



## **Activity Modalities – A Multi-dimensional Perspective on Coordination, Business Processes and Communication**

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### **Abstract**

The purpose of this paper is to analyse and reconstruct espoused conceptions of coordination, business processes and communication using the Activity Domain Theory as a guiding framework. The point of departure is shared or communal meaning. Meaning is seen as the link between the individual mind and the social reality in which the individual is immersed. The construction of communal meaning and social reality takes place in *activity domains* and proceeds along certain dimensions called *activity modalities*. Coordination is seen as an activity within the activity domain, which provides coordination of transformational activities in the same domain. Business processes are apprehended as manifestations the activity modality temporalisation. Communication has two principle functions: enabling communal meaning and coordinating transformational activities. From these results, we argue that the Activity Domain Theory provides a socio-technical integrative perspective on coordination, business processes and communication that can be applied both analytically and constructively.

**Keywords:** communal meaning, the Activity Domain Theory, coordination, business process, communication.

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## **1 Introduction**

The need for considering social issues in addition to technical ones is by now fully recognized in focus areas such as coordination, business process reengineering (BPR), knowledge management (KM), organisational learning, information system development (ISD), etc. Theories aiming at informing analytical and constructive endeavours in these areas need to include uniquely human aspects such as, for example, knowledge, action and meaning. Examples of such theories are Activity Theory (e.g. Engeström, 1999), Actor Network Theory (e.g. Latour, 1991), Structuration Theory (Giddens, 1984), Organisational Semiotics (Stamper, 2001) and Language Action Theory (e.g. Winograd & Flores, 1986).

Valuable results have been achieved in analysing information system (IS) practices using these theories as guiding frameworks. However, substantially fewer results

have been reported concerning their potential to influence practice (Bertelsen, 2001; Iivari & Lyytinen, 1998). This is particularly valid for complex organisational settings such as global engineering companies developing telecommunication systems, cars, airframes and the like. In such settings, engineering methods like Rational Unified Process (RUP), Rapid Application Development (RAD), etc., are used to inform practice. However, these methods are in general focused on technical issues, leaving human and social aspects more or less unattended. Thus, we have on the one hand mature, socially oriented theories informing analytical efforts, and, on the other hand, mature, technically oriented engineering methods informing constructive efforts.

The application of socio-technical theories are complicated by the fact that most of these theories were originally developed in subject areas different from those in which they are applied. For example, the original subject matter of Activity Theory was psychology and the development of individual human mind (Engeström, 2001). The appropriation of a theory implies a delicate translation of key concepts as well as an elaboration or adaptation of the original theory. Therefore, the internal consistency of the original theory may be jeopardized, and already complex theories might well become even more difficult to comprehend and master.

It is possible to conceive of alternative approaches where technically oriented engineering methods are extended and grounded theoretically in existing socially oriented theories. This would preserve the constructive capability of the method while considering social aspect. However, no results from such an approach are, to the best of our knowledge, reported in the literature.

Consequently, there is a need for integrative, socio-technical theoretical approaches that can be applied both analytically and constructively in complex settings. For the purpose of informing coordination, Taxén has proposed the Activity Domain Theory (ADT: Taxén, 2003; 2004; 2005c). The target of this theory is the coordination of complex development tasks aiming at providing products or services to customers and clients. The ADT emerged from a close interaction between observations, reflections and interventions in the development practice of Ericsson, a leading supplier of telecommunication systems worldwide.

The nexus of ADT is the issue of meaning or, more specifically, shared or communal meaning. Communal meaning is necessary to perform coordinated actions. Meaning provides a link between the individual mind and the technical and social context. The gist of the theory is a conjectural congruence between the structure of communal meaning and the structure of object-related activity as manifested in artefacts, symbols, institutions, ideologies, etc. In other words, we suppose that the way our mind is ontogenetically constituted is reflected in the social reality constructed, which in turn is reflected back into the construction of individual minds.

The purpose of this paper is to analyse and reconstruct espoused conceptions of coordination, business processes and communication using ADT as a guiding framework. In addition, we will discuss IS/IT, information structures and other elements related to coordination. The motivation for this venture is that these areas are often treated as distinct fields of inquiry. However, neglecting their interdependencies may cause severe misalignment in organisational development programs. Our intention is to provide a common, integrating perspective, which may provide new insights into how coordination, business processes and communication are interdependent. In addition, we discuss operationalization, that is, how theoretical constructs can be trans-

formed into elements that can be manipulated, measured or observed in practice in order to influence it.

The paper is organized as follows. In the following section, we provide a background and an elaborated motivation for the paper. Next, we discuss some aspects of meaning that have influenced the development of ADT. This is followed by a presentation of the main features of ADT, including its operationalisation. The central construct in ADT is the *activity domain*, which can be conceived of as a workpractice (Goldkuhl & Röstlinger, 2003; 2005) where coordination is emphasized. The process, in which the activity domain develops over time, is assumed to proceed along certain, dialectically interrelated dimensions called *activity modalities*. For example, a business process model in a certain organisation is seen as a manifestation of the activity modality *temporalisation*. Other modalities discussed in this section are *spatialisation*, *stabilisation*, *contextualisation* and *transition*. We suggest that the propensity of humans to coordinate actions along these modalities has ultimately evolved during the phylogenetic evolution of the human race.

In the following section, we present arguments for the empirical, theoretical and internal grounding of ADT. Next, we compare ADT to related works in the literature. This is followed by a discussion of what implications the ADT perspective has on espoused conceptualisations of coordination, business processes and communication. We also discuss some consequences for ISD. Benefits, drawback and pitfalls of the approach are examined as well as areas for further research. In the concluding section, the contributions of the paper are presented. The main results are:

- The activity domain is apprehended as having two foci: one where coordination is in focus and one where transformation of work objects are in focus. Coordination is conceived of as an activity that provides coordination to another activity – that of transforming prerequisites into results. The coordination and transforming perspectives of the activity domain are dialectically interrelated in the sense that the same work object is utilised in both activities, however differently apprehended depending on the perspective.
- Intra and inter-organisational business processes can be analysed in the same manner due to the recursive nature of the activity domain construct.
- Information systems are considered as key enablers of coordinating actions according to the activity modalities. ISD should be understood as one element in a larger context – the construction of the activity domain. This construction comprises the construction of communal meaning about the structure of the activity domain.
- The theory has been operationalized in the coordination of exceptionally demanding development tasks in the telecommunication industry.

In conclusion we claim that the Activity Domain Theory provides a socio-technical integrative perspective on coordination, business processes and communication that can be applied both analytically and constructively.

## 2 Background and Motivation

In this section, we give a background to our research and elaborate on the motivation for it. A suitable point of departure is provided by Goldkuhl (2002), who emphasizes the importance of linguistic determinations of terms. In daily “language games”, we do not have to reflect on the meaning of terms as long as their usage results in intended consequences. However, in scientific contexts we need to be more precise. Scientific conceptualisation is language use and we need to be aware of how we define our concepts:

“It is important to see that we use appropriate language forms when we label our concepts. We must be aware that an attribute, even if we use a substantive form, is a property and this means that it is a quality of something and not a separate entity in itself.” (Goldkuhl, 2002, p. 9).

Thus, a motivation of our research is to articulate the terms coordination, business process, information technology and communal meaning in such a way that this articulation can be made operational.

### 2.1 Coordination

Mintzberg sees coordination as a direct consequence of the necessity to divide the labor in an organisation into various tasks. He suggests five coordination mechanisms: mutual adjustment by informal communication, direct supervision, standardisation of work processes, standardisation of the output of the organisation, and standardisation of skills needed to perform a certain task (Mintzberg, 1983).

Although coordination is easily recognized when it breaks down, it appears that there is no commonly accepted way of defining coordination. In the literature, several definitions of coordination can be found. For example, Larsson (1990) lists nineteen definitions and Malone & Crowston (1994) report on eleven definitions. Malone & Crowston also emphasize that the study of coordination must draw on a variety of disciplines including organisation theory, management science, computer science, economics, linguistics and psychology (ibid, p. 88). They suggest that coordination should be defined as the management of “dependencies between activities” (ibid, p. 90).

Thus, there is a clear need to articulate the term “coordination” in order to make it operationalizable. In particular, the term “activity” needs to be problemized. This is done in Section 4.

### 2.2 Business processes

As with coordination, disagreement persists about the definition of business processes and related concepts such as BPR. For example, Biazzo reports on several definitions of BPR found in the literature (Biazzo, 1998). These definitions see BPR alternatively as modelling of old and new business processes, as alignment between IT and business processes or as the advancement of organisational performance by improving business process performance.

The definition of business process usually adopted is formulated by Bititci & Muir as “a collection of various tasks which produce an output.” (Bititci & Muir, 1997, p. 366). This definition implies a workflow and transformational view on a

process where an input is transformed into a product or service. Moreover, the definition also indicates a specific temporal dimension associated with processes.

The view on a process as a structured chain of activities has a direct coupling to coordination as defined by Malone & Crowston. Coordination is simply the management of the dependencies between these activities. This implies that coordination is an activity in itself carried out by some actors. The work object of the coordination activity is coordination manifested as various tangible and intangible elements in the organisation. For example, a business process model would be seen as a result of a coordination activity.

However, in the literature the temporal dimension is considered insufficient to define a process. For example, Davenport & Short suggest that processes may be based on three dimensions (Davenport & Short, 1990):

- Organisational entities: Processes take place between inter or intra-organisational organisational entities.
- Objects: Processes manipulate objects that can be physical or informational.
- Activities: Processes involve two types of activities: managerial (e.g. a budget process) and operational (e.g. fulfilling a customer order).

With the advent of the BPR initiative, it soon became clear that it was necessary to include other organisational dimensions in BPR besides the temporal ordering of activities. For instance, Deakins & Makgill identified eighteen different themes related to BPR in the literature (Deakins & Makgill, 1997).

Thus, there is a tendency to include other dimensions beside temporality in the definition of business processes. This is revealed by the linguistic determination used. For example, Chan states that “IT can be an initiator, a facilitator, and an enabler *in* [emphasis added] a business process.” (Chan, 2000, p. 235). Other expressions, such as “coordination *in* the process”, “information *in* the process”, both abundant on the Internet, indicate a similar shift in meaning. This “dimension compression” tends to veil the specific character of each dimension as well as the interdependencies between them.

Another aspect of business processes is discussed by Marjanovic (2005). In dynamic business environments, the process may evolve during the process execution as a result of new needs. Customer demands may change as well as competitors and partners. This places new focus on KM. The dynamic, evolving and knowledge intensive processes have been termed “emergent business processes”. In such processes, it is natural to “*include* general, specific and tacit knowledge distributed across experts and non-experts [our emphasis]” (ibid, p. 477). Thus, knowledge is considered to be part of the process.

