The Activity Domain Theory – A Framework for Investigating Enterprise Systems

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Abstract. The main point of this contribution is that issues related to Enterprise Systems (ES) can only be solved by placing the ES in a wider context that relates individual knowledge, sense-making and technology into a coherent whole. To this end, the Activity Domain Theory (ADT) is suggested as an alternative foundation for analytical and constructive inquires into ESs. The ADT theory has two roots: a theoretical one in the Russian theory of Activity and practical one in the Ericsson telecom practice, where the author worked for many years. The central constructs in ADT are the *activity domain*, which frames a social unit providing a capability that the organization needs; and the *activity modalities*, which represent innate predispositions for coordinating actions. With these constructs at hand, enterprise interoperability is conceived as a manifestation of one activity modality: the transition between activity domains.

1. Introduction

It is by now well accepted that fundamental issues related to Enterprise Systems (ES) can only be solved by placing the ESs in a wider context that brings individual knowledge, sense-making and technology into a coherent whole. Focussing on the IT-technology only will inevitably yield insufficient results. For Enterprise Interoperability (EI), this means that not only interface technology is essential. Equally important are human aspects such as interpretation of data and making sense of means enabling the transition between ESs.

ESs are meant to provide relevant capabilities for human actors to achieve something useful in an organization. This means that it is necessary to ground theoretical foundations in human action and coordination of actions. The purpose of this contribution is to suggest that the Activity Domain Theory (ADT; [1]) may provide such a foundation.

The ADT has two roots: a theoretical one in the Russian theory of Activity [2] and practical one in the Ericsson[1] telecom practice, where the author worked for many years. The central constructs in ADT are the *activity domain* and the *activity modalities*. The activity domain frames a social unit providing a capability that the

[1] Ericsson is a well-known leading supplier of telecommunication equipments worldwide: http://www.ericsson.com/

organization needs. The activity modalities - *contextualization*, *spatialization*, *temporalization*, *stabilization*, and *transition* between contexts – represent innate predispositions for coordinating actions.

The origin of these constructs can be traced to the authors' work with coordinating large and complex telecom projects. The means used – process models, product structures, business rules, information systems, etc. – stood out as different, yet tightly interrelated means that were profoundly important for the success or failure of projects. Gradually, the notions of the activity domain and the activity modalities materialized as a way to make sense of what seemed to be an incomprehensible complex, everyday reality. This process spanned more than fifteen years and is described in detail in [1].

The paper is structured as follows. First, a brief account of the ADT is given. Next, the theory is exemplified by organisational manifestations of the theory from the Ericsson practice. This is followed by a short discussion about EI, focused around one of the activity modalities – transition. Finally, some conclusions are drawn.

2. The Activity Domain Theory

The activity domain may be illustrated by the mammoth hunt scenery in **Fig. 1**.

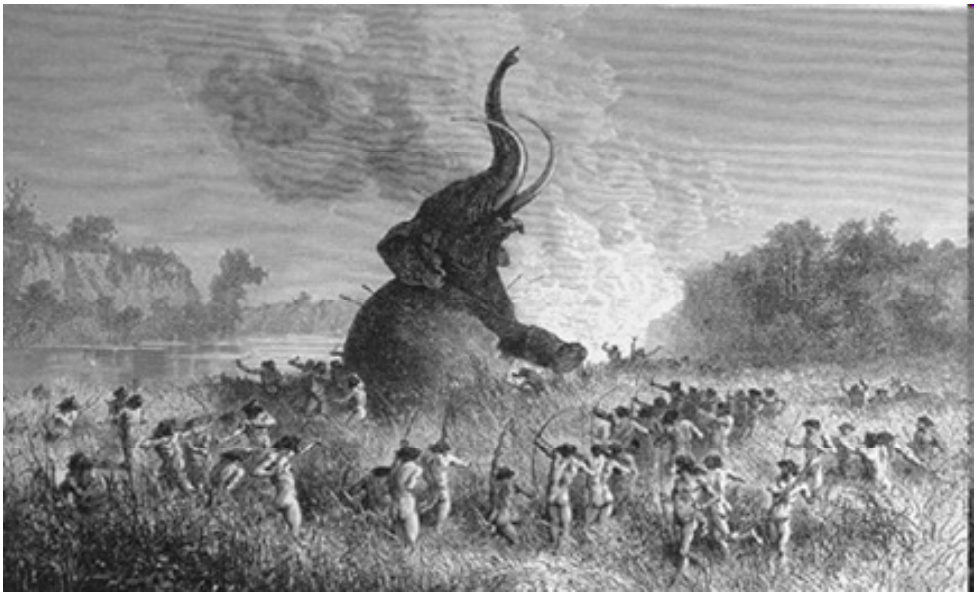

Fig. 1. Illustration of an activity domain ([3], Original wood engraving by E Bayard).

