A First Principle for Renewing the Sociotechnical Perspective

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Abstract

The purpose of this paper is to renew the sociotechnical perspective as an "axis of cohesion" for the IS field. The renewal departs from the first principle "the individual *is* the *social being*", which means that the *individual* is seen as a constituent in sociotechnical theorizing; alongside with the social and technical. This principle provides a basis for rethinking these elements as dialectically related and mutually constituting each other. The individual element is conceptualized in terms of *neurobiological predispositions for action* grounded in Kant's notion of a-priori categories. The social element is seen as *activity systems* grounded in Marx's notion of Praxis. The technical element is theorized as materiality apperceived by individuals as *relevant in the activity system*. Its philosophical grounding is Ilyenkov's notion of the *Ideal*, which concerns the problem of the allegedly non-material in the natural world. When such a rethinking is applied to the IS field, a foremost finding is that the IS comes forth as a social phenomenon in the minds of individuals as they struggle to make the IT artifact relevant in the activity system. Consequently, the defining question of the IS discipline may be reformulated as "researching how IT artifacts are efficiently metamorphosed into information systems in IT-reliant activity systems". How these findings may turn out in practice is illustrated by the development of a node in the 3rd generation of mobile systems in the telecom industry. In conclusion, the renewed sociotechnical perspective provides a fresh view of extant IS phenomena, thus advancing the IS field both theoretically and practically.

Keywords

Sociotechnical perspective, individual action, Praxis, materiality, neurobiological predispositions, information, IT artifact, information system, IS discipline, axis of cohesion, philosophy, first principle, dialectics, Kant, Marx, Ilyenkov.

1. Introduction

The subject area of the Information Systems (IS) discipline is "the human, social, and technological phenomena associated with the design, construction, implementation, and use of computer-based information systems by individuals, organizations, and societies" [1] (p. 525). The discipline's unique, identifying question is how an IS—as a semiotic and sociotechnical system—can "be effectively deployed in the human enterprise?" [2](p. 272). A prerequisite for answering this question is that we understand "the recursive intertwining of humans and technology in practice" [3](p. 1437).

However, IS research has not been able to answer its unique question for decades. Central IS phenomena remain unclear, as illustrated by these examples:

- The nature of *information* "has plagued research on information systems since the very beginning" [4](p. 363).
- The "vastly inconsistent definitions of the term '*the IT artifact'* … demonstrate why it no longer means anything in particular and should be retired from the active IS lexicon" [5](p. 47, emphasis added).
- The lack of an agreed upon definition of *information system* "is one of many obstacles troubling the academic IS discipline" [6] (p. 448).

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- The answer to what the *social* is "depends on which tradition the researcher chooses" [7](p. 12).
- The construct of *materiality* is "neither well defined nor consistently used" [8](p. 5).

Lee summarizes the state of play in IS as follows: The "terms 'information', 'systems' and 'information systems' have fallen into such careless use that they seemingly no longer denote anything different from one another" [9](p. 10).

Evidences are mounting that the main reason for this lamentable state of play is the failure to define the very foundation of the field. Currently, "information systems does not have a core. On this point, everyone agrees" [10](p. 584). Watson contends that the "academic field of IS lacks an appropriate conceptual foundation that uniquely situates it as focused on a specific set of questions not addressed by other academic domains" [11](p. 515). Throughout the 40 or so years of its history, "the IS field has been characterised by a lack of *first principles* as a stable and widely-accepted conceptual foundation has not yet been established" [12](p.3, emphasis added).[2]

In the search for a conceptual foundation, the sociotechnical (ST) perspective has been an enduring candidate ever since the inception of the IS field in the 1960s. This perspective sees a work system as the recurrent interaction between two components – the social and technical (see Figure 1)

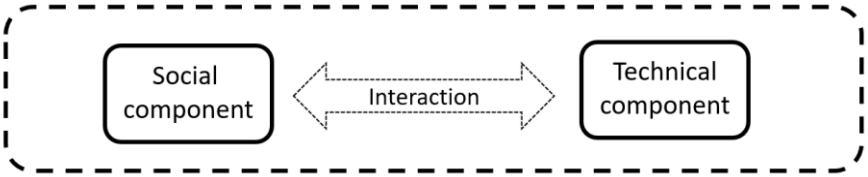

Figure 1 The traditional ST view of a work system.

The social component comprises "employees and the knowledge, abilities, skills, interrelationships, ideas, opinions, and needs they bring to their tasks" [98](p. 89). The technical component is comprised of "tools, mechanisms, and techniques" (ibid.). This view argues that a joint optimization of these components results in "better instrumental outcomes (e.g., higher productivity) as well as humanistic outcomes (e.g., greater job satisfaction)"[13](p. 698).

However, the bright future of the perspective has waned over time as problems persist. An extensive review by Sarker et al. [13] suggests that "IS research has lost sight of the discipline's sociotechnical character" (p. 695). In spite of this, ST remains a die-hard perspective. Sarker et al. propose that the IS field may be revitalized by defining ST as the "axis of cohesion" for the field – a "shared frame that provides the discipline with common language, broadly accepted research orientation(s), and/or communal knowledge in the form of shared assumptions and interests" (ibid., p. 696).[3] As such it "represents the '*central principles*' of the discipline" (ibid., p. 699, emphasis added). However, Sarker et al. left the elaboration of such an axis of cohesion to future research.

To this end, the purpose of this paper is to construct a renewed sociotechnical perspective (RST for short). This will be done in a series of steps departing from the first principle "The individual *is* the *social being*" [14](p. 105).[4] This principle is the gist of a long-lasting philosophical discourse over the relation between thought and being: "All problems of philosophy as a special science somehow or other turned on the question of *what thought was and what were its interrelations with the external world*" [15](p. 43). Examples of prominent thinkers in this philosophical stream – called "dialectical logic" by Ilyenkov [15] – are Descartes, Spinoza, Hume, Kant, Hegel, Feuerbach, Marx, and Ilyenkov.[5]

A profound implication of this principle is that the individual and social are seen as *dialectically* related. An infant does not develop into a conscious individual if deprived of a social environment at birth. Likewise, social environments exist only as a result of individual actions, carried out autonomously or jointly together with other individuals. Hence, the very concept of 'individual' is meaningless without the concept of 'social' and the other way around.

[2] A first principle is a "basic proposition or assumption that cannot be deduced from any other proposition or assumption" [17].
[3] This opinion was endorsed in the keynote address by Markus M. Lynne at ECIS'2021 [18].
[4] The full quote is: "What is to be avoided above all is the re-establishing of 'Society' as an abstraction vis-à-vis the individual. The individual *is* the *social being*. His life, even if it may not appear in the direct form of a *communal* life carried out together with others—is therefore an expression and confirmation of *social life*"
[5] Evald Ilyenkov (1924 – 1979) is "one of the most remarkable figures in 20th century philosophy" (Lotz, 2019, p. 1), however barely known in the West.

Accordingly, the individual is from the outset regarded as a *constituent* in the RST perspective, alongside with the social and technical. This point of view is conspicuously absent in IS theorizing. Recurrent perspectives are reductionist; seeing individual as 'users' of IT (e.g., [20]), focusing on cognitive aspects (e.g., [21]), or even neuroscientific aspects (e.g., [22]). As a result, the individual is routinely submerged under or amalgamated with the social, as evidenced by phrases like 'human/social actors', 'individual/collective', 'technical and the human (social) side of IT' (cf. also [7]). This is quite remarkable considering that neither the social, nor the technical, would exist without acting individuals. At first glance, it may seem that introducing the individual on par with the social and technical only aggravates matters further. However, as I have suggested ([24], [25]), this is in fact the key to renew the ST perspective.

Based on the first principle, the second step is to rethink the individual, social, and technological components as mutually constituting *elements* as follows:

- The individual element is conceptualized as requisite *neurobiological predispositions for action,* grounded in Kant's notion of a-priori categories. This provides a perspective of individual action as enabled by the phylogenetic evolution of the human species: "brains evolved to control the activities of bodies in the world" [26](p. 526). An important implication of this perspective is that *information* is seen as *constituted by* and *for the individual* as a precondition before deciding how to act.
- The social element is conceptualized as *activity systems,* grounded in Marx's notion of *Praxis.* This provides a perspective of the social as the "essence of human existence in terms of producing, forming, and transforming the world" [27](p. 119). Accordingly, all forms of socially organized activities are seen as different manifestations of Praxis.
- The technical element is clearly related to 'technology'. However, "definitions, uses, and understanding of technology have varied tremendously" [28](p. 1). In this paper, I adhere to Ihde [29], who maintains that "technology is necessarily concretist or 'materially' oriented insofar as the technologies operate materially at whatever level" (p. 92). Thus, the technical element is conceptualized as such materiality, which is apperceived by individuals as *relevant in the activity* system. This materiality may be tangible, such as the hardware of an IT artifact, or more ephemeral such as the acoustic wave from an utterance. Hence, the technical element provides an *individual* perspective of materiality, regardless of the essence of that materiality. Therefore, I will refer to the technical element as the *material* in the following. The philosophical grounding of this view is Ilyenkov's notion of the *Ideal,* which centers around the problem of the allegedly non-material in the natural world.