The transformational view on business processes has been challenged for neglecting the communicative aspects of coordination: “Coordination means an orientation towards the communicative interaction between different parties such as the customer and the producer” (Goldkuhl et al., 2001, p. 7). It is important to realize that the execution of a business process is dependent on commitments and agreements exchanged between the actors executing the process. Thus, from this perspective a proc-

ess is considered as something that has two facets: a transformational one and a communicative one.

### 2.3 Information Technology

Information technology is a key enabler for BPR (Davenport, 1993). In their extensive examination of the BPR literature, Deakins & Makgill found that IT and its implementation in organisations dominated the research agenda (Deakins & Makgill, 1997). However, in spite of the documented importance of human issues such as communal meaning and culture, the operationalisation of these aspects seems to be under-researched:

“Of particular concern [...] is the lack of attention given to so-called “people issues”. [One] might have expected that HR and change management issues would have featured in the literature as strongly as implementation and IT issues. However, this paper has clearly illustrated that the clarion call for researchers to concentrate on people issues in BPR has so far gone unheeded.” (Deakins & Makgill, 1997, p. 104).”

With the advent of Enterprise Resource Management (ERP) systems such as SAP, Baan, Oracle, and People-Soft in the early 1990s, the focus on information technology was even more accentuated. These systems promise, according to Davenport, “the seamless integration of all the information flowing through a company – financial and accounting information, human resource information, supply chain information, customer information.” (Davenport, 1998, p. 121).

However, according to The Gartner Group, 70 percent of all ERP projects fail to be fully implemented, even after three years (Gargeya & Brady, 2005, p. 501). Davenport claims that the main reason for this is that companies fail to reconcile the technological imperatives of the ERP system with the business needs of the enterprise itself. The system drives the company towards full integration and generic processes even when customized processes and some level of business unit segregation may be a competitive advantage (Davenport, 1998, p. 122).

The core of the dilemma is the coordination of business units in order to fulfil enterprise goals. There is a need to arrive at a communal vision of joint processes, information sharing, ways of working, etc. This might require efforts that are more costly than the up-front purchase of the ERP package (Gosain et al., 2005). The problem of coordination is considered as one of the most important ones leading to a number of failures in ERP implementations (Kumar & van Hillegersberg, 2000). Moreover, while the ERP system may contribute to the internal consistency of the company, it may also create problems in the supply chain due to sub-optimization (Cumbie et al., 2005). This problem is aggravated due to company mergers, acquisitions, etc. Thus, the effects of ERP on supply chains is a major topic for future research (Cumbie, *ibid*).

### 2.4 Communal meaning

The need for a communal meaning in coordination is emphasised by several authors (e.g. Kraut & Streeter, 1995; Battin et al., 2001; Herbsleb & Moitra, 2001; Ovaska et al., 2003; Prikladnicki et al., 2003; McChesney & Gallagher, 2004; Komi-Sirviö & Tihinen, 2005; Sakthivel, 2005). For example, Kraut & Streeter state:

“In software development, [coordination] means that different people working on a common project agree to a common definition of what they are building, share information, and mesh their activities. They must have a common view of what the software they are constructing should do, how it should be organized, and how it should fit with other software systems already in place or undergoing parallel development.” (Kraut & Streeter, 1995, p. 69)

In order to make coordination operational in a particular organisation, the general definition given by Malone & Crowston (1994) must be concretised. Based on experiences from Ericsson (Taxén, 2003) communal meaning about at least the following issues needs to be established:

- What entities are subject to coordination? In a product development organisation such entities are typically products and documents, drawings, CAD-models, requirements, engineering change orders, error reports, software builds, test cases, etc.
- What are the relationships between these entities?
- What is the status of an entity at any particular instant of time?
- What properties characterise an entity?
- How should the responsibilities for coordination be allocated?
- What guidelines, rules, norms, etc., are associated with the coordination?
- How should IS support for coordination be implemented?
- Which dependencies exist between activities manipulating the entities?

The issue of communal meaning becomes increasingly important when operationalising decontextualized, generic models in a particular organisation:

“A more contentious issue is whether a set of generic business processes can be defined with universal applicability. [At] an abstract level, some consensus may be achieved over a generic set of business processes. However, it is also becoming evident that as the level of detail increases, disagreements begin to surface. Since most enterprises are concerned with detailed operational models rather than abstract models, the value of a top-down, i.e. generic, approach to business process definition is becoming increasingly questionable.” (Bititci & Muir, 1997, p. 366)

Thus, operationalised coordination includes more than just managing the dependencies between activities. Moreover, what holds true about the coordination is socially and situationally determined. This is emphasized by Malone & Crowston:

“In order to analyze a situation in terms of coordination, it is sometimes important to explicitly identify the components of coordination in that situation. [...] It is important to realize that there is no single ‘right’ way to identify these components of coordination in a situation. (Malone & Crowston, 1994, p. 101)

The capacity of an organisation to manage complex patterns of interdependent activities is closely related to its capacity to manage the communication required for

coordination (March & Simon, 1958, p. 183). There is a close connection between communal meaning, communication and language. The actors need to have a common language to enable coordination:

“A practice is coordinated through communication. Different linguistic actions are necessary in order to coordinate actions so that the intended result can be produced. This is necessary within a practice in which several producers cooperate” (Goldkuhl & Röstlinger, 2005, p. 6, our translation)

March & Simon also point out that the language needed for communication is well developed when it refers to concrete things or things that have acquired a state of “facts” in the organisation. When this is not the case, the communication is much harder:

“[It] is extremely difficult to communicate about intangible objects. Hence, the heaviest burdens are placed on the communications system by the less structured aspects of the organization’s tasks, particularly by activity directed towards the explanation of problems that are not yet well defined.” (March & Simon, 1958, p. 186)

The importance of communication for establishing communal meaning in coordination situations is stressed by Melin:

“Communication about other actions (of coordinating and coordinated character as well as executed or planned) is important to the establishment of a common understanding in the actual coordination situation.” (Melin, 2002, p. 402, our translation)

Thus, we can talk about at least two principal functions of language: coordination of actions through various speech acts when a communal meaning is established, and communication in order to establish a communal meaning. In daily language use, these two functions are intertwined.

## 2.5 Motivation

It is clear from the discussion in the preceding sections that coordination, communication, business processes, and information technology are heavily intertwined focal areas of organisational inquiry. We argue that the persistent confusion about the definitions of these areas is due to the lack of an integrating perspective. Taking any of them as a basic perspective for inquiry implies that a multi-dimensional problem is “compressed” into a one-dimensional one where other dimensions are concealed or unfocused. A consequence of this superficial way of approaching a multi-dimensional problem is that interdependencies are veiled. Without an integrative perspective that lay bare these interdependencies, and thus makes them accessible for operationalization, it is unlikely that the inherent complexity in organisational change management can be mastered.

This calls for a “decompression” approach where relevant dimensions are recognized per se, however dialectically related to each other:

“When analysing processes it is important to recognize that such analysis must be based [...] on a, necessarily, “multi-perspective” representation [...]. As regards the problem of intervention, [...] it is clear that the problem of redesigning [business processes] is [...] no different from the more general problem of organisa-



tional change, which latter consists of the complex search for mutual adaptations between tasks, structure (communications, authority and workflow systems), people and technology. Thus it is also clear that (re)designing a process poses a socio-technical problem.” (Biazzo, 1998, pp. 1012-1013).

In line with Goldkuhl et al. (2001), we claim that semiotics, linguistics and meaning are key enablers of operationalizable, integrative perspectives:

“If we look at BPR and KM together we can see that these approaches contribute with a claim for an integrated development of information technology, business processes and humans, and their knowledge and competences. How this integration should be done in practical development and change has seldom been thoroughly described. We think this is due to an insufficient theoretical integration of these different aspects. [...] We think that one key to the lack of such a theoretical integration in BPR and in KM literature is the lack of semiotic and linguistic awareness.” (Goldkuhl et al., 2001, p. 2).

We argue that communal meaning provides the link between individual cognition and social reality that enables coordinated action. In the following we shall elaborate on this line of inquiry.

### 3 Aspects of meaning

Meaning has been suggested as fundamental for understanding the human mind. For example, Bruner claims that “The central concept of a human psychology is meaning and the processes and transactions involved in the construction of meanings.” (Bruner, 1990, p. 33). Furthermore, meaning is intrinsically related to culture and human action:

[C]ulture and the quest for meaning within culture are the proper causes of human action. The biological substrate, the so-called universals of human nature, is not a cause of action but, at most, a constraint upon it or a condition for it. (Bruner, *ibid.*, p. 20)

In this section, we shall put forward some arguments for grounding socio-technical approaches in the concept of meaning. It is not possible to treat a cardinal concept like meaning in depth in this paper<sup>1</sup>. Rather, our aim is to point out some aspects of meaning that are subsequently used in elaborating the ADT.

#### 3.1 Idiosyncratic and social

Through interaction with its environment, an individual gradually constructs a meaningful world ranging from the meaning of near-sensory impressions to, in due time, abstract symbols in a particular cultural-historical setting. Each individual acquires her own, unique understanding of the world. This understanding is located in the mind of the individual. Thus, one aspect of meaning is idiosyncrasy. Meaning is inherently individual. The *construction* of meaning, however, is a different matter. In order to construct meanings, an individual needs to interact with other individuals. This is formulated by Vygotsky in his genetic law of development:

<sup>1</sup> For a thorough discussion of meaning in connection with ISD, see Hirschheim et al. (1996).

Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (*interpsychological*), and then inside the child (*intrapsychological*). (Vygotsky, 1978, p. 57).

Thus, another aspect of meaning is its inherent social nature. The mediator between the social and individual is the sign. The sign bridges internal, mental processes and external physical and social reality:

By its very existential nature, the subjective psyche is to be localized somewhere between the organism and the outside world, on the borderline separating these two spheres of reality. [...] the organism and the outside world meet here in the sign (Vološinov, 1986, p. 26).

### 3.2 Communal

The idiosyncratic and social aspects of meaning are basic to the Russian theory of activity (Bedny & Meistner, 1997). Leont'ev (1978) differentiated between subjective, personal "sense" and objective "meaning". Objective meaning refers to the meaning of a word given in a lexicon. This meaning is "independent of any particular individual and is thus trans-individual, but [it] exist only through the activity and reason of individuals" (Kosík 1976, p. 146). Sense refers to the translation of objective meaning into an internal, idiosyncratic impression for each individual.

In the literature, it is common to describe objective meaning as "shared" indicating that meaning can somehow be split and distributed among individuals. However, from the discussion above it is clear that there is no such thing as "shared" meaning in a strict sense. This has also been pointed out by Boland (1996) and Walsham (2005).

