Reviving the Individual in Sociotechnical Systems Thinking

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Abstract. Sociotechnical Systems theory sees an organizational work system as comprised of two distinct subsystems – a technical and a social one – that influence each other. Together, these subsystems determine the performance of the work system. However, it is far from clear how to define them. Alternative trends, such as the sociomaterial one, focus entirely on the relation between the social and the material. A problematic feature of both approaches is the conflation of the individual and the social. We propose an alternative approach for sociotechnical systems thinking, based on the premise that the individual and social are distinct, however dialectically constituting each other in everyday activities.

Keywords: Sociotechnical Systems theory, dialectics, neurobiology.

1 Introduction

The aim of sociotechnical systems theory is to elucidate the relation between the human, social, and technological aspects of work systems. In mainstream theorizing, this relation is conceived of as linking two relata - a technical subsystem and a social subsystem – which should be jointly designed and optimized to achieve optimal performance [1]. Another theory addressing the same core problem is the influential sociomaterial line of research [2], which focuses entirely on the relation between the social and the material: "People and things only exist in relation to each other" [3, p. 455].

As evident from their labels, both sociotechnical systems theory and sociomateriality foreground the 'social' before the 'individual'. Although "the sociotechnical approach is innately human centred" [4, p. 495], the difference between 'human' and 'social' is rarely problemized. If attended at all, the individual is usually conflated with or subsumed under the social. However, according to Baxter and Sommerville, sociotechnical design methods are rarely used, which may partly be due to "issues of individual interaction with technical systems" [5, p. 4]. More outspoken, Kant claims that "The individual as a fundamentally social construct remains underemphasized" [6, p. 309] in sociotechnical systems theory.

The conspicuous inattention to the individual in theorizing the social is indeed strange, considering that the individual is the acting subject in every human society, regardless of when and where in history. The social and technological come into

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existence only through individual actions. Likewise, a human infant cannot survive on its own; it is fundamentally dependent on a social environment to become an individual.

To this end, the purpose of this position paper is to make an inquiry into sociotechnical theorizing, based on the core tenet that the individual and social mutually constitute each other – a *dialectical* approach.[1] This approach was conceived in the telecom industry from the author's experiences of coordinating complex system development projects [26, 27, 28].

The line of argument is as follows. First, we describe the *communal infrastructure*, which is a prerequisite for any action: "There is always something that exists first as a given" [8, p. 5]. This infrastructure is comprised of individual *biomechanical* and social *communal* factors. Next, we outline *communalization* as the dialectical process by which biomechanical and communal factors evolve. Biomechanical factors are conceptualized as a group of neurobiological, mental *predispositions*, which enables the individual to act in whichever situation she encounters. Together, this line of thinking provides a theoretical framework for inquiries into the relation between the individual, social and material/technological. Based on this foundation, we indicate theoretical and practical implications to be further developed in future research. In conclusion, we assert that advancing sociotechnical systems thinking necessitates the revival of the individual as a constitutive element.

2 The communal infrastructure

Brains "evolved to control the activities of bodies in the world… the mind consists of structures that operate on the world via their role in determining action" [9, p. 527]. Ultimately, these structures can be traced back to neurobiological predispositions for action, which the phylogenetic evolution of humankind has brought about. However, it is only in social settings that these predispositions develop into situation-specific abilities for acting. We conceive of such situations as *communities*, which

> develop, change, *and* remain constant as a result of individual actions, and … constitute, for each new individual born into it, a pre-established environment to be discovered and structured [10, p. 31, original emphasis].

Thus, any action presupposes a "stabilized moment in an interminable process of becoming" [11, p. 696] – a *communal infrastructure*. This infrastructure enables individual and joint actions, which in turn modify the infrastructure.

The individual and social are conceived in terms of *biomechanical* and *communal* factors respectively. Communal factors concern institutional 'facts', which "provide stability and meaning to social behavior" [12, p. 33]. Such factors develop during particular cultural-historical circumstances. Biomechanical factors, on the other hand, develop from innate predispositions, rendering the individual abilities to act in a diversity of situations, however constrained and enabled by communal factors. Thus, "Doubtless many contemporaries of Julius Caesar had the biomechanical capacity to become

[1] Dialectics has a long philosophical tradition from Aristoteles, Hegel, Marx and others [7].

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pianists, but were never able to develop the corresponding biomechanical ability because the pianoforte had not yet been invented" [13, p. 29].

3 Communalization

Communalization is the process by which the communal infrastructure unfolds as a result of actions as follows. The evolution of biomechanical factors has enabled humans to perceive a range of physical sensations emanating from the environment. Such sensations are integrated together with motivation and previous experiences retained from memory into a multi-dimensional, mental construct – a Gestalt by which a decision of what to do, how to do, and when to do is taken. After carrying out the action, the result is evaluated. Depending on the outcome, the cycle is repeated or halted. The entire episode is then retained in memory for acting relevantly in future, similar situations [14].