A consequence of this conceptualization is that the relations between the elements are *dialectical* in nature, implying that they get their characteristics by being part of a whole, which in turn is constituted by the elements. Thus, the RST perspective is void if any of the individual, social, and material elements are absent.

The third step is to rethink *joint action* and *communication*; both inherent aspects of any activity system. Joint or social action is understood as the "collective form of action that is constituted by the fitting together of the lines of behavior of the separate participants" [30](p. 70). Linguistic communication is also seen as form of joint action, which "embodies both individual and social processes" [31](p. 3). However, mainstream communication models do not sit well with the first principle. To this end, the *Integrational Linguistics* [32] communication model is adopted in RST.

The RST perspective is pertinent to any activity system, regardless of whether the system includes any information technology or not. In the next step, the IS field is scrutinized through the glasses of this perspective. The most profound implication is that the *information system is seen as social phenomena, comprised of individuals* and the *IT artifact.* When struggling to make the artifact relevant in an activity system, the IT artifact is metamorphosed in the minds of individuals into an IS. Thus, the IS is in the eye of the beholder. Accordingly, individual actions and activity systems are preconditions for the emergence of an IS. During this process, the IT artifact *remains an artifact,* although adapted to the needs of the activity system. Hence, the IS and the IT artifact are seen as inescapably related, however *ontologically different* phenomena, concurring with Paul's view that "Information Systems is Information Technology in Use" [33](p. 379). This means that the IT artifact is central to the discipline,

not only because Information Technology pervades virtually all fields today, but also because it is requisite for the emergence of an Information System.

The final step in the construction of RST is to illustrate its significance by recapitulating the development of a node in 3rd generation mobile system in a telecom company. The practical relevance of RST is sustained by the fact that the ideas behind it were instigated from experiences in this setting ([50], [51]).

In Figure 2, the steps in the construction of the RST perspective are illustrated:

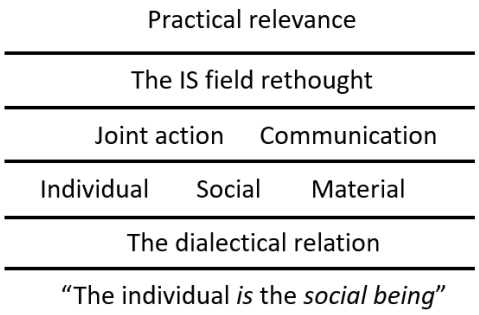

Figure 2: The construction of the renewed ST perspective

In the following, these steps of construction the RST perspective are described in detail. In conclusion, I submit that this perspective advances sociotechnical thinking into a prime axis of cohesion for the IS field; thus, contributing to unravelling the conundrums of the field, and resurrecting it into a position that no other discipline or field take.

2. The renewed ST perspective

A main implication of the first principle is that the dialectical relation between the individual and the social needs to be maintained throughout the construction of the RST. This will be done in terms of *biomechanical* and *macrosocial factors*. Biomechanical factors relate to neurobiological functions enabling the individual to act, while macrosocial factors relate to anything in the social realm, requisite for that action. So, for example, a red traffic light is a macrosocial factor in car-bound societies that triggers the driver to stop. The halting of the car is enabled by biomechanical factors such as sensing the red light, understanding what this means, and executing the action of stepping on the brake pedal.

2.1. The dialectical relation

The relation between the individual and social is usually treated in Western metaphysics as two realms, which can be demarcated and investigated as self-contained, autonomous areas. The individual is the subject area of cognitive science, neuroscience, psychology, and the like. The social is seen as an auxiliary phenomenon, often referred to as "world" or the like. Correspondingly, the social is the subject area for social sciences, organizational sciences, etc., in which the individual is often seen as a subordinate phenomenon. Hence, the relation between the individual and social is *external*, which means that the categories have nothing in common other than that they happen to be juxtaposed in a certain context.

In the dialectical view, the relation between the individual and the social is *internal*, meaning that they mutually *constitute* each other. According to Israel [27] an internal relation is characterized by the following:

- The relata in the relation form a unity or totality.
- The relata are different, i.e., each relatum can be identified as something specific.
- One relatum cannot be conceived without the other.

An example of the internal relation is Hegel's 'master' – 'slave' relation.[6] The master is defined by slave and vice versa. Although they may appear as disjoint categories, they mutually constitute each other. Without master, there is no slave. As soon as this relationship is established, they inevitably become dependent on each other for their subsistence and further development.

This understanding of a relation has profound implications for how we apprehend parts-whole relationship. Consider the following example from Levins & Lewontin [34]. A person cannot fly by flapping her arms, no matter how much she tries, nor can a group of people fly by all flapping their arms simultaneously. But people do in fact fly. This is a consequence of a long and tedious historical process where socially organized human activity has over time produced airplanes, pilots, landing strips, fuel, and all the other things necessary to fly. Although the biological constitution of humans remains unchanged, we have in fact acquired a qualitatively new property as social beings. Today, we can look down to clouds from thousands of feet above the ground, while before the twentieth century, we could see the clouds only from below. Moreover, the airplane and its parts have also acquired new properties: they can fly by being parts of the airplane. A jet engine would never get off the ground if it was not part of this totality. Thus, a dialectical world view carries with it an intrinsic way of apprehending the relationship between parts and the whole made up by these parts:

> But the ancient debate on emergence, whether indeed wholes may have properties not intrinsic to the parts, is beside the point. The fact is that the parts have properties that are characteristic of them only as they are parts of wholes; the properties come into existence in the interaction that makes the whole [34](p. 273).

Therefore, the individual, social, and material elements cannot be treated as self-contained, externally related components that happens to be co-located in certain situations. On the contrary, they constitute a dialectical totality which is destroyed in anyone of them is removed.

2.2. The individual element

The empiricists (Hume, Locke) claimed that individuals are born without built-in mental content. The mind is a *tabula rasa* – a blank slate, and hence, all knowledge comes from experience or perception. Kant questioned this view. It is plausible that direct sensations emanating from, for example, seeing animals could give rise to ideas like 'bear', 'cat' 'snake' and so on. But the concept of 'animal' cannot emanate from direct sensation, since there is no such thing out there.

Accordingly, Kant concluded that the mind must be pre-sensitized to apprehend the world according to certain forms, which Kant called *a-priori*. These forms are necessary conditions for any possible experience, enabling us to confer a certain fabric of meaning onto brute reality. In particular, Kant mentioned *space* and *time* as exigencies for our knowledge. Every sensation is experienced as located in space, i.e., above or beneath, to the right or to the left, and as antecedent, subsequent, or concomitant to other sensations. Thus, all objects of possible experience are conceived as positioned in space and time.

The notion of a-priori forms has profound implications for the relation between thought and being. Rather than seeing meaning as 'embedded in' or 'contained in' objects in the outside world, we *attribute* or *confer* signification to these. This is nicely illustrated by Harris [36](p. 68):

> I may look out for a particular tree, knowing that I have to take the first turning on the left after that tree on my usual way home. (On reaching the tree, I change down into a lower gear, move into the left-hand lane, etc.). Thus, for me the tree signifies something, has a certain semiological value. Its value as a sign arises simply - and solely - from the fact that I rely on it to integrate certain programmes of activity in my daily comings and goings.

Thus, the attribution of meaning to the tree is idiosyncratic. Harris passenger sees just a tree, if noticing it at all. Further, it doesn't matter what the essence of the tree really is: its materiality, how its biology works, its color and form, and so on. What matters is Harris' neurobiological ability to integrate his experience of the tree into the activity of travelling home. Hence, we experience the world as it appears to us – the *phenomena* – but we have no access to the profound essence of that which is attributed – the *noumena* or "thing-in-itself" (Ding an Sich). Nor is that necessary.

[6] For an extensive account of this example, see [35].

Kant was never successful in explaining the origin of a-priori forms, and why these neatly relate to experienced reality. However, "once we take into account also the phylogenetic development of the human brain through evolutionary history, it becomes clear that individuals can also know something of the world innately, prior to and independent of their own experience" [37](p. 199). The evolution has equipped us with mental faculties for acting purposely in the world. These are common for all human beings, regardless of when and where the individual saw the first light: "We all discover walking rather than hopping" [38](p. 91). Further, the a-priori forms must have evolved in such a way that these contributed to the survival of the species when encountering the external world. This world can be "sensorily perceived only inasmuch as it 'fits' these forms" [39](p. 3). The internal functional space that is made up of neurons "must somehow be homomorphic with [the external world] [40](p. 65).[7]

Thus, the notion of "a priori knowledge is not implausible at all, but fully consonant with present mainstream evolutionary thought" [37](p. 199). Accordingly, Kant's philosophy indicates that the individual relatum of the first principle is biomechanically anchored in the a-priori forms.