The distinction between "shared" and "communal" may seem insignificant. However, we claim that this distinction is of major importance when discussing the foundations of socio-human reality. If meaning cannot be "shared", we must find another way to explain that humans can understand each other and perform coordinated actions. In the search for such explanation the term "communal", with its connotations of contextuality and social action appears to be more appropriate: "By virtue of this actualization in culture, meaning achieves a form that is public and communal rather than private and autistic." (Bruner, 1990, p. 33).

### 3.3 Situated

The social foundation of meaning implies situatedness. Different meanings evolve in different cultures separated in time and space. The interactions between individuals in a particular society bring about institutionalised aspects of meaning that stabilises the social system:

"All social interaction is situated interaction - situated in time and space. It can be understood as the fitful yet routinised occurrence of encounters, fading away in time and space, yet constantly reconstituted within different areas of time-space. The regular or routine features of encounters, in time as well as space, represent institutionalised features of social systems." (Giddens, 1984, p. 86)

### 3.4 Material

Signification occurs through physical stimuli picked up by sensory organs of various modalities such as sight, sound, taste, smell, and touch. Everything that possesses meaning is ultimately physical in origin. The sign is a material phenomenon:

“Signs [...] are particular, material things; and [...] any item of nature, technology or consumption can become a sign, acquiring in the process a meaning that goes beyond its given particularity.” (Vološinov, 1986, p. 10)

### 3.5 The congruence of mind and activity

The constitution of meaning is still being discussed among scholars (e.g. Zinchenko, 2001). Usually, this discussion is framed in terms of internalization and externalization. In object-related activity, the human mind is externalized into the objectified social world, which in turn is internalized into the consciousness in the course of socialization (Berger & Luckmann, 1991). However, in this discourse the idea that the human mind does not have its own structure and logic of development, distinct from the structure of object related activity, has been lost (Stetsenko, 1999, p. 246). According to Zinchenko, we should assume that “what is considered mental, or subjective, is objective at the same time” (Zinchenko, 2001, p. 138). The mind, just like culture, does not have its own enclosed territory, but is “situated instead at the borders between own and not-own” (ibid, p. 139). According to this view, the structure of communal meaning develops in congruence with the structure of object-related activity. This is a most important principle that has far-reaching consequences.

The constitution of meaning brings about two forms of objectivizing. The transformation of the world into meaningful artefacts such as tools, institutions, organisations, etc., is *objectification* (“Vergegenständlichung”) (Kosík, 1976). However, in societal praxis, the individual needs to coordinate his actions with other individuals. In order to do so, he needs to be integrated in a trans-individual whole as one of its elements. This incorporation transforms the subject. “The subject abstracts from his subjectivity and becomes an object and an element of the system” (Kosík, 1976, p. 50). This second form of objectivizing is *objectivation* (“Objektivierung”) (ibid., p. 131). The essence of objectivation is the appropriation of communal meaning necessary to perform coordinated actions.

In order to illustrate the objectification – objectivation process we will use a concrete example – the activity of playing a string quartet. First, there are obvious objectified elements involved like the instruments and the musical score. Each individual actor / player has to appropriate her instrument by a long and intense interaction with it. Technical and musical abilities must be learned.

However, in order to bring forth music the musicians cannot act one by one. They have to appropriate a communal meaning of scores, notes, tuning procedures, performance manners, etc. In short, they have to be integrated in a trans-individual whole – the activity of playing – where they start playing at the same time, use the same phrasing and dynamics, etc. Without going through this objectivation process, the musicians cannot coordinate their actions.

The objectification – objectivation process should not be seen as consisting of two distinct processes. Rather, objectification and objectivation should be regarded as areas of attentions in a dialectical process that is constituted in two realms – in the human mind and in societal praxis. The essence of this reasoning is that persistent,

objectified elements in societal praxis are congruent with persistent, objectivated elements in the brain.

### 3.6 Meaning as basis for a socio-technical approach

In summary, meaning has an individual, idiosyncratic as well as a social facet. The construction of meaning takes place in cultures or social systems that are situated in time and space. Meaning is mediated by signs that relate the external physical and social reality with the psychological reality in the mind. The structure of the objectified social and material reality is congruent with the structure of objectivated reality in the mind. Socio-human reality is a reality where processes of semiosis are inseparably intertwined with material processes:

Semiotic formations [...] are essential elements in the material dynamics of human communities, and this material-semiotic coupling is reciprocal. There cannot be two systems here, changing according to separate laws, relatively independent of one another. There can be only one unitary ecosocial system, material and semiotic, with a single unified dynamics, described under two aspects, by two different sorts of culture-specific discourses. (Lemke, 1993)

The aspects of meaning as sketched in this section form a general background that can be exploited in the development of socio-technical approaches. In the next section, we will discuss how this is done in ADT.

## 4 The Activity Domain Theory

The Activity Domain Theory is inspired by the notion of praxis (Kosík, 1976; Israel, 1979) and the Russian theory of Activity (AT) (Bedny & Meister, 1997; Engeström, 1999). In socially organized human labor – praxis – humans transcend the limitations of individual action and produce social and material conditions unachievable individually. The praxis perspective emphasizes certain qualities of human activity such as historicity, dialectical interaction, contradictions as the drivers of change, etc.

A fundamental principle in AT is the unity of mind and activity, where the concept of activity (*deyatel'nost'* in Russian) has quite a specific meaning. The activity is motivated by social needs. These needs are met by goal-oriented, coordinated actions, directed towards an object in order to produce an outcome. Each action is realized by motor and mental acts, called operations in AT. Thus, in AT activity, action and operations (acts) are distinct, albeit dialectically interrelated, concepts.

A famous example illustrating the difference between activity and actions is given by Leont'ev (1981) where he considers the role of the beater in the activity of hunting. Although the motive of the activity is hunting for food, the action of the beater drives the quarry away. This action is meaningful only from a social needs perspective. The object of the activity is the quarry and the goal-oriented actions of individual actors, whether beater or hunter, are coordinated in order to achieve the outcome – a brought-down quarry.

In ADT, we strive to maintain the basic principles of praxis and AT while simultaneously articulating these principles for analytical and constructive purposes related to coordination. This is done by introducing the *activity domain*, which can be conceived of as a workpractice (Goldkuhl & Röstlinger, 2003; 2005) where coordination

is emphasized. The existence of the activity domain is motivated by the transformation of a *work object* by socially organized actors into an outcome fulfilling a social need. The work object and the motive are the key elements that define the domain and separate different domains from each other. Work objects can be material or intangible things as long as they can be shared for manipulation and transformation by the actors (Virkkunen & Kuutti, 2000, p. 301).

#### 4.1 Activity modalities

The praxis roots of ADT imply that we consider the activity domain as an entity that is in constant motion and development. Through the emergence and resolution of inner contradictions, the activity domain proceeds along certain, dialectically interrelated dimensions, which we call *activity modalities*. These are characterized as follows:

- The propensity of humans to coordinate actions along the modalities has ultimately evolved during the phylogenetic evolution of the human race.
- As a result of human activity, each modality is manifested as objectified elements in the activity domain and objectivated elements in the minds of the actors during the ontogenetic constitution of mind.
- The structure of objectified elements is in some sense congruent to the structure of objectivated elements.

What does this mean? For example, temporalisation is one activity modality. Examples of objectified manifestations of temporalisation are business process models. In order to perform coordinated actions according to the business model, the actors must construct a communal meaning about the model. This construction is manifested as objectivated elements in the minds of the actors, which in some sense resembles or mirrors the structure of the business model. Thus, a development or construction of a coordinating instrument implies two types of results – a tangible, objectified result in the domain and an intangible, objectivated result in the mind.

The activity modalities are as follows:

##### 4.1.1 Contextualisation

The contextualization modality concerns the construction of a context in which actions are meaningful. Contextualization implies at least two things: framing and context dependency of meaning. Framing is mainly determined by the motive of the activity, that is, what needs it fulfils. Only those things that are relevant for this purpose become meaningful. This means that the same thing can be characterized differently depending on the context (Parsons, 1996).

Contextualisation is inextricably related to the classification of things into categories or types. Our visual system simplifies a visual scene into foreground and background. Certain things are attended in the foreground while other things remain unattended in the background (Jackendoff, 1983, p. 42). Thus, a capability to contextualize appears to be innate. Examples of objectified contextual elements are work practices, organisational units, etc.

#### 4.1.2 *Spatialisation*

Spatialisation manifests a spatial framing of the activity domain. It enables the actors to acquire a communal meaning of what entities are relevant, how these entities are characterized and related to each other, and in what state or condition they are. Examples of objectified manifestations of spatialisation are information models, product structures, conceptual models, etc. Spatialisation can refer both to direct, physical objects or composite signs referring to such objects. For example, both a map of a city and the city itself has a spatial structure.

#### 4.1.3 *Temporalisation*

Temporalisation manifests a temporal framing of the activity domain. It enables the actors to acquire a communal meaning about actions and the dependencies between them. Thus, manifestation of temporality are compliant with the definition of coordination given by Malone & Crowston (1994, p. 90). Examples of temporal elements are business process models, interaction diagrams, use cases, etc.

#### 4.1.4 *Stabilisation*

Stabilisation manifests stability in the domain. Without stabilising elements, no coordination is possible. They have the function of "... reducing the infinite number of things in the world, potential or actual — to a moderate number of well-defined varieties" (March & Simon, 1958, p. 181). Together, stabilising elements constitute an ideology, that is, a wide-ranging system of belief or thought. Some elements of the ideology may be common to several domains, but in general, these vary between domains. Manifestations of objectified stabilising elements are, for example, norms, values, habits, routines, rules, standards, domain specific languages, etc.

#### 4.1.5 *Transition*

Transition manifests a capability of actors in one domain to interact with each other in any constellation of domains. The result of one domain may be the prerequisite for other domains. Since stabilisation brings about different domain ideologies, the outcome may be characterized differently. If so, there is a need for a translation and interpretation of the results in the transition between activity domains. Transitional elements provide such mappings and translations between ideologies. Manifestations of transitional elements are, for example, interface specifications and rules for translation between organisation specific languages such as product identification conventions.