A central issue in communalization is how to conceptualize biomechanical factors. We suggest that at least the following dimensions of a particular situation need to be discerned by the individual:

- Acting in a situation implies attending some-thing, an *object*. This entails an *objectivating* neurobiological ability to focus onto the object. The nature of this object "is constituted by the meaning it has for the person or persons for whom it is an object… this meaning is not intrinsic to the object but arises from how the person is initially prepared to act toward it" [16, pp. 68-69].
- Focusing attention onto some-thing implies that other things will be unattended. This entails a *contextualizing* ability to project in the mind a *context* of relevance around the object - a "horizon of meaning" [18, p. 383].
- The *spatial* structure of the situation needs to be comprehended, which entails a *spatializing* neurobiological ability. Spatial factors signify "the way we shape the very world that constrains and guides our behavior" [17, p. 31].
- A *temporalizing* neurobiological ability [14] is requisite for anticipating the *temporal* structure involved in the situation; the sequence of actions towards the object, leading to the fulfillment of the need that motivates the activity in the first place.
- The *normative* structure of the situation, manifested as habits, rules, conventions, traditions, etc., needs to be adhered to, which entails a *habitualizing* neurobiological ability.
- When acting in a particular situation is finished, attention is directed to other situations. A *transition* from one situation to another entails a *transiting* neurobiological ability to refocus attention in which "the cortical system rapidly breaks functional couplings within one set of areas and establishes new couplings within another set" [19, p. 4].

Accordingly, we propose that the phylogenetic evolution has brought about *objectivating*, *contextualizing*, *spatializing*, *temporalizing*, *habitualizing*, and *transiting* as requisite neurobiological predispositions for acting in the world. These predispositions, which we refer to as *activity modalities* [20], develop into differentiated neurobiological abilities depending on situations the individual encounters. Hence, regardless of the specific nature of a situation, action always necessitates the mental capacity to confer signhood onto communal factors signifying *objects*, *contexts*, *spaces*, *times*, *norms*, and *transitions*.

Communalization thus conceived implies that we attend sensations emanating from the external world that we comprehend as meaningful, and which can inform us how to best act in any situation we encounter. If I see a red light when driving, I stop. If I perceive the church on my way back home, I know I shall turn right after I passed it. If I hear someone cry "watch out!" I understand that I should avoid something.

However, we do not merely observe the environment – we also change it to fulfill our needs. We define grand goals such as putting a man on the moon or defeating an enemy at war, reflecting our objectivating ability. If we previously navigated by observing landmarks in the nature, we now do it by maps or GPS systems reflecting our spatializing and temporalizing abilities. We write laws and establish courts reflecting our habitualizing abilities. And so on.

Consequently, the meaning we assign to communal factors will reflect our neurobiological predispositions (cf. Kant's 'a priori' categories [15]). This means that we conceive of the dialectical relation between the individual and the social as constituted by the six dimensions of the activity modalities. These make up a totality in the sense that action is thwarted if anyone is inhibited, for example, by a lesion in some part of the brain. However, even if all modalities are necessary for acting, this does not mean that they are sufficient. Other factors, such as intentions, trust, emotions, power structures, and more, are indeed relevant for carrying out actions.

The framework thus outlined brings about profound theoretical and practical implications for sociotechnical theorizing. Some of these are indicated below. The central point is that each individual "necessarily occupies a different position, acts from that position, and engages in a separate and distinctive act" [16, p. 70]. Stated differently, the individual experience of the world is unique since brains differ. This is the vantage point from which all social, material and technological considerations must depart.

4 Theoretical implications

Social. The social realm is conceived of as a communal infrastructure in which biomechanical and communal factors dialectically constitute each other. Actions necessitate intact mental abilities to confer signhood onto communal factors reflecting all activity modalities. The infrastructure evolves with every action, although on vastly different timescales, ranging from microseconds (individual neurons), years (individuals), decades (communal factors), to eons (the phylogenetical evolution of the human species).

Material. The material is seen as any internal or external physical sensations that we can perceive. In a particular situation, a subset of these are contextualized into relevance for acting. Such sensations may emanate from 'tangible' things like a hammer, that hurts when you drop them on your toe, or from 'intangible', ephemeral things like

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utterances or fantasies in your mind. What matters is how these sensations contribute to informing the individual how to act.

Technology. Technology is seen as material artifacts designed for particular social purposes, and “relevant only in relation to the people engaging with them” [21, p. 131). In order for any technology to become relevant, it must be communalized, which requires dialectical relations to be developed between each individual and the technology at hand.

Information. Information is seen as the result of integrating previous experiences, motivation, and situational perceptions into a holistic mental Gestalt, comprised of the activity modalities, and requisite for deciding a course of action.