2.2.1. The activity modalities

Kant's a-priori forms of space and time are necessary but not sufficient for acting in the world. Neuroscientific research is unanimous that a full account of requisite predispositions includes at least the following:

- Acting entails the attention to "some-thing" – an object – necessitating an *objectivating* predisposition 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" [30](pp. 68-69).
- Focusing attention onto some-thing entails disregarding other things. This requires a *contextualizing* predisposition to project in the mind a context of relevance around the object - a "horizon of meaning" [41] or "context frame" [107].
- The spatial structure of that contextualized needs to be grasped, which necessitates a *spatializing* predisposition. Such a biomechanical factor enables us to mentally envisage "the very world that constrains and guides our behavior" [42](p. 31).
- A *temporalizing* neurobiological predisposition is requisite for anticipating the sequence of actions towards the object, leading to the fulfillment of the need that motivates the activity in the first place [43].
- The normative structure of the context, manifested as habits, rules, conventions, traditions, etc., needs to be adhered to, which requires a *habitualizing* predisposition: "People's thoughts, feelings, and predispositions for action are inherently dynamic, displaying constant change due to internal mechanisms and external forces, but over time the flow of thought and action converges on a narrow range of states — a fixed-point attractor — that provides cognitive, affective, and behavioral stability" [44](p. 351).
- When acting in a situation is effectuated, attention is re-directed to other contexts. A transition from one context to another is enabled by a *recontextualizing* predisposition, in which "the cortical system rapidly breaks functional couplings within one set of areas and establishes new couplings within another set" [45](p. 4).

Hence, the phylogenetic evolution of humankind has brought about the biomechanical factors *objectivating*, *contextualizing*, *spatializing*, *temporalizing*, *habitualizing*, and *recontextualizing* as requisite neurobiological predispositions for acting.[8] The ending '-ing' in these terms indicate an innate

[7] The word homomorphism comes from the Ancient Greek language: ὁμός (*homos*) meaning 'same' and μορφή (*morphe*) meaning 'form' or 'shape' [46].

[8] How these capacities are realized in the brain is the subject area of neuroscience. To exemplify, the place cells found in the posterior hippocampus [47], [48] and the grid cells in the entorhinal cortex [49], are involved in spatialization. A lesion in any of these cortical zones destroys the ability to navigate spatially in the environment and, consequently, to act.

propensity of doing; of exploring the surrounding environment. I will refer to these six dimensions as the *activity modalities* [50], [51] in the following.[9]

Thus, armed with this neurobiological 'infrastructure', the individual is confronted at birth with an existing social 'infrastructure' in which predispositions develop into *abilities*. This requires that the individual is able to confer a fabric of meaning onto external reality according to the activity modalities, i.e., to apperceived *objects*, *contexts*, *spaces*, *times*, *norms*, and *transitions* between contexts. In this way, abilities are *anchored* to the social reality encountered. So, for example, many Vikings doubtless had the biological propensity to become proficient astronauts, but never developed the requisite abilities since space rockets were not yet invented. Hence, action requires both the six predispositions and the anchoring of these onto corresponding macrosocial factors.[10]

In order to clarify this rather grueling argumentation, the traffic light example may provide some help. The apperception of the red light as the object of the activity, is enabled by the objectivating modality. The attribution of the meaning 'stop' onto that object is enabled by habitualizing the neural association between the red light and the action of stepping on the brake pedal. The context enabled by contextualizing includes anything relevant, such as the car, the road, the brake pedal, the speed, and so on. Spatialization enables orientation – where the traffic light is, where the cross roads are situated, where other cars are, etc. Temporalizing enables the anticipation of a sequence leading to the halting of the car: reducing speed, changing gear, and braking. After stopping at the red light, the transition to a new situation takes place, enabled by recontextualizing. So, action is a ceaseless interplay between biomechanical and macrosocial factors, the relevance of which depends on the circumstances of the situation.

2.2.2. The dynamics of action

To articulate the dynamics inherent in the first principle, we make use of the *Theory of Functional Systems* (TFS) conceived by the Russian biologist Pyotr Anokhin. The distinctive feature of TFS is its emphasis on *stability*, based on self-regulation principles as the primary characteristic of life processes [52]. In Figure 3, a simplified version of TFS is illustrated:

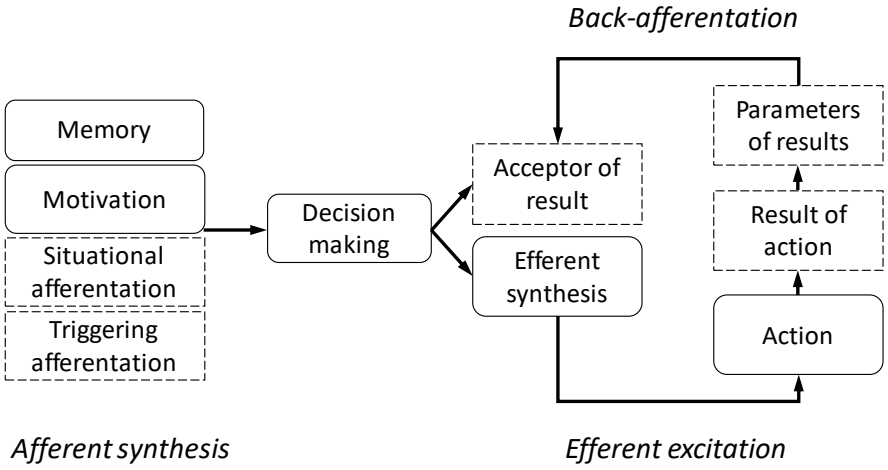

Figure 3: General architecture of an individual functional system Solid lines mark strictly internal mental functions, while dotted lines indicate functions depending on external sensations (adapted from [52]).

Action proceeds as follows. In *Afferent synthesis*, sensations from the external world (*Situational afferentation*), previous experiences retained from *memory*, and *motivation* are integrated into a coherent mental image of the situation – a Gestalt. Based on this Gestalt, a *Decision* of what to do, how to do, and when to do is taken. This involves two functions: anticipation of the expected result (*Acceptor*

[9] The term 'activity modalities' are deliberately crafted to connote the 'sensory modalities' of vision, hearing, touch, proprioception, taste, smell. Sensations from the environments received in these modalities trigger afferent nerve impulses, which the brain integrates into the activity modalities.

[10] However, these are not sufficient. Other mental functions such as emotions, motivations, trust, and more, are also needed.

of result) and the formation of an action program (*Efferent synthesis*): "if I act in this way, I assume this will result". *Triggering afferentation* sets off *Efferent excitation*, in which the action is performed. The result is evaluated against the anticipated via *Back-afferentation*. Depending on the outcome, the sequence is repeated anew or discontinued. The entire episode is then retained in memory for acting relevantly in future, similar situations.[11]

The TFS model implies that information can be conceptualized as *the Gestalt resulting from the Afferent synthesis stage*. The individual informs herself about the situation before acting. Cognitive systems "construed as dynamic systems do not process information transduced from the outside world; they reconfigure themselves in response to an ongoing stream of sensory events" [55](p. 173). Thus, "information is constituted – not just interpreted – or symbolically represented and exchanged – but actually constituted *as* information by the social (cooperatively ordered) aspects of the situated social orders in which it occurs" [53](p. 13). It follows that the locus of information is the *individual neurobiological system*, the structuring of which is requisite on apperceiving the external world *according to the activity modalities*. So conceptualized, information has been requisite for the survival of our species ever since the dawn of humankind.

Two kinds of nerves are involved in action: *afferent* one's going from the periphery of the body to the brain, and *efferent* one's going from the brain to effectors such as muscles or glands. This means that macrosocial factors may be seen as providing afferent or efferent *affordances*, depending on which stage in TFS is involved. The notion of affordances was coined by Gibson, who defined it as what the environment "*offers* the animal, what it *provides* or *furnishes*, either for good or ill… It implies the complementarity of the animal and the environment" [56](p. 129).[12]

Afferent affordances are foregrounded in Afferent synthesis and Back-afferentation stages, while efferent affordances prevail in Efferent excitation. Thus, every affordance has both an inward-directed aspect – "how can I make sense of this?" – and an outward-directed aspect – "what can I do with this?" This applies equally well for sensations emanating from things we conceive as tangible, such as a hammer, and things we tend to see as intangible, such as an utterance.

The quintessence of the of the individual element so conceptualized is that action is anchored in two ways. The first is in neurobiological predispositions conceptualized as the activity modalities. The second is the attribution according to these modalities onto corresponding macrosocial factors providing afferent and efferent affordances for action.