### 4.2 Operationalisation

By operationalization, we refer to the process in which communal meaning is constructed. In order to advance the construction of communal meaning, Taxén (2004b) has suggested a *domain construction process* (DCP) in which certain *coordination constituents* are constructed. These constituents are chosen in such a way that each constituent is targeted to primarily one specific modality. In other words, the intended result of the construction process is a set of constituents that reflect the modalities and their interdependencies. The coordination constituents are as follows:

- Spatialisation is manifested as a *spatial coordination model*, which signifies what entities are relevant for coordination and how these are related to each other. This means that the model frames the spatial context of the domain; thus, it is also a manifestation of contextuality. In order to alleviate the construction of communal meaning, the nomenclature in the model should be easily comprehended by the actors. Examples of such nomenclatures are Object Modeling Technique (OMT: Rumbaugh et al., 1991) and Universal Modelling Language (UML: Jacobson et al., 1992). In Figure 1, an example of a spatial model from Ericsson is given. The entity in focus, “Feature Increment” was the central entity in a new methodology for incremental development of large software systems (Taxén, 2003). It can be noted that most entities in the model are Ericsson specific, reflecting the fact that these are meaningful only in the Ericsson context.

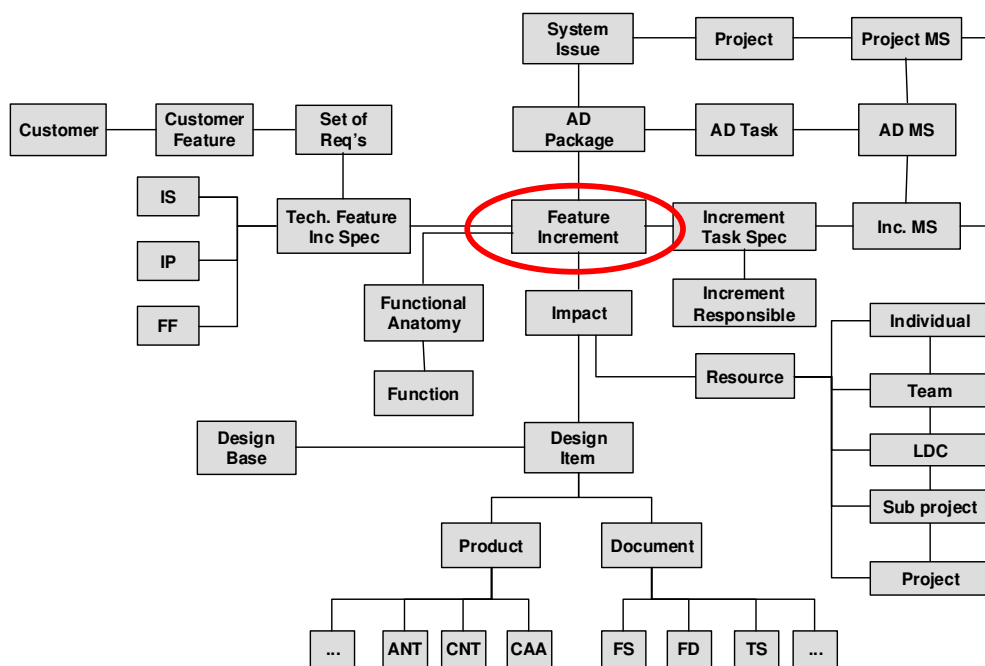


Figure 1: Spatial coordination model from Ericsson (1997)

- Temporalisation is manifested as a *temporal coordination model*. As such, it signifies the dependencies between actions needed to achieve the outcome of the domain. In this sense, the temporal model manifests coordination as defined by Malone and Crowston (1994). Temporal models may be expressed by Information Flow Diagrams (IFD: Taxén & Svensson, 2005), which are a specific type of Entity Process Models (Humphrey & Kellner, 1989). In Figure 2, an example of a temporal model is given. The IFD notation is constructed in such a way that entities are lined up vertically to the left. The actions operating on these entities are lined up horizontally at the bottom. The output from each action changes the state of the entity as indicated by an arrow (black in Figure 2) intercepting an item line.

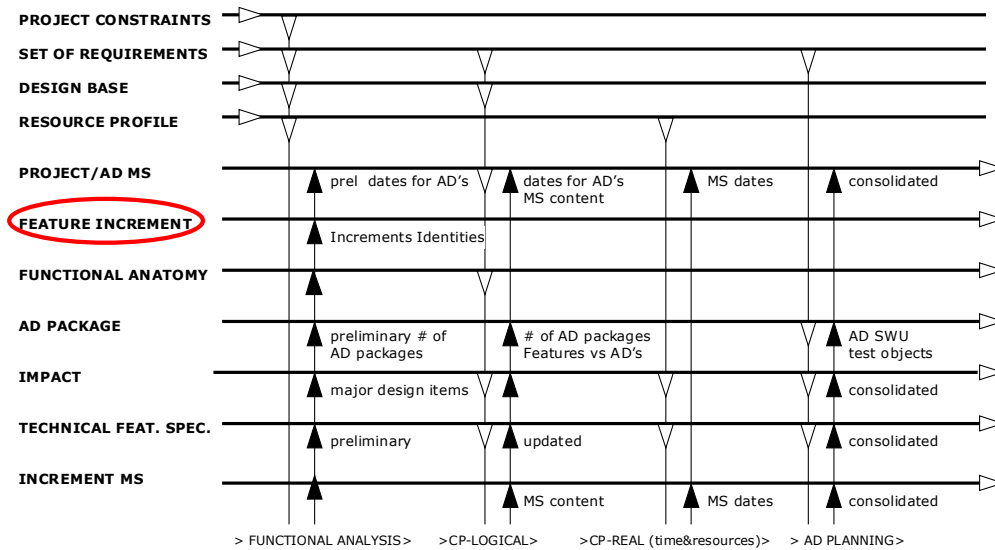


Figure 2: A temporal coordination model from Ericsson (1997)

Again, the reason for using this particular kind of model is that it advances the development of communal meaning more efficient than ordinary, activity based process models. Moreover, it can be seen that the same entities appear in the temporal model as in the spatial model in Figure 1. Thus, the spatial and temporal models signify two different, albeit dialectically interrelated, activity modalities.

- Stabilisation is manifested by a *domain ideology*. Stabilization items may by routines, rules, standards, norms, domain specific terminology, etc.
- Transition is manifested as a *transition coordination model*. An example of such a model is an elaboration of the Specification Based Data Model (SBDM) suggested by Gandhi & Robertsson (1992). The basic feature of this model is a recursive structure where specifications are implemented by implementations that in turn need other specifications. This feature makes the SBDM particularly suitable for manifesting transition.

The coordination constituents should be seen as *type* categories that signify persistent coordination patterns in the activity domain. These patterns are recurrently employed in the execution of tasks. During each execution, *instances* of the coordination constituents must be managed in order to coordinate activities. This may be done by implementing the coordination constituents in an IS. For example, in Figure 3 an IS view of instances and their relations according to the spatial model in Figure 1 is shown.



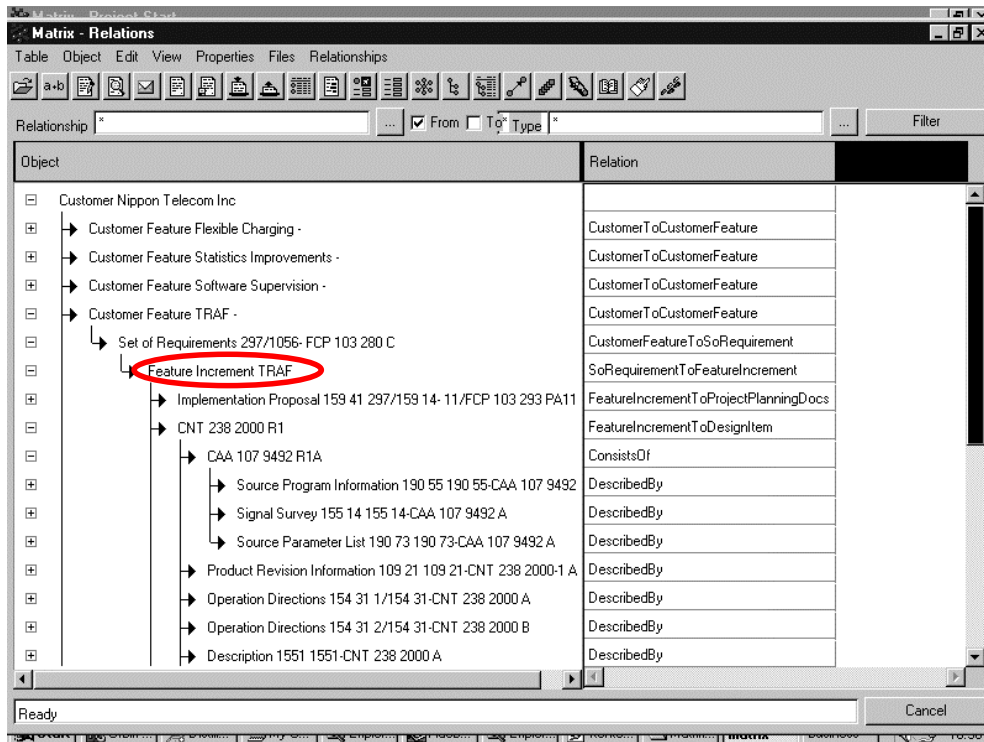


Figure 3 A view of instances managed in an IS (Ericsson 1997)

### 4.3 The Domain Construction Process

The DCP is based on an experiential learning approach (Kolb, 1984), and carried out in three phases: the *mathetic*, *consolidation* and *pragmatic* ones. The terms *mathetic* and *pragmatic* are adopted from Halliday (1975), who distinguishes between *pragmatic* and *mathetic* functions of language. *Pragmatic* functions involve coordination of actions when a communal meaning is established, while *mathetic* functions have to do with the construction of communal meanings. The gist of the process is an ongoing iteration between reflection and action where a communal meaning is gradually established among the actors. In this process, a gradual shift is made from the *mathetic* to the *pragmatic* functions of language. In Figure 4 the construction process is illustrated.

