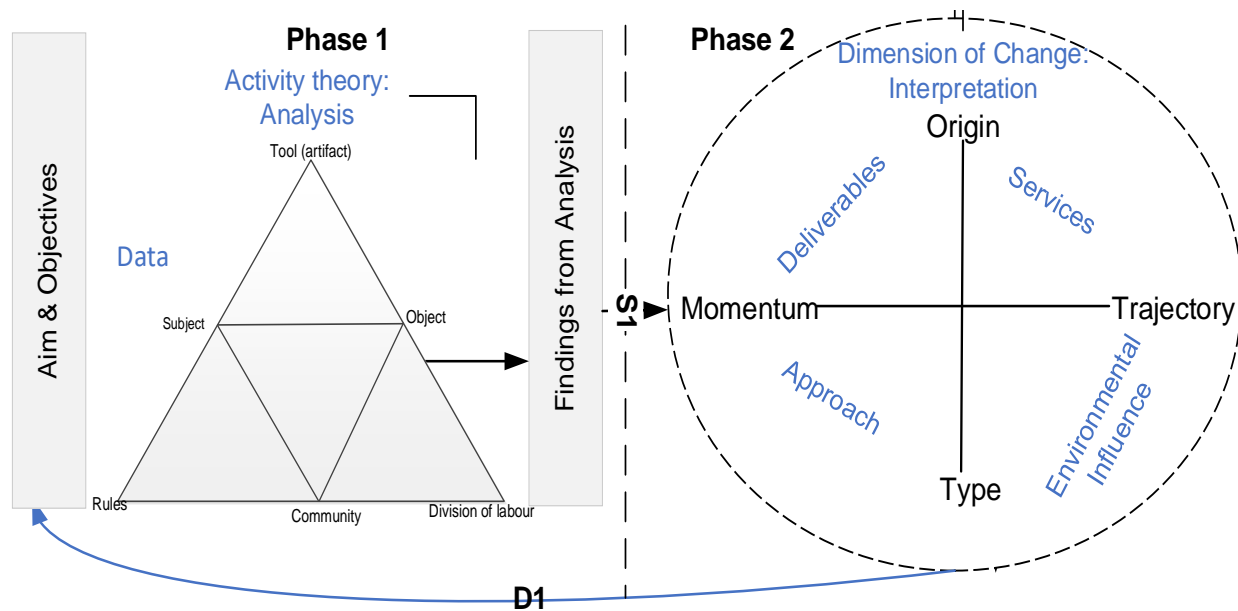
Figure 4: Analysis and Interpretation Process

As shown in the theoretical framework, there is no conflict or confusion in the use of the two theories, AT and ST in the study. Complementarity of theories has been demonstrated by other studies such as Nehemia-Maletzky et al. (2018), Iyamu and Roode (2012), and Atkinson and Brooks (2003). There is a boundary, indicated with a line (S1), between two phases: Phase 1 and Phase 2. Each phase has its distinctive focus but complementarily achieves the aim of the study, which is to develop a metrics model for EA.

Phase 1: employs the dimension of social change, which consists of four components, and focuses on the analysis of the data. As depicted in Figure 4, it is guided by AT in which the interpretive approach can be employed for analysis. During the phase, the data collected is analyzed using the AT model (see Figure 1), which has six components: tools, subjects, rules, community, objects, and division of labor (Engeström, 1987)). This means that each of the components can be used as a lens to examine the objectives of the study. Findings from the analysis are organized for interpretation purposes, towards achieving the objectives of the study.

Phase 2: employs the dimension of change, which consists of four components, origin, type, momentum, and trajectory. The phase focuses on the interpretation of the findings from the analysis. In the interpretation process, the primary focus can be on aspects such as services, environmental influence, approach, and deliverables in the development, and implementation of the phenomenon being studied. This helps to gain a collective understanding of the dimension of the IT solution change that happens in the environment. As the arrow (D1) in Figure 4 indicates, the results obtained from the interpretation can be used to achieve the aim of the study.

Conclusion

Applying DS (or ST) alone for data analysis in an IS study might have inherent limitations, where the phenomenon being studied is concerned with knowledge evolvement and computer-supported collaborative activities. AT assumes that knowledge evolves through collective activities, and it resonates with the

practice-based view of knowledge. The theory conceptualizes human activities by focusing on the dialectic relationship between humans' consciousness and social reality, mediated using "tools", to produce an outcome. Thus, it is critical to complement both theories, which is the main contribution of this paper.

In summary, the theoretical framework is designed, and its purpose is to be used to underpin studies, where it fits or is appropriate. The theoretical framework was designed using two socio-technical theories, AT and DS (of ST), to sequentially guide the data analysis and interpretation of findings. The theoretical framework was divided into two phases 1 and 2, to avoid conflict and confusion. Additionally, the distinctive focuses of each of the phases provide clarity on which theory comes first in the order of use. The theoretical framework encompasses the diachronic dimension of the duality of activities and the synchronic of the components of AT and DS. Although it is not a given as each study is unique. Practically, during data analysis, the theoretical framework enables the tracing of interaction, communication, and meaning associated with entities, from the origin of activities as they are recursively reproduced.

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