2.3. The social element

This thread explores "the eternal natural condition of human existence" [57](p. 998), i.e., the work without which we all would be dead. The universal elements of work, or "labor process" as Marx called it, are "(1) purposeful activity, that is work itself; (2) the object on which that work is performed; and (3) the instruments of that work" [57](p. 284). These features are all

> independent of every historical and specifically social conditioning and they remain valid for all possible forms and stages in the development of the processes of production. They are in fact immutable natural conditions of human labour [58](pp. 1021-1022).

In the first thesis on Feuerbach [59], Marx elaborates the labor process further.[13] He points out that the goal of purposeful human activity [*Gegenstand*] has either been considered as merely something in the mind or some external, concrete material object: positions which Marx referred to as 'pure idealism' and 'simple materialism' respectively. The heart of the matter is to understand object-oriented activity

[11] These stages are separated for analytical purposes. In reality, they are highly intertwined. For example, perception is guided by anticipation of action as well [54].

[12] Strictly speaking, the environment does not 'offer' anything. The animal *confers* meaning onto phenomena in the environment. If a lion sees a deer, this means 'meal' to the lion. For the deer, the perception of a lion means something quite different, such as 'run for life'.

[13] Der Hauptmangel alles bisherigen Materialismus (den Feuerbachschen mit eingerechnet) ist, daß der Gegenstand, die Wirklichkeit, Sinnlichkeit, nur unter der Form des *Objekts oder der Anschauung* gefaßt wird; nicht aber *als sinnlich menschliche Tätigkeit, Praxis*; nicht subjektiv. Daher die *tätige* Seite abstrakt im Gegensatz zu dem Materialismus vom dem Idealismus - der natürlich die wirkliche, sinnliche Tätigkeit als solche nicht kennt - entwickelt. Feuerbach will sinnliche - von den Gedankenobjekten wirklich unterschiedne Objekte: aber er faßt die menschliche Tätigkeit selbst nicht als *gegenständliche* Tätigkeit [60].

as dialectically constituting both thinking and being. The concept, capturing the very nexus of the labor process, is Praxis:[14]

> Praxis […] is the essence of human existence in terms of producing, forming, and transforming the world. At the same time, praxis as collective productive and transforming activity, makes it possible to comprehend the social world as produced and being transformed, in contrast to viewing it as given [27](p. 119).

Thus, in Praxis, the activities of human beings do not only bring about products and social reality, but also *creates the social existence of human himself*. To illustrate this, consider the famous cellist Mstislav Rostropovič giving a solo concert (Figure 4):

Figure 4: Mstislav Rostropovič (Wikimedia Commons)

The ability of Rostropovič to play the cello is preceded by a long and arduous practicing, in which his biomechanical abilities develop in interaction with macrosocial factors such as musical scores, teachers, instruments, stage performances, and so on. Over time, this may converge into a unity between the musician and his instrument, so intertwined that playing becomes virtually effortless:

> There no longer exist relations between us. Some time ago I lost my sense of the border between us…. I experience no difficulty in playing sounds…. The cello is my tool no more (Rostropovič, quoted in [62], (p. 295).

Accordingly, by being relata in a dialectical relation, new qualities of both relata come into existence – the ability of Rostropovič to play the cello, and the capacity of the cello to produce sound we experience as music.

The profound insight is that Praxis is seen as the universal form of socially organized, goal-oriented activity. No matter how these are manifested as specific cultural-historical forms, the basic constituents are always the same. Also, since action requires the actuation of the activity modalities, the universal elements of work are conceptualized accordingly. Thus, in each manifestation of Praxis, there will be phenomena, which can be apprehended as objects, contexts, spaces, times, norms, and transitions. In the following, I will refer to such manifestations of Praxis as the more convenient term "activity systems".

2.4. The material element

The conceptualization of materiality in the RST perspective departs from the observation that sense organs are "absolutely necessary for the mental development to take place at all" [63](p. 34). Everything we know must ultimately originate from the brute, physical materiality of the environment. Acting requires that the individual can attribute meaning to sensations arriving through sensory modalities. The origin of such sensations may be tangible things like stones, hammers, computers, and the like. However, what is the nature of intangible, seemingly non-material phenomena like heavenly powers

[14] It is necessary to distinguish between 'practice' and 'practices' (in German between *Praxis* and *Praktiken*) [61]. 'Practice' (*Praxis*) describes the whole of human action, while a 'practice' (*Praktik*) is a "routinized type of behaviour which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge" (pp. 249-250).

(God, Allah, Shiva, ...), value, love, hospitality, etc.? These cannot be observed, pointed at, or touched. Notwithstanding this, they come forth as a reality as solid as any tangible materiality, and allegedly detached from individual doings and beings. Yet, we know that this reality has been forged only by the actions of individuals, preceding each individual living here and now. How does this happen? This is the profound topic of Ilyenkov's philosophy of the *Ideal*.[15]

Ilyenkov's answer is that so called 'non-material' phenomena are indeed material; otherwise, we could not talk about them, write novels about them, imagine them, building temples to worship them, and so on. As long as these remain phantoms of a single mind, they have no impact on society. However, in activity systems, their materiality takes on a particular form; they are *idealized* into a social reality. Bertram Russel provided a vivid example of this process:

> If I were to suggest that between the Earth and Mars there is a China teapot revolving about the sun in an elliptical orbit, nobody would be able to disprove my assertion provided I were careful to add that the teapot is too small to be revealed even by our most powerful telescopes. But if I were to go on to say that, since my assertion cannot be disproved, it is intolerable presumption on the part of human reason to doubt it, I should rightly be thought to be talking nonsense. If, however, the existence of such a teapot were affirmed in ancient books, taught as the sacred truth every Sunday, and instilled into the minds of children at school, hesitation to believe in its existence would become a mark of eccentricity and entitle the doubter to the attentions of the psychiatrist in an enlightened age or of the Inquisitor in an earlier time [93]

To illustrate the idealization process, we may use the activity of celestial navigating (Figure 5):

Figure 5: Celestial Navigation (Image by Angela Yuriko Smith from Pixabay)

Celestial navigation dates back at least 4000 years, and presumably it started with someone noticing that a certain star seemed to be fixed on the night sky, in contrast to other stars (Figure 6):

[15] The concept of the 'ideal' has a long philosophical legacy, mostly related to mental concepts like consciousness, thought, creativity, mind, soul, spirit, etc. The core of Ilyenkov's philosophy is that ideal forms of matter only develop in activity systems.

Figure 6: The North Star, a.k.a. Polaris (courtesy: Ken Christison, Conway, North Carolina, USA)

Somehow, the idea was born that this particular star could be useful in navigation. Sailors discussed pros and cons of using it, and eventually tried it out. Gradually, the star became a crucial element in maritime navigation, and given different names: Polaris (پولاریس; पोलरिस; полярная звезда; 北极星; …). Although each sailor interpreted the star differently – some may have had a blurred vision, being drunk, not very interested in the discussion, and so on, the star turned into a social reality, confronting each new sailor as a given fact for a limited historical period.

Outside navigation, however, Polaris was irrelevant. Also, the star did not change during this process. It just kept on shining, and the sailors had no idea about the essence of its physical nature. Nor did it matter. The only thing that counted was that sailors could observe it, and that it remained fixed on the night sky.

In this way, the materiality of a shining dot on the night sky emerged as an idealized form; as a social reality that was integrated together with the materiality of the mast, the sails, rudder, navigation-specific terms, and countless other things, into the accomplishment of the activity system.

Thus, the ideal exists only in the minds of individuals, but is inexorably linked to the activity system. If this system is destroyed, or the individuals disappear, there is no ideal. Hence, the ideal is simultaneously idiosyncratic and yet profoundly social, a "unity in diversity". In this way, Ilyenkov "offers the deepest of foundations for the analysis of activity systems" [64](p. 839).

2.5. Joint action

Joint action can be defined as "the larger collective form of action constituted by the fitting together of the lines of behavior of the separate participants. ... Joint actions range from a simple collaboration of two individuals to a complex alignment of the acts of huge organizations or institutions" [30](p. 70). To understand joint action, it is necessary to distinguish between two types of individual actions. When a pianist gives a recital, she performs an *autonomous* act [31]. There is no other musician involved. When the same pianist plays in a piano trio, she also preforms an individual act, but now together with other musicians. Such individual acts, performed only as parts of joint actions, are called *participatory* [31]. Macrosocial factors are requisite for both types of actions. However, in joint actions, these factors become *common identifiers*, which supply "each participant with decisive guidance in directing his own act so as to fit into acts of the others" [30](p. 71). Thus, participatory actions are uniquely individual, but they may be sufficiently aligned to contribute to a common goal.