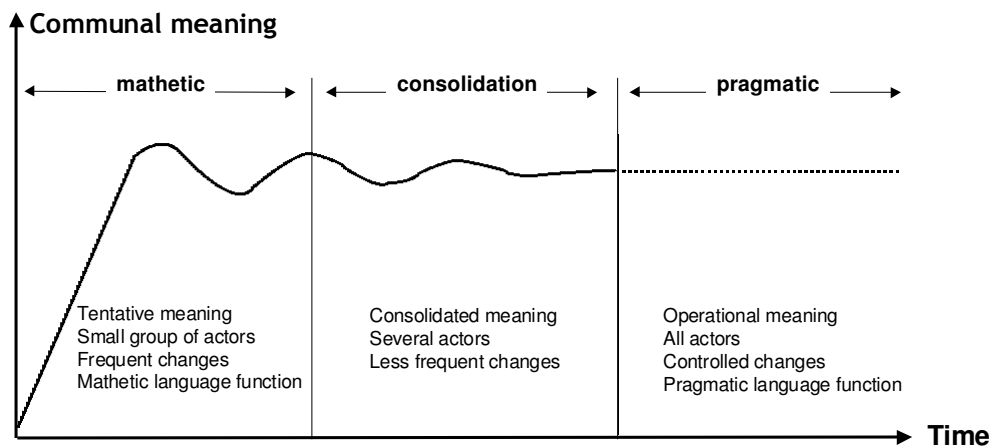


Figure 4: The construction of communal meaning

The purpose of each phase is as follows:

- *Mathetic*: In this phase, the purpose is to construct an initial, tentative activity domain that acts as a catalyst for the upcoming operational domain. The focus in this phase is on the mathetic function of language. The construction work is carried out in a “daily build” manner by a small group of actors representing various roles such as configuration managers, project managers, IS vendors, etc. Provisionary coordination constituents are suggested, implemented in the IS, and evaluated with respect to their usefulness in providing the intended outcome of the domain. Changes are suggested and implemented anew in the IS. This iterative process is continued until a working consensus is achieved.
- *Consolidation*: The purpose of this phase to construct a “prototype” of the operational domain in order to make actors confident with it. The communal meaning achieved in the mathetic phase is consolidated. Several actors are involved, possibly at other geographical locations, and immediate, personalized support is provided to enhance the objectivation process. The performance of the IS is secured, measures are taken to make actors trust the data in the IS, etc. Changes appear less frequent, and no major reconstruction of the domain is done at this stage.
- *Pragmatic*: In this phase, the domain becomes operational in coordinating actions in, for example, a concrete development project. All concerned actors are involved according to their roles. Changes are done in a controlled and formalized way through, for example, engineering change orders. The focus in this phase is on the pragmatic function of language as manifested by various speech acts such as requests, directives, commitments, etc. (Austin, 1962; Searle, 1969; Habermas, 1984).

In summary, the DCP aims at the construction of the entire activity domain, rather than merely single artefacts mediating specific actions. The intention is that communal meaning construction and the construction of artefacts should proceed simultaneously. The coordination constituents manifest all dimensions of coordination according to the activity modalities. Moreover, since the activity domain is con-

sidered to be in constant evolution, the DCP should be conceived of as a continuous redevelopment process. A similar approach for ISD has been suggested by, for example, Truex et al. (1999).

## 5 Grounding the ADT

According to Goldkuhl & Cronholm (2003), a theory should be *multi-grounded*, i.e., grounded in empirical data, pre-existing theories and an explicit congruence within the theory itself between elements in the theory. The different types of grounding are called empirical, theoretical and internal grounding respectively.

### 5.1 Empirical grounding

Empirical grounding of ADT has so far been done in one setting: the development practice of Ericsson. From observations and interventions in this practice over several years, communal meaning concerning manifestations of the modalities was identified by the author as crucial for coordinating exceptionally complex projects. These projects, which took place between approximately 1999 and 2003, developed telecom systems for the 3<sup>rd</sup> generation of cellular networks according to an engineering process called Integration Centric Development (Taxén, 2005b). Around 140 main projects and sub-projects were involved.

Four activity domains developing different parts of the 3G system were constructed: three in Sweden and one in Germany. Coordination was supported by domain specific IS applications built on the same platform, the Matrix system from MatrixOne (MatrixOne). This system is positioned by the vendor as a backbone for managing product related data in large, globally distributed organisations. It can be characterized as a high performance, complex system of its own.

In one domain called the S-domain in Stockholm, the mathetic phase occurred between 1998 and 1999. The work was carried out by this author, another Ericsson employee and two IS consultants. In addition, user representatives such as a project manager, a requirement coordinator and two configuration managers took part in the development. Altogether, around 6 – 8 persons were involved in the initial construction of the domain. The result in terms of functionality and effort was unmatched in the history of Ericsson. In 19 months, the following coordination support was implemented:

- A common project repository for development sites distributed to Sweden, Italy, Australia, Norway and Croatia,
- requirement management,
- engineering change order management,
- baseline and milestone management,
- test configuration management,
- support for the integration centric engineering process,
- product and document management for the needs of the project,

- three general report generators,
- an interface to the Ericsson common document library,
- data transfer from legacy systems and requirement specification documents,
- an application specific web-client in order to improve performance and stability,
- support for complete traceability between coordination entities,
- basic functionality such as logging all events in the IS, defining user roles and access rights, security checks, etc.

One of the other domains, the A-domain in Aachen, Germany, was initially constructed between the end of 1999 and mid 2000 with similar results. Altogether, the effects on coordination were profound. For example, some project managers claimed that the development of one of the most complex nodes in the 3G system would not have been possible without the coordination support provided by the constructed domains:

“Especially for the execution part I think we would not have been able to run this project without the tool. I think if you simply look at the number of work packages [increments], the number of products that we have delivered, the number of deliveries that we have had, if we would have had to maintain that manually, that would have been a sheer disaster.” (Project manager, A-domain).

The main reason for constructing four different domains was the anticipated, prohibitive efforts of reconciling different opinions concerning the meaning of coordination. However, since the domains were all developing different parts of the same system, some coordination between the domains was necessary. This was never fully attended during the construction of the domains. As a result the trans-domain coordination had to be carried out in a traditional manner, mainly by documents and personal communication.

In spite of the positive results, the impact of ADT at Ericsson became a one-time shot. The crisis in the telecom industry during the early years of 2000 resulted in a frantic hunt for cost savings. Unification, centralisation and concentration strategies were enforced by top management as perceived ways to reduce costs. Having several separate domains coordinating the development projects was considered too costly, and initiatives were launched to reconcile all domains into one, single domain in Stockholm. At the same time, the iterative DCP was replaced by a traditional development process where one group of actors wrote specifications for the IS that another group implemented. Eventually, the implementation group was outsourced to another company.

The result was that the internal cohesion of the ADT began to disintegrate. Separate organisational responsibilities were assigned for each modality. For example, the responsibilities for the evolution of the spatial domain model and the IS were placed in different organisational units. Traditional patterns of working were re-installed. In effect, the coherent approach towards coordination as informed by the ADT has ceased to influence the development practice at Ericsson.

## 5.2 Theoretical grounding

The theoretical grounding of the ADT originated from practical experiences in contrast to theories that are appropriated from established “grand theories” and subsequently applied in practice. Thus, the theoretical grounding is focused on theories that support or explain the practical consequences of ADT. We argue that this is a more productive way to develop “practical theories”, that is, theories that are focused on making a difference in practice (Cronen, 2001).

As discussed before, the foremost theoretical grounding of ADT is the Russian theory of Activity. The notion of activity modalities is an attempt to move the initial, individual centric focus of AT to the coordination of human activity while, at the same time, maintaining the central ideas in AT (Taxén, 2005c).

In a weak sense, the grounding of activity modalities is self-evident. Every-day human life is abundant with elements manifesting the modalities, such as, for example, maps (spatialisation), calendars (temporalisation), traffic rules (stabilisation), and dictionaries (transition). In addition, contextuality is evident in, for example, the meaning of words or cultural expressions. Thus, humans are biologically equipped for cognizing elements that can be categorized according to the activity modalities. However, the alleged congruence between the human mind and the structure of object-related activity implies that the human race has acquired specific capabilities to discriminate different types of modalities during phylogenesis. This is a much stronger claim that needs to be grounded in theories that addresses the underlying “biological substrate” of humans.

The strong grounding of the modalities is, of course, an overwhelming task. At most we can provide some indications of such grounding. For example, Vygotsky claims that the emergence of speech capability made it possible to extend the temporal dimension beyond the immediate present:

“In addition to reorganizing the visual-spatial field, the child, with the help of speech, creates a time field that is just as perceptible and real to him as the visual one.” (Vygotsky, 1978, p. 36).

Another hint is provided by Jackendoff, who claims that there is a single level of mental representation where linguistic, sensory and motor information are compatible: the *conceptual structure* (Jackendoff, 1983 p. 17). Indications of this level can be found in expressions like “I have read that book” which relate linguistic and visual information. Such utterances are examples of *pragmatic anaphora* (ibid, p. 48). The existence of the conceptual structure indicates that “semantic structures could be simply a subset of conceptual structures – just those conceptual structures that happen to be verbally expressible” (ibid, p. 19). Thus, by studying the study of semantics and grammar of natural language, evidence may be found for the organisation of the conceptual structure.

It turns out that there is a set of grammatically different classes of pragmatic anaphora, which can be identified by various types of grammatical phrases. The utterance “I have read that book” is clearly about [THING]s, and the part “that book” can be identified as a noun phrase (NP). However, an utterance like “Your book is there (pointing)” is about a [PLACE], which is recognized by a prepositional phrase (PP). [PLACE] and [THING] are separate kinds. Such different types of basic categories are called *ontological categories*. Through an elaborate linguistic discussion,

Jackendoff identifies a set of such categories. The categories, which are of prime interest for our purposes, are as follows:

- [THING]
- [PLACE]
- [PATH]
- [EVENT]
- [STATE]
- [PROPERTY]
- [DIRECTION]
- [ACTION]

In later works, Jackendoff includes *thematic roles* as part of the conceptual structure (Jackendoff, 1990). A thematic role can be then seen as a relationship that ties a term with an event or a state, establishing a semantic relationship between a predicate (e.g. a verb) and an argument (e.g. the noun phrases) of a sentence. Examples of the thematic roles are [AGENT] (the instigator of an action), [ACTOR] (the willfull instigator of an action), and [GOAL] (what the action is directed towards).

As can be seen, ontological categories and activity modalities are compatible, at least on a superficial level. For example, spatialisation can be associated with the conceptual structure as follows:

- [THING]s are related to other [THING]s.
- [THING]s have [PROPERTIES].
- [THING]s have [STATE]s.
- [DIRECTION]s provide orientation.

A similar association can be made for other modalities (Taxén, 2006). Thus, it appears that the structure of language indicates that the activity modalities are compatible with the conciliation of sensory modalities represented by the conceptual structure. However, it is clear that this grounding needs to be substantially more elaborated.