Information Systems. An Information System (IS) is seen as the *communalized IT artifact*. Consequently, there is no such thing as an separate IS artifact, distinguished from the IT artifact [22]; only an ongoing, perpetually open-ended communalization of the IT artifact during which the artifact may be changed but never transformed into a different ontological entity. This means that the ‘system’ in ‘information system’ is comprised of the individual’s neurobiological structure and the IT artifact.

Communication. The mainstream view of communication as a process of 'transmitting' information or ‘messages’ from one person's mind to another’s, is rejected. As an alternative, the communication model of Integrationism is proposed [23]. Communication implies setting up conditions allowing all parties involved to construct possible interpretations, depending on the context. These contextual possibilities are intrinsically ongoing and open-ended [ibid.].

Knowledge. All knowledge is personal and internally generated by the human capacity for sign-making. Thus, knowledge is not something outside the individual. The external world supplies input to this creative process, but does not predetermine its outcome [24].

5 Practical implications

Work system analysis. A work system is conceived of as a community, structured according to the activity modalities. The analysis of such a system implies the identification of communal factors signifying the work system’s

- Object – what is being changed and acted upon by individual actions?
- Context – which is its scope and how does it border to other work systems?
- Spatial structure – which elements are relevant in the work system, how are these characterized and related to each other?

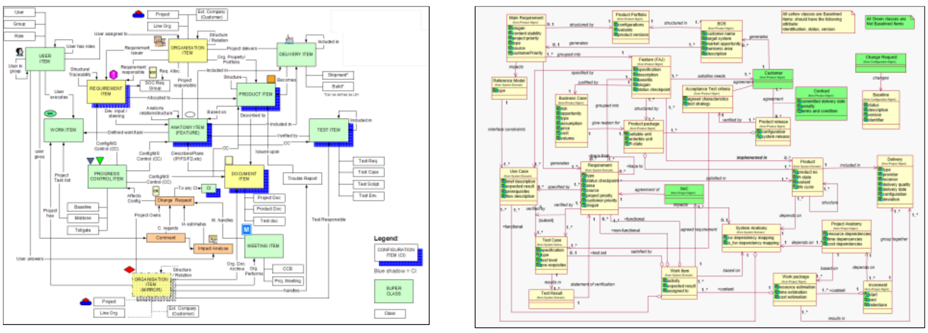
- Temporal structure – which sequences of actions are taken towards the object?
- Normative structure – which standards, rules, etc., are adhered to in order to keep the work system stable?
- Transitions to other work systems – how does it collaborate with these?

In line with this, an organization (a work system of its own) is seen as comprised of a set of work systems, each structured according to the activity modalities.

Design of IT artifacts. The key feature distinguishing IT-artifacts from other artifacts is that it is intentionally designed to be informative: “This is actually the most important trait and what distinguishes it from many other types of technical artefacts” [25, p. 93]. Someone using the IT-artifact should be informed about the state of things in the world in order to act relevantly. Since we propose that the relation between individuals and the IT-artifact comprises all activity modalities, the IT artifact should be designed in such a way that objects, contexts, spaces, times, norms, and transitions are easily recognized by individuals interacting with the artifact.

6 An illustration of the relevance of dialectical thinking

Around year 2000, Ericsson™ – a provider of telecommunication systems worldwide – launched the 3rd generation of mobile systems. The projects developing this system required sophisticated IT support in order to coordinate activities. To signify what information had to be managed in the IT artifact, two different “information models” were created (see Fig. 1).



A B

Fig. 1. Two information models

These models are so called Entity-relationship models [29], in which each box signifies a relevant entity such as ‘requirement’, ‘customer’, ‘feature’, ‘product’, ‘delivery’, etc. Lines indicate relationships between entities.

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The A model evolved gradually during several years when specialists (project managers, requirement managers, configuration managers, etc.) discussed it, tried it out in IT artifact, evaluated the results, modified it and tried it out anew. During this period (roughly between 1998 and 2004) the IT artifact and the model were modified several hundred times [27]. Consequently, the IT artifact was communalized into an IS, comprised of the IT artifact and individual's sense making of it. The B model, on the other hand, was developed by a consultant after discussing with key persons at another unit at Ericsson. No IT artifact was involved.

On the surface, the two models appear very similar. However, the evolution of biological factors, i.e., changes in individual minds, cannot be seen in the models. Thus, the immense resources spent in communalizing the A model and the IT artifact, is invisible. In short, the A model became relevant for supporting the projects, while the B model was in fact useless. This profound difference may remain unnoticed without a dialectical mindset in which both biological and communal factors are taking into account.

7 Concluding remarks

The central idea brought forward in this contribution is that the individual and social are ontologically different entities, however mutually constituting each other. This tenet is seen as a prerequisite for theorizing the relation between the social and material/technical. Consequently, the view of sociotechnical systems as comprised of two subsystems – a technical and a social one – needs to be reconsidered. Reviving the individual from its present lurking in the shadows entails a paradigmatic shift of foundational assumptions for sociotechnical systems thinking.

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