Whatever mental capacities for survival in the world that the evolution has brought about, these are of course retained in both autonomous and participatory actions. We are not transmuted into some new species just because we act together. Since we have conceived of action as requisite on the totality of activity modalities, it follows that common identifiers also need to adhere to these. Thus, joint action requires identifiers that can be apperceived by individuals as the object of the activity system, its context, its spatial and temporal structure, its norms, and its transitions to other activity systems. The nub of this observation is above all practical. A well-functioning activity system, for example a project,

should be designed so that its common identifiers adhere to the activity modalities. This is the key to efficiently fit individual lines of action together into joint action.

2.6. Language and communication

Language and communication are undoubtedly inherent elements in the ST perspective. The mainstream communication model is that of *transmission of messages* between senders and receivers. The essence of this model is that "mental content (conceived variously as concepts, ideas, symbolic representations, etc.) is neatly conveyed intact from the mind of one party to the other" [65](p. 176). However, such a model is incompatible with the RST, since mental content in this perspective is inescapably contained inside the skull of individual.

An alternative communication model, compatible with the RST, is *Integrational Linguistics*, which was insitigated by Roy Harris ([66]; [32]; [67]).[16] Integrational Linguistics is a radical departure from traditional assumptions about language and communication in that

- it abandons the idea of communication as a "sender-receiver" process,
- it rejects code-based and rule-based models of language,
- it questions the existence of any natural or universal distinction between language and non-language.

Communication is seen as an open-ended continuum of integrated activities, shaped by the initiative of individuals. This means that

- there is continuous and simultaneous creation of meaning,
- all signs are products of the communicational situation,
- there are no autonomous, context-free signs,
- signs are created by individuals.

From an integrationist perspective, the "primary function of the sign is to integrate an individual's past, present and (anticipated) future experience. That is an essential prerequisite for making sense of any situation in which we are involved. Without it, there can be no question of communication" [67].

Integrational Linguistics concurs with the RST in several ways. Concerning temporalizing and contextualizing, Integrational Linguistics states that "There are no timeless signs" [32](p. 97). The "act of contextualization and the identification of the sign as sign are one and the same. We contextualize as a condition of integrating new signs into the temporal dimension of experience" [68](p. 103). Further, the tenet that there is no universal distinction between language and non-language, implies that language can be seen as "complementary to more basic forms of neural processing" [70](p. 372). Thus, language is an

> extension of the physical environment generally, and one that we may perceive (by language comprehension) and act upon (by language production), just as we do with any physical environment [71](p. 363).

Hence, language is seen as having both afferent and efferent affordances (comprehension and production respectively), like any other affordance. In essence, communication is conceived as coordination dynamics "in which words and structured linguistic encodings act to stabilize and discipline (or 'anchor') intrinsically fluid and context-sensitive modes of thought and reason" [70](p. 372).

2.7. Summing up

The different ST perspectives are illustrated in Figure 7:

[16] For an extensive overview of Harris' works, see [69].

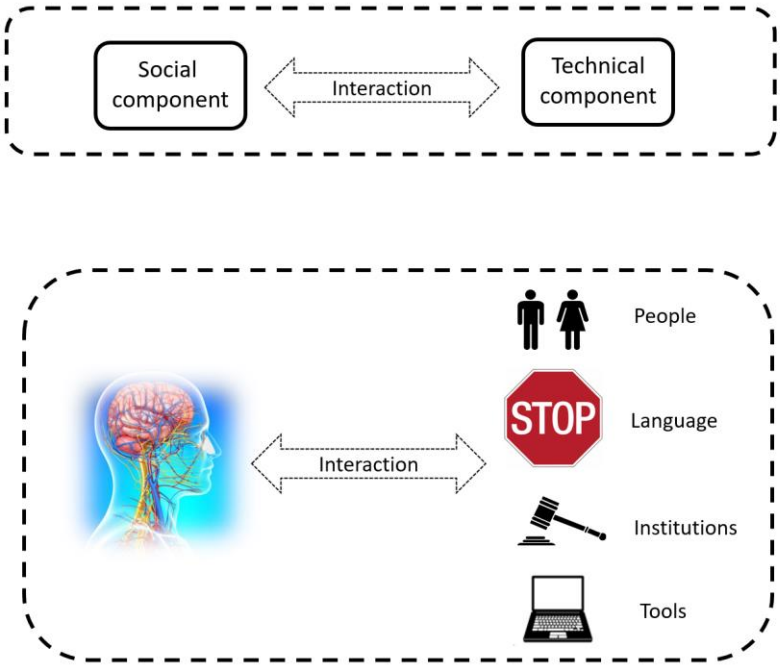

Figure 7: Above – the traditional perspective of a work system. Below – the RST perspective.

In the RST perspective, the two interacting components in a work system are replaced by individual, social and material elements of an activity system. The evolution has equipped human beings with the biologically requisite means for the survival of the species. But these means are actuated only in Praxis; in activity systems where they take on specific forms. In this system, the thinking and action of individuals are forged into a social reality; the materiality of which paradoxically come forth as objectively existing, independent of any individual. However, this reality is not fixed. Although our neurobiological constitution has remained unchanged for eons, the social and material elements of the activity system are always in flux, perhaps now more frequent than ever with the revolution in information technology.

3. The IS field reconceptualized

The RST perspective outlined above is pertinent to any activity system. This section focuses on implications for IT-enabled activity systems. An obvious observation is that these are in principle not different from any other form of Praxis. What differs is the digital technology employed: computer-based IT artifacts, mobile cell phones, radio technology, optical fiber networks, the internet, and more. This 'digital transformation' [108] instigates new forms of organizations, business models, power structures, etc., and is often apprehended as a qualitatively new ontological phenomenon (e.g., [109]). What remains unchanged though, is the human neurobiological constitution; the individual infrastructure.

In the following, I outline how the central IS phenomena of information, the IT artifact, the information system, the social, and materiality may be rethought from the RST perspective.

3.1. Information

No term is more fundamental and vital to IS than information: "Information forms most of the significant compound labels in IS – information technology, information processing, information management, information sharing, information acquisition, and IS" [23](p. 355). Boell [74] has made an extensive compilation of extant conceptualizations of information in the IS literature, and found four different views:

- The *physical* stance asserts that information "is a fundamental property of the material world" (ibid., p. 5), existing independently of human observers.

- The *objective* stance sees information as contained in sign-vehicles "that exists independently, outside of humans" (ibid., p. 7).
- The *subjective* stance regards information as "something that is appropriated by a subject" (ibid., p. 7), thus informing the individual by conveying some "information substance", as it were, from the environment into the individual.
- The *sociocultural* stance affirms that "information is specified by a social context determining what is regarded as information" (ibid., p. 9).

The physical, objective, and subjective stances are all incompatible the RST view for different reasons. Information is constituted by the individual and not something existing in the external world. Signs do not 'contain' information – "signs, and hence knowledge, arise from creative attempts to integrate the various activities of which human beings are capable" [36](p. 162). There is no 'information' contained in the external stream of sensory events. The sociocultural stance fails to see the role of the individual in the constitution of information.

The RST perspective on information concurs with Watson [11] in that a foundation for information system "must begin by thinking about how people have used information for tens of thousands of years—not with how people use machines today to process information" (p. 517). Further, information cannot be explored as an isolated phenomenon. The constitution of information requires external sensations, originating from physical materiality in activity systems. Thus, the social and material elements need to be included as well.

3.2. The IT artifact

The core subject matter of the IS field is the IT artifact [75]. This is a computer-based system, relying on technology such as software running on some hardware, and intentionally designed to be informative: "This is actually the *most important trait* and what distinguishes it from many other types of technical artefacts" [76] (p. 93). Someone using IT artifacts should be informed about the state of things in the world in order to act relevantly. This means that IT artifacts should be designed to render *afferent* affordances signifying objects, contexts, spaces, times, norms, and transitions.

However, most IT artifacts also render *efferent* affordances. You can do something with the artifact besides monitoring it; sending commands, starting a conversation, modifying it, and so on. This means that a 'pure' informative IT artifact is an extreme case. Likewise, artifacts that render mainly efferent affordances, such a hammer or a shotgun, also render informative, afferent affordances in the sense that someone using it must recognize what it is and how to use it: "A tool is also a mode of language. For it says something, to those who understand it, about the operations of use and their consequences" [77](p. 52). Accordingly, there is no sharp borderline between IT artifacts and other types of artifacts, only a qualitative difference.

3.3. The Information System

When an IT artifact is introduced in an activity system, it becomes an object of attention. At first, the artifact is what Heidegger calls *present-at-hand* [78]. The meaning of the artifact, and what can be done with it, is unclear. By repeated engagement with the artifact, it may turn into *ready-at-hand*, fluently employed in order to achieve the task at hand. This process changes the neurobiological organization of the individual:

> [External] aids or historically formed devices are *essential elements in the establishment of functional connections between individual parts of the brain*, and that by their aid, areas of the brain which previously were independent become the *components of a single functional system* [79](p. 31).