### 5.3 Internal grounding

In order to clarify the congruence between the elements in the theory, the conceptual map in Figure 5 is used:

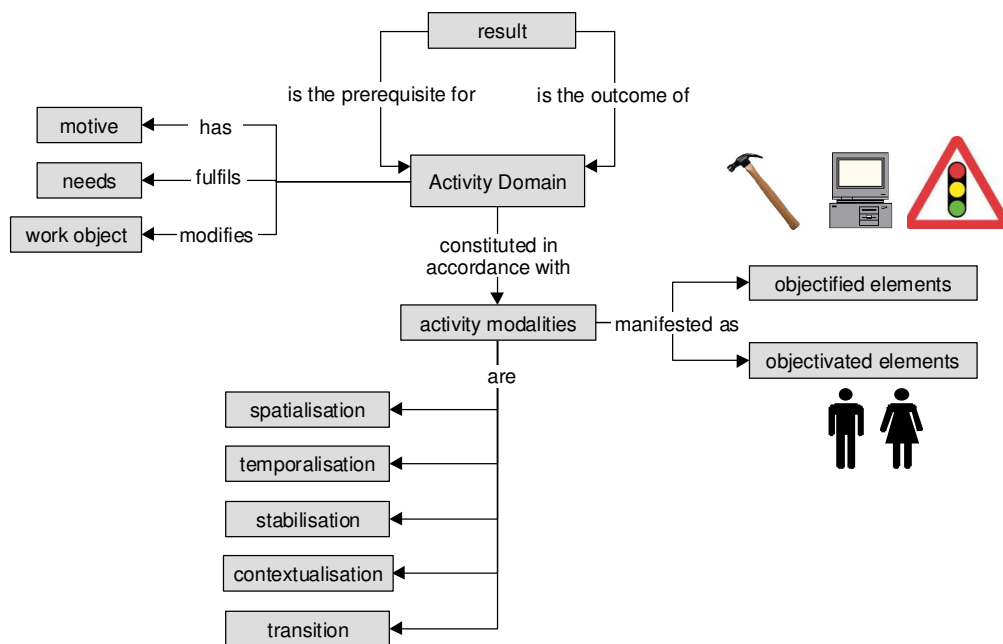


Figure 5: A conceptual map of the elements in ADT

The *activity domain* is the central construct. The *motive* for its existence is to fulfil certain social *needs* by modifying or transforming a *work object*. The domain is constituted in accordance with the activity modalities *spatialisation*, *temporalisation*, *stabilisation*, *contextualisation* and *transition*. These modalities become manifested as *objectified elements* in the domain, and congruent *objectivated elements* in the mind. Only such elements that are meaningful for coordinating actions become manifested. Such elements may be essentially material (as a hammer) or symbolical (as a traffic light). Information systems take a middle position in that it mediates both material and communicative actions.

The coordination of several activity domains is enabled by the *transition* modality, which provides a mapping and translation between communal meanings in different domains. Thus, the *outcome* of one domain may be used as a *prerequisite* in another domain provided that this *result* can be interpreted through the transition modality. This means that the activity domain is a recursive construct that can be applied both to inter and intra-organisation coordination.

From on this description of ADT we claim that the elements are congruent with each other, which means that ADT is grounded internally.

## 6 Comparison

In this section we compare ADT to a number of theoretical approaches from social sciences that have been proposed as socio-technical frameworks for IS practice. The analysis is by necessity superficial and most likely arguable. However, the intention is to provide a broad illumination of the main features of these approaches in relation to ADT. The approaches we will discuss are:

- Structuration Theory (ST: Giddens, 1979; Giddens, 1984; Jones, 1999; Rose, 1998, Rose & Lewis, 2001; Rose & Scheepers, 2001),
- Actor Network Theory (ANT: Latour, 1991; Walsham, 1997),
- Activity Theory (AT: Engeström, 1999; Kuutti, 1991; Kuutti 1996),
- Organisational Semiotics (OS: Stamper, 2001; Liu, 2000),
- Language Action Perspective (LAP: Iivari & Lyytinen, 1998; Lyytinen, 2004; Weigand, 2005).

## 6.1 Basic categories

By basic categories we have in mind fundamental driving forces in the development of ADT.

### 6.1.1 *Integrative construct*

In ADT, the activity domain is a central category which integrates elements of human activity into a coherent whole. AT has a corresponding construct in the “activity system”, which is articulated as elements in a triangular structure (Kuutti, 1996, p. 28). In OS, the concept of organisation is inherent: “Organisational semiotics” is defined as informatics from a social angle. However, Stamper does not define “organisation” very precisely. Some traces of an integrative construct can be found in “subcultures”, which are described as “overlapping groups of people subject to shared norms that enable them to behave in an organised fashion.” (Stamper, 2001, p. 154). In ST, the practice is a salient element. However, the internal structure of it is only vaguely articulated. In ANT, the actor networks of aligned interests, including people, organisations and standards have some resemblance with activity domains. Again, these networks are only vaguely defined. In LAP, there does not seem to be any integrative construct. Such constructs can be found, however, in some theories building on LAP, for example, the practice theory elaborated by Goldkuhl and others (Goldkuhl & Röstlinger, 2005).

### 6.1.2 *Meaning*

OS is particularly expressive in its focus on meaning. Signs are inherent in OS and articulated in the form of the semiotic ladder. Signs can be dealt with in the intersubjective domain, and a language community can bridge the sign - reality gap. Moreover, OS emphasizes strongly communal meanings and mutual commitments. This is true also for LAP with its focus on language and speech acts. In the early versions of AT, meaning was a central theme. This has however become less attended in the elaboration of AT called Cultural-Historical Activity Theory (CHAT: Engeström, 1999). In AT, signs are put on equal terms as instruments, machines, methods, laws, etc., in mediating between the subject and object. The object in AT can be material or intangible, and shared for manipulation into the outcome. Thus, there are some, albeit vague, notions of communal meaning in AT. Concerning ST, the interpretative schemes are considered to be embedded in social structures as signification or meaning. In ANT, meaning is not a salient theme. This is understandable since signs mark a clear distinction between humans and technology, something which is subdued in ANT.



### 6.1.3 *Historicity & change*

Historicity and change are inherent in ST, AT and ANT. This is valid also for ADT, since this approach is based on praxis. In contrast, OS means that the only reality we can know directly consists of here and now. The past and future exist only through signs. Thus, in OS historicity and change are weak. The same seems to be the case for LAP.

### 6.1.4 *Human mind, cognition*

The nature of the human mind was the prime knowledge interest for the Russian Theory of Activity as conceived by Vygotsky, Leont'ev, Luria and others. In AT, mediation can take place at both the individual and societal levels (Engeström, 1999). However, it seems that the main influence in the IS community has been to re-focus the unit of analysis from an individual, cognitive oriented focus to a focus on social oriented activity (Virkkunen & Kuutti, 2000; Kuutti, 1996). The subject can be both individuals and groups, which makes the individual less salient in AT. In ST, the structures of society are seen as traces in the mind, which are instantiated only through action. The communication focus in LAP indicates a close affinity with cognition and perception. However, LAP has primarily concentrated on the structural aspects of language and not on its cognitive basis. The individual as an actor is not emphasized in ANT. Concerning OS "... informatics have no need for perceptions and conceptions" (Stamper, 2001, p. 123). By this, Stamper means that a theory of information cannot take individual perceptions and conceptions as its starting point.

### 6.1.5 *Technology & artefacts*

In both ADT and AT, technology and artefacts are inherent elements in the activity. In ANT artefacts are agents and meanings can be inscribed in artefacts. OS considers the only reality we can know as consisting of the here-and-now and being composed of actual, performable repertoires of behaviour. In this context, technology is perceived only as 'affordances' of agents. In spite of this, there is an outspoken purpose in OS to provide methods and tools for working with organisational semiotics, and thus making organisations more effective and improving the use of technology. In LAP, there is a clear separation between communicative acts performed by language and material acts performed by tools. Thus, technology as a constituent for human action has not been emphasized in LAP. However, the separation between communicative and material acts has been challenged in later contributions (Goldkuhl, 2001; Bødker & Bøgh Andersen, 2005). ST regards technology only as "resources" to be drawn upon in the structuration.

## 6.2 *Activity modalities*

Since LAP is concerned with language and language, according to the discussion in Section 5.2, can be related to modalities, all these are to some extent present in LAP. However, particular modalities are less attended in favour of the overall focus on communication and speech acts. In the evaluation below, we have indicated only specific exceptions from this general pattern.

### 6.2.1 *Contextualisation*

Contextuality is present in all approaches. In ST, the study of context is inherent in the investigation of social reproduction. Context is salient also in ANT on an abstract level as the substitution (paradigm) construct in the program – anti-program trajectory of an invention. In AT, cognitive processes “are processes occurring in concrete, practical activity and are formed within the limits of this activity” (Kuutti, 1996, p. 33). In OS, contextuality is inherent since the affordances of certain agent are context dependent. An explicit treatment of context can be found in some branches of LAP (Lyytinen, 2004).

### 6.2.2 *Spatialisation*

Spatialisation is salient in all approaches to some extent. However, with the exceptions of AT and OS, this category is not particularly articulated. Especially OS emphasizes spatialisation in the form the semantic model, which signifies socially shared affordances and their relations.

### 6.2.3 *Temporalisation*

Temporalisation is also salient in all approaches albeit not very articulated. The emphasis in AT on action in relation to operations and activity has a strong temporal character. In OS every universal and particular affordance has its start and finish for which some agent is responsible. However, this is a rather weak notion of temporalisation.

### 6.2.4 *Stabilisation*

Stabilisation is salient in all approaches. In ST, for example, routinisation is considered to be fundamental. In AT, rules are mediating between the subject and the community. In OS, norms play a major role.

### 6.2.5 *Transition*

Only ADT appears to emphasize transition. In AT, the construct “division of labour” mediates between community and object in a particular activity system. However, there is no indication of a mapping and interpretation between activity systems. A transitional element is traceable in the discussion of “boundary objects” (Bertelsen, 1999). These are objects that can be interpreted differently by different groups (say users and designers) but still maintain some commonly recognised feature which tie different praxes together. In ANT the “black box” concept indicates something relevant to context. However, the internal structure of the black box is not accessible or relevant in that particular context. The black box construct can possibly be apprehended as an activity domain, the outcome of which is used in another domain. In ST, the notion of ‘bracketing’ an area of investigation in the analysis is akin to transition (Giddens, 1979, p. 248 ff.). OS does not seem to recognize transition, neither does LAP.

## 6.3 *Communicative function*

These categories concern the mathetic and pragmatic communicative functions as they are interpreted in the domain construction process (see Section 4.3) in ADT.

### 6.3.1 *Mathetic*

The mathetic function of communication is concerned with the construction of communal meaning. In OS, there is an iterative element in the Semantic Analysis method when eliciting requirements put on an IS. Communal meaning is gradually achieved by refining the semantic model (Liu, 2000). However, this model serves as a specification for further design, for example, using object oriented methods. Thus, the method does not include feedback from the usage of the IS. In essence, OS argues for a linear development model where specification and design are two distinct phases. Concerning AT, Engeström describes an ‘expansive learning’ cycle consisting of seven steps which has an experiential learning touch (Engeström, 1999b). The experiential mode of learning is present also in ST as routinised and recursive social practices. ANT does not appear to have this element. In LAP, the focus is on the pragmatic function. The mathetic function seems to be less attended to.