From the IS point of view, we may understand this process as the formation of an *autonomous* 'information system', comprised of the *individual's neurobiological structure* and *the IT artifact*. Thus, each individual cognizes the artifact in her own way, even though they attend the same artifact. In activity systems, these autonomous information systems become *participatory* since individuals act jointly. In repeated interactions with the IT artifact, and in communication with other individuals,

autonomous interpretations of the artifact gradually converge into a new social reality – an *Information System.* Just as the Polaris star became a social reality in navigation, the IT artifact is gradually metamorphosed into a social reality. In Ilyenkov's words: the IS has become an *idealized* form of the IT artifact; a process that can only take place in activity systems.

During idealization, the IT artifact is modified according to the needs of the activity system by, for example, changes in the application software or the setting of application parameters. Such modifications of the IT artifact are inevitable since activity systems are always different. However, the artifact will *maintain its ontological status as an artifact.* It is not transmuted into a different kind of phenomenon just because it emerges as an IS in the minds of individuals. This mental change cannot be observed from the outside, making it is impossible to grasp the 'IS status' of the IT artifact merely by inspecting it. This can only be assessed by investigating the idealization history of artifact. Accordingly, we "do not need to put humans inside the boundary of the IT artifact in order to make these artifacts social" [76](pp. 93-94). Its sociality lies in it being idealized in the activity system.

So conceived, the IS will always be an intangible, ephemeral, open-ended, and continuously changing phenomenon. The most far-reaching implication is that the individual is an inescapable element for theorizing the IS. Without the individual, there is simply no such thing as the IS. Hence, the IS and the IT artifact are understood as inexorably related but *ontologically different* phenomena.

3.4. The Social

Several forms of Praxis have been proposed in the IS field. Schatzki et al. [80] sees 'practice' as the primary generic social thing, understood as "embodied, materially mediated arrays of human activity centrally organized around shared practical understanding" (p. 2). Other examples are "communities of practice" [82], 'workpractice' [83], or simply 'community' [84].

Alter proposes 'work system', by which is meant "a system in which human participants and/or machines perform work using information, technology, and other resources to produce products and/or services for internal or external customers" [81](p. 368). This view recognizes the insight that activity systems are basic for rethinking core IS concepts. However, the conception that all "work systems use or create information" [85](p. 80) is at odds with RST.

The Activity Theory (AT) form of Praxis, as developed by Engeström [96], has a similar genesis as the RST perspective. A thorough comparison is outside the scope of this contribution. A main difference, however, is that the acting subject in AT is usually identified with an individual or a group (e.g., [97]). Thus, AT has a similar tendency to downplay the individual as in the main IS discourse. In addition, there are still many unsolved problems of activity theory, among them the relation of collective and individual activity ([97], p.7), which have been thoroughly treated in this contribution.

From the RST perspective, all these social organizations are seen as various forms of activity systems. Each one takes a different but limited perspective in the sense that the individual is not a *constituent* in the activity system. Thus, the extant conceptualizations may be further advanced with the RST perspective as a point of departure.

3.5. Materiality

The proliferation of sociomaterial theorizing in the IS field has brought the issue of materiality to the fore. However, as Leonardi et al. [8] has pointed out: "the term 'materiality,' and other related terms …, such as 'material,' 'material property,' 'material consequence,' 'materialize,' 'materialism,' 'sociomaterial,' and 'sociomateriality,' are neither well defined nor consistently used" (p. 5).

This confused state of play is further aggravated by the recent IS discourse over the 'non-material' in relation digitalized technology. For example, Faulkner & Runde maintain that non-material objects "possess a nonphysical mode of being" [86](p. 806). Examples of such objects are "research articles, sales reports, employment contracts, product designs, musical compositions, and bitstrings such as computer files" (ibid.). They propose a theory of 'digital' objects, based on strict separation between material and non-material objects. In particular, "one type of syntactic object stands out as fundamental. This is the *bitstring*, a type of syntactic object made up of bits, the 0s and 1s employed in a binary numbering system" [87](p. 1285).

However, as can be easily seen, all the examples given do indeed possess materiality in the sense that we can apperceive them and talk about them. According to Ilyenkov, such putatively 'non-material' objects are ideal forms of material objects, and such forms cannot be abstracted from the activity systems in which they emerge. The material anchoring of the ideal implies that there is in essence nothing we can sensibly refer to as 'non-material', which, if taken literally, would be inaccessible to our minds; they simply would not exist for us. Hence, we need to rethink this very concept along the lines Ilyenkov proposes.

4. Practical relevance

This section illustrates the practical relevance of the RST perspective by describing the idealization of an IT artifact into an IS at Ericsson™, a main provider of telecommunication systems worldwide. The purpose of this endeavor was to support the development of the 3rd generation of mobile systems, which was a huge undertaking in the late 1990s (illustrated in Figure 8:

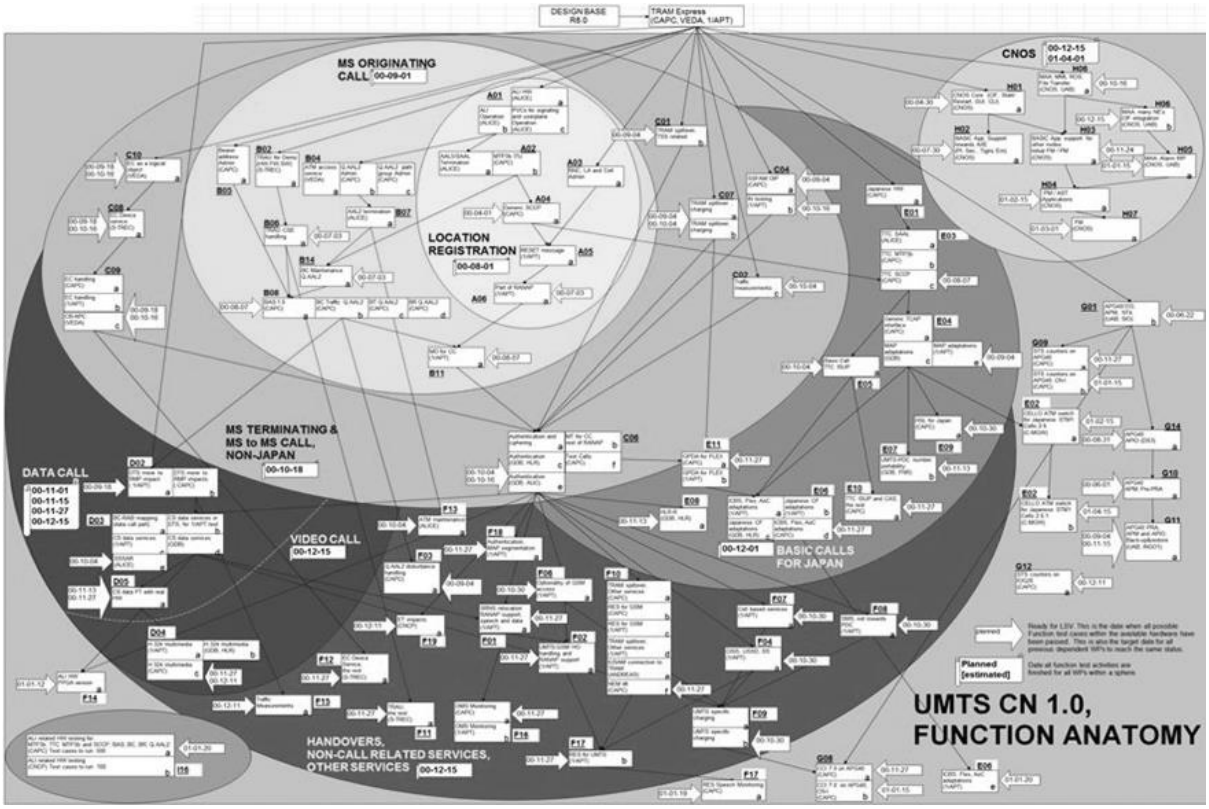

Figure 8: The development of the 3rd generation of mobile systems (courtesy Ericsson™)

The image, which should be read from top to bottom, is called an "integration plan". It is used to coordinate development tasks (square white boxes) that each develops a specific functionality in the system. The thin lines mark dependencies between tasks, indicating which tasks must be ready in order for other tasks to function properly. Thick arrows show the datum for integration and verification of the tasks. The ovals signify basic services like registering the location of the mobile, calling the mobile, answering a mobile call, etc. The main project involved several thousand persons working at development sites all over the world.

One subproject named Beamon, (reported in [50], [51]), developed a specific part of the mobile system. In order to coordinate the development, an advanced IT artifact by the name of Matrix was acquired. The architecture of Matrix is illustrated in Figure 9:

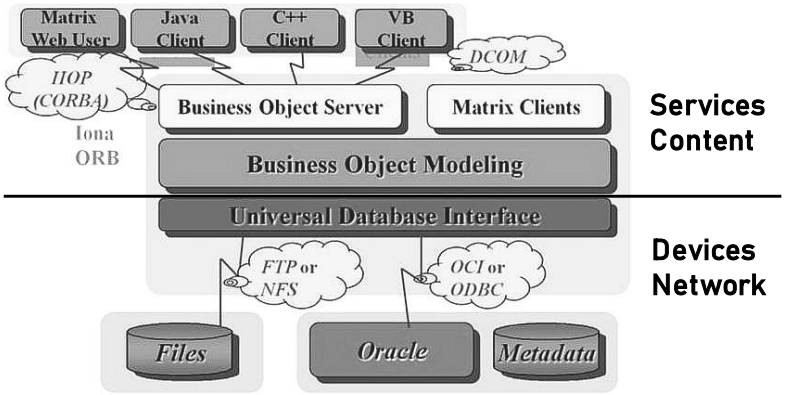

Figure 9: The layered modular architecture of the Matrix IT system. The Devices Network layer provides a general-purpose platform, which can be adapted to organizational needs using the Service Content functionality. With permission from Technia™

When Matrix was introduced, it was just a technical artifact, irrespective of any specific activity system. The first step in making Matrix useful in Beamon was to figure out which phenomena were relevant for managing the development, and how Matrix could keep track of these. This job was assigned to a small task group, including this author, a requirement manager, a configuration manager, and a consultant, acquainted with Matrix. We started by drawing a so-called Entity-relationship model (Chen [91]), exemplified in Figure 10:

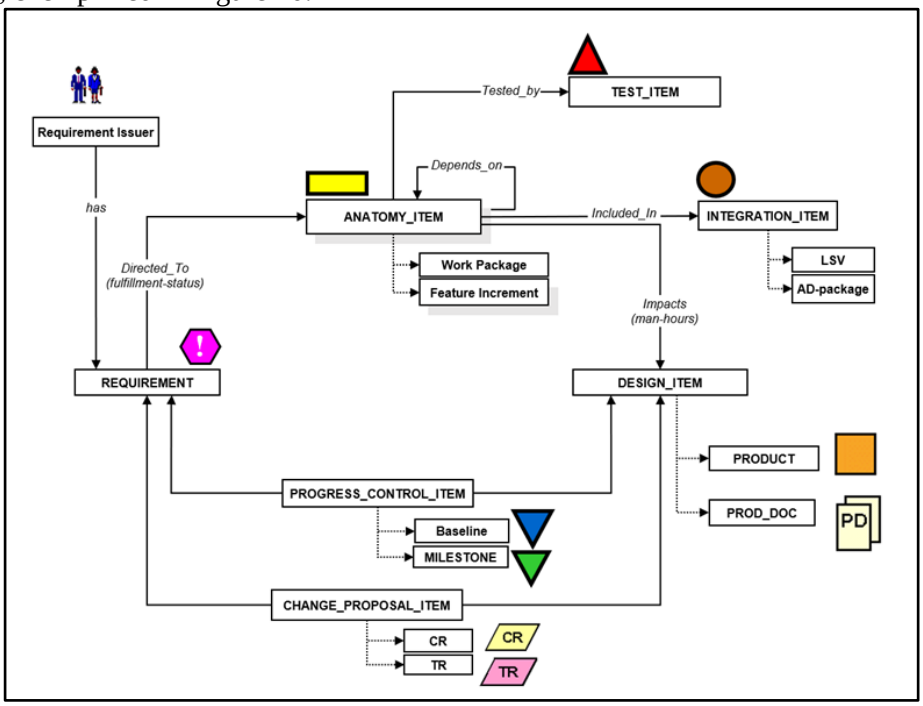

Figure 10: An information model in Beamon (courtesy Ericsson™)

Such models are usually called "information models" in practice, since the entities are conceived as providing information about what they 'represent' in the 'real' world.[17] Each member of the task group had their own ideas of which phenomena were relevant in the context of Beamon, how these were related to each other, and how to describe them. This was subject of many heated and distressing discussions in the group. On a high level, there was ample agreement ("we all know what a requirement is!") but when detailing the model, it was impossible to reach closure. An illustration of the complexity is shown in Figure 11, which is a zoomed in area of left upper corner in Figure 10:

[17] This conceptualization is clearly at odds with the understanding of information as constituted by and for the individual, as proposed by the RST perspective.

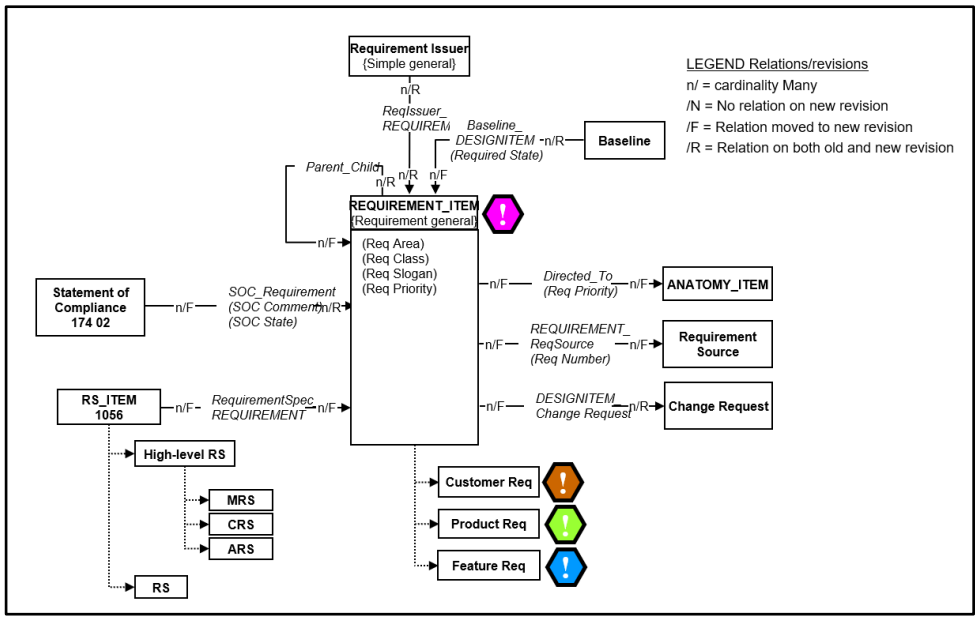

Figure 11: The detailed information model (courtesy Ericsson™)

The import of this process is that individual minds in the task group slowly were synchronized around the common identifier constituted by the information model. In doing so, the model gradually became relevant in the activity system. In the words of Ilyenkov, the model acquired an *idealized* form. Outside the Beamon activity system, it is just an illustration on paper (or a computer screen), irrelevant for other individuals.[18]

The idealization process was further advanced by implementing the model in Matrix and trying this out: did it contribute to the purpose of Beamon or not? If it didn't, changes were made, sometimes in the model, and sometimes only in Matrix, and tried out anew. A screen dump of the model implemented in Matrix is shown in Figure 12:

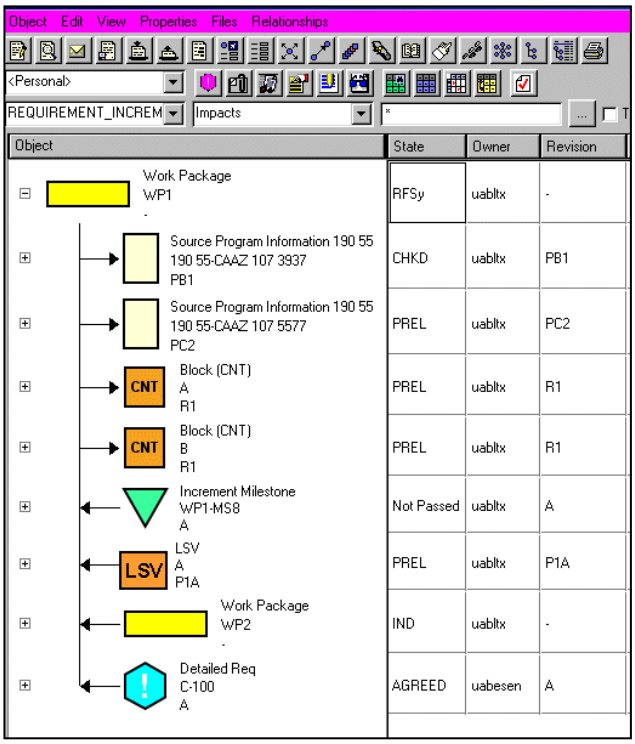

Figure 12: The information model implemented in Matrix (courtesy Ericsson™)

[18] Other employees at Ericsson may of course recognise some entities in the model, but outside the activity system, it loses its functional existence as an integrated element in the system.