### 6.3.2 *Pragmatic*

The pragmatic function of communication is concerned with the coordination of acts when communal meaning has been established. This is obviously the focus of LAP, and also, to some extent, OS. The other approaches do not emphasize this aspect.

## 6.4 Results achieved

The comparison in this section concerns analytical and constructive results achieved in IS practice. We are interested in the influence of each approach in complex organisational and industrial settings. This means that the type of ISs involved are large, globally accessible enterprise systems like, for example, ERP or Product Life-Cycle Management (PLM) systems. Thus, we are not concerned with applications developed in the academy for demonstrating a particular approach or advancing the theoretical development of the approach.

There are substantial evidence that all the approaches are viable for analysing IS practices. Concerning the constructive aspect, ADT and OS approaches appear to be the strongest ones. OS has been applied in a number of organisations with large cost savings (Liu, 2000). However, it seems that the applications reported are of less complexity as compared to ADT. Concerning ST, some recent constructive results have been reported (Rose & Lewis, 2001). The same is valid for AT (Korpela, 2004). There are no examples of uptakes of LAP in industrial settings (Lyytinen, 2004). The same is valid for ANT.

## 6.5 Summary

In the table below, the analysis is summarized. A hyphen (-) indicates no presence. The stars indicate different emphasis given to the element, from weak (\*) over modest (\*\*) to strong (\*\*\*). Naturally, these judgments are subjective and should be taken as fairly coarse indicators of the relative weight of each category in relation to the same category in ADT.

Table 1 Comparison between different approaches

	Category	ST	ANT	AT	OS	LAP	ADT
<b>Basic categories</b>	Integrative construct	*	*	***	**	-	***
	Meaning	**	-	**	***	***	***
	Historicity & change	***	***	***	-	*	***
	Human mind, cognition	**	-	**	-	**	***
	Technology & artefacts	*	***	***	***	*	***
<b>Activity modalities</b>	Contextualisation	***	***	***	***	**	***
	Spatialisation	*	*	**	***	*	***
	Temporalisation	*	*	**	*	*	***
	Stabilisation	***	***	***	***	**	***
	Transition	*	*	*	-	-	***
<b>Communicative function</b>	Mathetic	*	-	**	**	*	***
	Pragmatic	*	-	*	**	***	**
<b>Results achieved</b>	Analytical	***	***	***	***	**	**
	Constructive	*	-	*	*	*	***
	<b>Category</b>	<b>ST</b>	<b>ANT</b>	<b>AT</b>	<b>OS</b>	<b>LAP</b>	<b>ADT</b>

Some observations can be drawn from the analysis. The approach that has the closest affinity with ADT is AT. This is not surprising since ADT and AT are based on similar principles. However, no approach is strong on all categories in ADT.

A most striking observation is that the modality transition is not salient in any approach except ADT. This is even more surprising since contextualisation is strong in all approaches. It would seem close at hand to consider not only contextual aspects but also the interaction between different contexts. This is possibly due to the lack of integrative constructs that can leverage the attention to context interdependencies. An awakening interest in this matter can be traced in the discussion of the so called 3<sup>rd</sup> generation of AT (Engeström, 2001).

Most approaches seem weak on the *construction* of communal meaning. The focus appears to be on the pragmatic communicative function. In contrast, meaning construction was one of the main drivers in the development of ADT. This is possibly due to the fact that controversies concerning the meaning of things surge when concrete and detailed IS implementation decisions are imminent (Bititci & Muir, 1997). This is particularly proliferated in, for example, industrial settings. Since most IS applications developed in academia do not make an inroad into industry, it might be that the issue of meaning construction is less attended to.

Finally, it can be seen that only ADT has had a substantial influence on the particular type of IS practice we are concerned with in this paper. The reason for this might be that ADT, in contrast to the other approaches, was devised in the very same

practice it influenced. Thus, it was geared from its outset to the specific needs found in complex, industrial settings.

## 7 Discussion

In this section we discuss how coordination, business processes and communication may be apprehended from the ADT perspective. In addition, we point out some consequences for ISD, state benefits, drawbacks and pitfalls of the approach, and indicate areas for future research.

### 7.1 Coordination – an activity within the activity domain

In the activity domain two intertwined activities are carried out – the coordination activity and the transformation activity. The motive of the coordination activity is to provide coordination to the transformation activity, the motive of which is the transformation of a work object into some outcome such as, for example, a telecom system.

In the coordination activity, actors are constructing coordination manifested as objectified items like information models, business process models, IS support, etc. In the transformation activity, these items are utilized in the transformation of inputs into outputs satisfying the needs of some clients. Thus, by a focal shift between a coordination and transformation focus the activity domain is gradually constructed. Actors may participate in both activities or in either one of them. An example of an actor role, which is relevant in both activities, is a project manager.

The focal shift implies that the same entities are present in both activities. However, different aspects are emphasized depending on the focus. For example, an entity like a requirement may be characterized in the coordination activity by identity, state, revision, attributes and relations to other entities according to the spatial coordination model. In this activity, the actual content of the requirement – the text describing the requirement – is irrelevant. However, the content of the requirement is highly relevant in the transformation activity since it states a capability that must be met by the result of the activity. An illustration of the two perspectives on the activity domain is given in Figure 6:

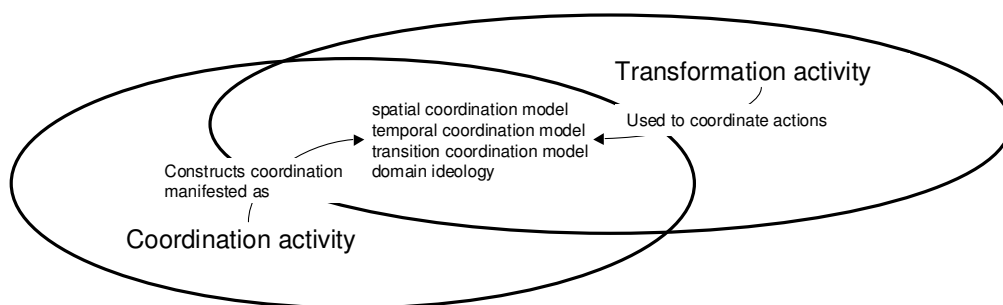


Figure 6: The interplay between the coordination and transformation activities.

The conception of coordination as an activity in the AT-sense implies that we have extended the definition of coordination according to Malone & Crowston. In complex and turbulent organisational environments, it is not sufficient to manage the

temporal dependencies between actions. Spatial dependencies between objects, transitional dependencies between activity domains, technological dependencies between ISs, etc., must also be managed. Moreover, the dependencies between different modalities must be managed. For example, the temporal ordering of actions is dependent on the spatial dependencies between objects, rules and available IS support for carrying out the activities. Consequently, coordination can be apprehended as the management of dependencies between and across elements in a multi-dimensional space given by the activity modalities.

The recursive and scalable nature of the activity domain means that it can be seen as a generic construct, applicable to various work contexts. Teams, projects, functional units, divisions, subsidiaries, the entire organisation, networks of organisations, etc., can all be apprehended as different types of activity domains. The key issue is whether these work contexts have a motive and a work object being transformed. This means that the constituting elements of ADT are found in all these contexts. Accordingly, generic methods for constructing the domains, such as the DCP, are applicable, regardless of the type of work context. For example, intra and inter-organisational coordination can, in principle, be treated in the same way.

## 7.2 Business processes – manifestation of temporalisation

From the ADT perspective, a business process is an objectified manifestation of one activity modality – temporalisation. Models of processes should reflect this modality in the sense that the dependencies between actions should be in focus. The model should also indicate interdependencies with other modalities.

It is customary to illustrate business processes with workflow diagrams as the one in Figure 7:

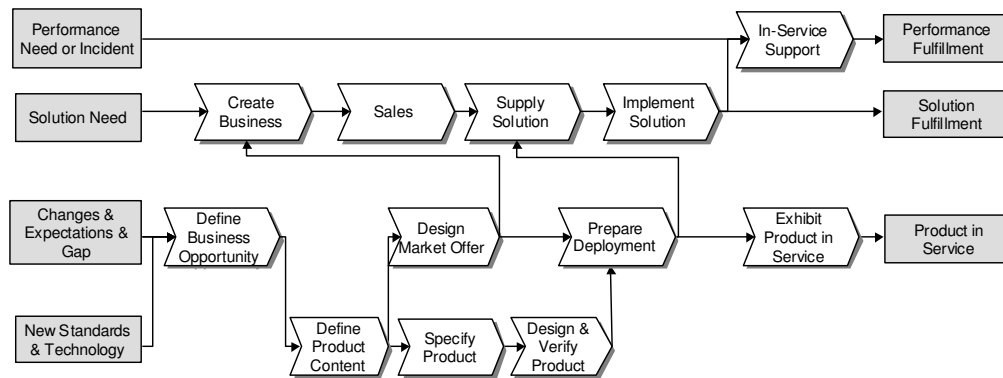


Figure 7: A workflow model of a business process (Ericsson)

Such a model emphasizes the dependencies between actions. However, the state progression of entities is not easily discernable. Thus, the interdependency with the spatialisation modality is obscured. The Information Flow Diagram (IFD) nomenclature is more explicit in this respect. In Figure 8, such a diagram corresponding to the workflow model in Figure 7 is shown:

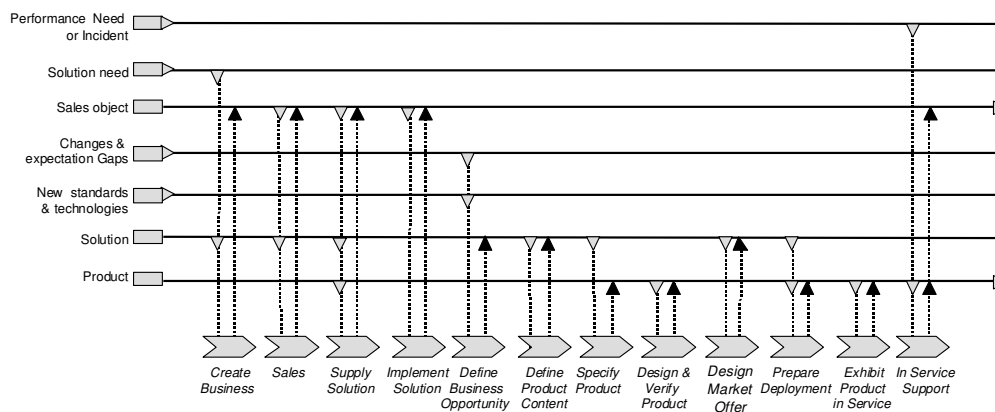


Figure 8 An Information Flow Diagram of a business process (Ericsson)

Although the IFD process model may appear complicated at first glance, it signifies the interdependencies between the spatialisation and temporalisation modalities more distinctly than the workflow model. These interdependencies are manifested by the network diagram relating entities with actions. In this way, the effort of constructing communal meaning concerning the business processes is alleviated. It can also be noted that the dependencies between *entities* is not shown in the IFD model. To this end, the spatial coordination model is needed.