This means that Matrix also acquired an ideal form in Beamon – the IT artifact gradually became an IS for the project participants. This idealization process progressed over almost a decade as illustrated illustrated in Figure 13:[19]

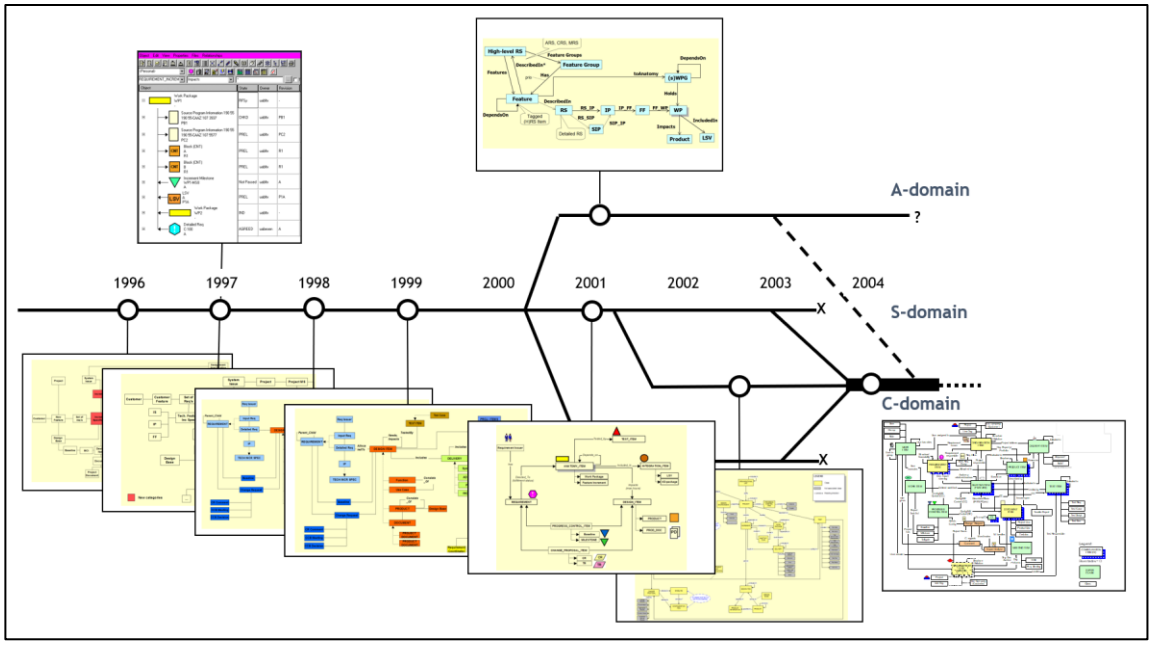

Figure 13: Evolution of the information model and Matrix. The A, S, and C domains are units at Ericsson, where separate Matrix servers were established (courtesy Ericsson™).

The gist of this example is to show that the idealization process emerges as a result of the dialectical interaction between individual minds and material phenomena (the model, Matrix, the utterances in in the discussions, etc.) in activity systems. This fundamental process is usually not given much consideration in practice, although it may in fact be a major reason what projects fail. One reason for this may be that what happens inside the skulls of individual participants cannot be observed. What is not seen, is not attended.

5. Discussion

Suspicions have been raised in the IS community that the received ST perspective lacks something essential:

> Our socio-technical roots would warn that attempts to reduce IS to its organizational subsystems and its technology subsystems will invariably yield an incomplete and incorrect understanding of the holistic system. Perhaps this irreducibility suggests our past fundamental systems analysis of IS in general has not been ideal. Here again is an important opportunity to rethink our assumption ground [92](p. 350)

I submit that the prevalent sociotechnical idea of *interaction* between a social and technical subsystem [94] is a category mistake. Interaction implies action, and neither the social, nor the technical are agential categories. However, individuals do act. A rethinking of the assumption ground of the ST perspective needs to depart from the insight that the individual cannot be subdued under or equated with the social. By unleashing the individual from the social, the fundamental interaction is repositioned to the individual-social, in contrast to the social-technical dualism that have permeated ST thinking from its inception. This clears the way for constructing a renewed ST perspective grounded in the philosophical first principle "the individual *is* the *social being*" without obliviating the technical/material element.

The adaption of such a renewed ST perspective as an axis of cohesion for the IS field, entails profound implications for the IS discipline. First, central IS elements such as information, the IT artifact, the social, the material, joint action, and communication are reconceptualized. In particular, this

[19] A detailed account of this endeavor is given in [50].

concerns the information system, which is given a new, alternative conceptualization as the idealized IT artifact. This in turn means that the IS and the IT artifact are ontologically different, although inexorably related, phenomena that cannot be treated as interchangeable (e.g., "the IS/IT artifact is also central to systems development research" [95], p. 14).

Second, these elements must be investigated as a holistic system, where each element acquires its characteristic properties as parts of the whole. The properties come into existence in the interaction that makes the whole. The constitution of information requires the ability to confer relevant meaning onto material phenomena in the environment. ISs emerge from idealization of IT artifacts in activity systems. Activity systems develop only from individual actions, and individuals only from acting in activity systems. Etc. Investigating these elements in isolation will at best provide an incomplete understanding and at worst an erroneous one.

Third, the renewed ST perspective offers an opportunity to disambiguate deep-rooted conundrums troubling the IS discipline, such as 'meaning', 'non-materiality', 'sharedness of mental content', and more. All these are given alternative interpretations by introducing the individual element in ST theorizing. 'Meaning' is individual and not located somewhere in the environment. The 'non-material' is indeed material and acquires its functional relevance in activity systems. Mental content cannot be 'shared'. Etc.

Fourth, the renewed ST perspective opens up for a revitalized discussion about the identity of the IS discipline. In searching for the intellectual core of the discipline, Sidorova et al. [88] found five main research areas: (1) information technology and organizations; (2) IS development; (3) IT and individuals; (4) IT and markets; and (5) IT and groups. The analysis "demonstrates that the information systems academic discipline has maintained a relatively stable research identity that focuses on how IT systems are developed and how individuals, groups, organizations, and markets interact with IT" (p. 467).

These results indicate that the IS discipline can be seen as trans-disciplinary in the sense that it investigates the impact of IT in other discipline's study areas (c.f. Galliers, [89]): "What happens when a new kind of technology appear above the horizon – IT?" Thus, the IS discipline may contribute to advancing research in IT impacted disciplines (which today encompasses virtually all). Conversely, such disciplines may bestow the IS discipline with insights, advancing it in areas such as HCI (Human Computer Interaction), design science, AI, and more. For example, the recently established IS subdiscipline of NeuroIS "examines topics lying at the intersection of IS research and neurophysiology and the brain sciences" (NeuroIS, [90]). Some examples of research questions in this context may be: "How should a human-computer interface be designed in order to comply with our neurobiological predispositions for acting?"; "Which properties should IT-related models have for alleviating the idealization process?" Etc.

Finally, the discipline's unique, identifying question may be reformulated as *how can information technology be effectively metamorphosed into information systems in IT-reliant activity systems?* Hence, the IT artifact is central to the discipline, not only because IT pervades virtually all fields today, but also because it is requisite for the inception of an information system.

Such a position towards the RST perspective has been advocated by several IS scholars (e.g., Mingers [99]; Beynon-Davies [100]; Mingers & Willcocks [101]; Ramiller [102]; Mingers & Willcocks [103]; McKinney & Joos [23]). These scholars are in turn inspired by the works of Merleau-Ponty [104] and Maturana and Varela [105]. The gist of this line of thinking is that the

> body is a nexus for the interaction of both the individual and society, and action and cognition, and is, therefore, of *central importance* both for developing more effective information-based systems, and for observing the effects of such systems on people and society ([99], p. 124, emphasis added).

6. Conclusion

In focusing of the 'social' as in 'sociomateriality' and 'sociotechnical', the individual has been demoted to the background in the IS discourse. As a consequence, a fundamental dimension of human experience has been marginalized. This has driven the IS discipline into its current confused state of how to construe its foundational assumptions.

The main contribution of this paper is to bring back the individual to the front stage, on par with the social and material. The point of departure from the quasi-stable, biological predispositions for individual action in the world, opens up for new ways to theorize extant IS phenomena, and make these relevant in practice. The dialectics inherent in the first principle "the individual is the social being" precludes such theorizing to drift into the cul-de-sacs of methodological individualism or collectivism [106].

By using the renewed sociotechnical perspective as 'an axis of cohesion' for the IS field, many of the conundrums plaguing the field can be resolved. In conclusion, the renewed sociotechnical perspective enables the discipline to weigh anchor from its current harbors and advancing it into a position that no other discipline takes. Needless to say, this is only the outset of a long and hopefully rewarding endeavor, which have to be further enlightened by future research.

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8. References

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