The association of business processes with one modality enables a more precise conception of the nature of business processes. Since the information that the process is operating on is defined in another coordination constituent (the spatial coordination model), it is evident that expressions like “the information in the process” are misleading. Such expressions indicate a primacy of temporalization over other modalities, something that is alien to ADT.

### 7.3 Communication – pragmatic and mathetic

If Jackendoff is correct in assuming that semantic structures are a subset of conceptual structures, and, furthermore, the conceptual structure is reflected in the activity modalities, then, the semantic structures should exhibit traces of these modalities. This is certainly the case. We can communicate about things and their relations (spatialisation) and how to perform actions (temporalisation). There are grammatical rules for how to combine morphemes into meaningful sentences (stabilisation). The meaning of a word is ultimately determined by its context (contextualisation). Different languages can be translated into each other (transition). Consequently, communication in the ADT perspective is seen as a mechanism that enables coordination according to the activity modalities.

This means that the objectivation – objectification process applies to language as well. Objectified elements are the physical patterns of sound waves that become meaningful through the manifestation of objectivated elements in the mind. This process concerns the mathetic function of language, that is, the establishment of communal meaning that can subsequently be applied in coordination through the pragmatic language function.

The distinction between pragmatic and mathetic functions of language has also been discussed by Habermas. In his Social Action Theory (1984) Habermas coined

the notion of communicative action, which is usually defined as “actions towards mutual understanding (*Verständigung*) whose goal is the coordination of the actions of the participants.” (Weigand et al. 2003).

According to Weigand & Dignum (1997), Habermas’ definition of communicative action consists of two elements: *conversational* action and *consensual* action. In conversational action, the emphasis is on achieving mutual understanding. The actors exchange messages without a particular coordination goal in mind. Conversational action contributes to a mutual definition of a situation at hand. In this type of communicative action, the mathetic function of language is emphasised. Consequently, in the DCP, conversational action is dominant in the mathetic phase.

Consensual action has a clear coordination objective and is based on an established, shared definition of the situation. Actions towards achieving mutual understanding are not necessary. In this type of communication, the pragmatic function of language is emphasised. Thus, consensual action is dominant in the pragmatic phase of the DCP.

It follows that there is a straightforward relation between phases of the DCP and Habermas’ theory of communicative action. This might be further elaborated in the future with other elements in communicative action, for example, validity claims.

#### 7.4 From IS development to domain construction

From the ADT perspective, the purpose of an IS is to implement the coordination constituents in a particular activity domain. This means that different properties of the IS are needed depending on the phase of the DCP. Moreover, IS development should be regarded as submerged to a more encompassing construction process – that of constructing the activity domain itself, including the construction of communal meaning.

A general property needed in all phases is signifying accuracy. Sign-tokens like icons, accompanying text, etc., should be easy to understand. For example, the experiences from Ericsson indicate that the OMT nomenclature is easier to comprehend as compared to UML (Taxén, 2003). Thus, in this context, OMT is a better choice than UML as a nomenclature for the spatial coordination model. Moreover, care should be taken to use the same graphical layout of icons in the models and the IS to alleviate the meaning construction.

In the mathetic phase, an initial, tentative communal meaning is constructed. Coordination models, rules, etc., are suggested and tried out frequently. Thus, in this phase, the primary property needed from the IS is flexibility in terms of ease of changing the implementation of coordination constituents. In the consolidation phase, a “prototype” domain is constructed that eventually will become operational. A key issue is to make actors confident with the IS and the data in it. Important IS properties in this phase are acceptable performance worldwide, and interfaces to ISs in other domains. In the operational phase the prime property is the ability to manage instances of all coordination constituents and to change the implementation according to new needs encountered.

The DCP implies that the domains are constructed differently. Even if the same IS platform is used in all domains, the coordination constituents in each domain will be different depending on the motive of the domain, its history, the pre-understanding of its actors, etc. Thus, if some entity, like a product, is modified in different domains, it will be characterized differently. For example, a product in a marketing domain will



emphasize different characteristics of the product that a production domain. This means that the built-in information model of the IS platform should recognize contexts in order to discriminate what properties are relevant. Such an information model has been proposed by Parsons (1996). Established modelling languages, such as UML, do not appear to recognize context as a key modelling construct.

## 7.5 Benefits, drawbacks and pitfalls

Without doubt, the main benefit of ADT is the practical results achieved by applying its principles in providing coordination support for extraordinarily complex development tasks. As pointed out earlier, the results were unparalleled in the history of Ericsson in terms of functionality and effort spent. Several information system applications were developed that supported coordination world-wide. We claim that the key factor responsible for these results is the inclusion of communal meaning as a constructible element.

The robust empirical grounding of ADT is a strong argument for its viability. However, as an attempt to introduce a novel socio-technical approach, the ADT is of course open for criticism from a number of viewpoints. One of the most controversial issues is the assumption of congruence between the structure of mind and the structure of object-related activity. The theory of Jackendoff is not undisputed (e.g. Bunn, 2000). The linguistic based derivation of the ontological categories is open for the same kind of critique as the universal grammar proposed by Chomsky (Chomsky, 1965).

Another drawback of the ADT concerns the nature of activity modalities. There is an uncertainty about what dimensions of human activity should be regarded as an activity modality. For example, in previous contributions (Taxén, 2004, 2005c) technologization or instrumentation was included in the set of activity modalities. The purpose of this modality was to capture the dimension of tools, ISs and other artefacts. However, at present, it seems more appropriate to regard this dimension as mediating actions according to the other modalities. The uncertainty is aggravated by the fact that the empirical grounding comes from one setting only, that of the development practice of Ericsson.

A main pitfall in implementing the ADT approach concerns the organisational awareness of communal meaning as a key constructible element. If the cost of arriving at a working consensus about central terms is neglected or unattended in the organisation, the apparent additional cost of constructing different domains with the same motive can never be justified. This is precisely what happened at Ericsson. When cost-cutting programs were implemented, the four domains were amalgamated into one, thus saving costs for IS licences, maintenance work and employees. However, this in fact wiped out the ADT approach, in spite of its glaring effectiveness in supplying coordination support for some of the most complex systems ever developed at Ericsson.

Another pitfall concerns the implementation of coordination between domains. Such coordination is needed if the domains are contributing to the same goal in another, common domain. The attention of actors in a particular domain will necessarily be focused on the motive of their own domain. Thus, if the common domain is not in place, the coordination between domains will be left unattended, something that was painfully evident in the Ericsson implementation.

Concerning the theoretical grounding of ADT, an obvious pitfall is that the theory may turn out to be of little explanatory or constructive value. After all, it is obvious that human actions draw on spatial orientation, sequencing of activities, some kind of stability and context dependency. Moreover, all the elements of ADT are easily recognized from every-day, ordinary life. However, there is abundant evidence from the literature that these elements are not combined in an integrating socio-technical perspective where the interdependencies between them are emphasised. This is where ADT may play a role in uncovering the basic coordinating mechanisms of human activity.

## 7.6 Areas of future research

Future research concerning the ADT should be focused on strengthening its empirical and theoretical grounding, as well as exploring potential applications of the approach. As with any theory, its viability as a basic framework is determined by the extent and diversity of the areas in which it contributes to relevant results. Some applications reported so far are as follows.

In Taxén & Svensson (2005), an alternative platform for Product Life-cycle Management (PLM) is suggested. PLM is a thriving area in the product development industry representing huge economical values. The alternative platform is based on the activity domain construct and seeks to re-direct the current technology focus towards a socio-technical one.

A central element in Integration Centric Development engineering process at Ericsson is the *anatomy*, which is an illustration – preferable on one page – of crucial functional dependencies in the system. The anatomy is the basis for planning and controlling the project. The approach has proven to be very successful and is now a standard instrument in the development toolbox at Ericsson (Lilliesköld et al., 2005).

In Taxén & Lilliesköld (2005), the Integration Centric Development has been analysed using ADT as a guiding framework. The authors claim that the anatomy and its associated plans can be seen as manifestations of various activity modalities. It is hypothesised that complex development projects need scaffolding by objectified manifestations in several modalities in order to be managed.

The ADT has also been applied in the analysis of aligning business strategies with business processes and business process support systems (Taxén, 2005). The key point in introducing the activity domain is that it enables a “divide and conquer” strategy towards managing complexity while considering cultural and social issues. Alignment is achieved by manipulating either the coordination pattern of activity domains or the inner structure of each individual domain. These two types of alignment are called external and internal alignment respectively. In external alignment, the external context of an activity domain is emphasized while internal alignment emphasizes its internal context.

A theoretical application is reported in Taxén (2005c). In the Cultural-Historical Activity Theory (CHAT) elaborated by Engeström (2001) there is an ongoing discussion of the so-called third generation of CHAT. This generation concerns the coordination of several activity systems. The proposal put forward is to structure activity systems as activity domains. Since ADT and AT are based on the same principles, this should be a feasible way to advance the development of CHAT.

## 8 Conclusions

We have presented the Activity Domain Theory as a socio-technical approach towards coordinating human activity. The main results are:

- The activity domain is apprehended as having two foci: one where coordination is in focus and one where transformation of work objects are in focus. Coordination is conceived of as an activity that provides coordination to another activity – that of transforming prerequisites into results. The coordination and transforming perspectives of the activity domain are dialectically interrelated in the sense that the same work object is utilised in both activities, however differently apprehended depending on the perspective.
- Intra and inter-organisational business processes can be analysed in the same manner due to the recursive nature of the activity domain construct.
- Information systems (IS) are considered as key enablers of coordinating actions according to the activity modalities. ISD should be understood as one element in a larger context – the construction of the activity domain. This construction comprises the construction of communal meaning about the structure of the activity domain.

The ADT perspective implies that the activity domain is the fundamental integrating construct, rather than the business process or coordination. The identification of the activity modalities makes it possible to “decompress” and lay bare fundamental dimensions human activity associated with coordination. By analysing the properties of each dimension and how they are interrelated, strategies for operationalisation of coordination may be envisaged, which includes the construction of communal meaning concerning the coordination. In summary, ADT provides a socio-technical integrative perspective on coordination, business processes and communication that can be applied both analytically and constructively.

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