When looking at this scenery some things immediately come to mind. The mammoth is clearly the *object* in focus for actions. According to the Russian theory of Activity, actions are always directed towards some tangible or intangible object [2]. There are also several perceivable *motives* for the hunt: the primary one presumably to get food.

Related motives may be to get material for clothing, making arrowheads, and the like. Together, the object and the motive form a centre of gravity around which everything else revolves: hunters, bows, arrows, actions, shouts, gestures, and so on.

In order for hunters to coordinate their actions, certain capabilities are needed. To begin with, there must be a common understanding about the context around the mammoth. This context frames the relevance of individual actions. For example, it can be seen in the background of the illustration that some hunters, the beaters, have started a fire and make noises to scare the quarry away. The mammoth escapes in a direction where other hunters wait to circumvent the quarry and kill it. However, it is only in the light of the activity domain as a whole that the beaters' actions of scaring the quarry away make sense.

Second, a common sense of what things are relevant in the context must be developed. This enables the actors to orient themselves in the same way as a map does. For example, the river is probably relevant since it is hinders the mammoth to escape in that direction. On the other hand, the fishes in the river are certainly irrelevant in this activity domain (they are of course relevant in a fishing activity domain).

Third, individual actions must be carried out in a certain order. For example, the hunters must be in place before the beaters start making noises, the archers may shoot their arrows at a certain command, and so on.

Fourth, the archers cannot shoot their arrows in any way they like. If shooting in a wrong direction, other hunters may be hit rather than the mammoth. Gradually, after many successful (and less successful) mammoth hunts, a common understanding about how to perform appropriate mammoth hunting will evolve. This provides a common sense of the "taking for granted"; rules and norms indicating proper patterns of action that need not be questioned as long as they work.

Fifth, activity domains are not isolated. The brought-down quarry will be cut into pieces and prepared to eat. This is done in a cooking activity, which in turn has its particular motive (to still hunger) and object (which happens to be the same as for the hunting activity: the mammoth). Other related activities might be manufacturing weapons and weapon parts from the bones and the tusks of the mammoth. So, when several activity domains interact, certain issues must be resolved in the transition between activities, such as how to share the quarry among hunters and cooks, or decide how many ready-made arrow heads will be returned for a certain amount of food. Thus, there must be a common understanding about how to coordinate different activity domains.

These five dimensions of coordinating actions are called *activity modalities*, and represent inherent predispositions for acting in the world. In fact, it is possible to conceive these modalities as an extension of Kant's a priori forms of conception (space and time) that exist without any appeal to previous experience. The term "activity modalities", is deliberately coined to connote with *sensory modalities* such as vision, hearing, touch, taste, smell, etc. Thus, the way we experience the world through our senses, is transformed by our brains into an activity modality percept that enables acting as individuals and together with others [4].

An inherent part of activity domain is that actions are always *mediated* by tools or means. The hunters make use of bows and arrows, the beaters use some kind of tools to make a fire, the assault of the mammoth is most certainly coordinated by gestures

and shouts, and so on. However, these means need to be *enacted*, which is a process by which capabilities of means and humans together become meaningful resources in the domain [6]. The result is that the activity domain frames an *ideology* - that is, a wide-ranging system of beliefs that prescribes what phenomena are considered real and which actions are regarded as valid.

In summary, the activity domain is characterized by the following aspects:

- The actions in the domain are *motivated* be some need, and directed towards an *object*.
- The object and motive impel the formation of a context in which actions make sense (*contextualization*).
- Actions require a spatial comprehension of the context (*spatialization*).
- Actions are carried out in a certain order (*temporalization*).
- Actions require rules, norms, etc., that signify which actions are valid in the domain (*stabilization*).
- The formation of activity domains according to different motives and objects brings about a need to coordinate domains (*transition*).
- Actions are *mediated* by activity-relevant means.
- Means need to be *enacted*.

3. Illustrating the theory

In this section, I will use some examples from the Ericsson telecom development practice to illustrate the ADT in a contemporary organizational setting. The reason for doing so is to demonstrate that the fundamental structures involved in human action are invariant over time and space. In that respect, there is no difference between hunting a mammoth and "hunting" a telecom system.

3.1. The object and motive

A striking way of representing the object in new product development is the *system anatomy*; a frequently used means at Ericsson for visualizing complex telecom systems. The anatomy is an illustration – preferably on one page – that shows *the dependencies between capabilities* in the system from start-up to an operational system [1]. Here, "capability" shall be understood as the ability of a certain system element to provide something that other system elements need. An anatomy for a telecom processor is shown in **Fig. 2**:

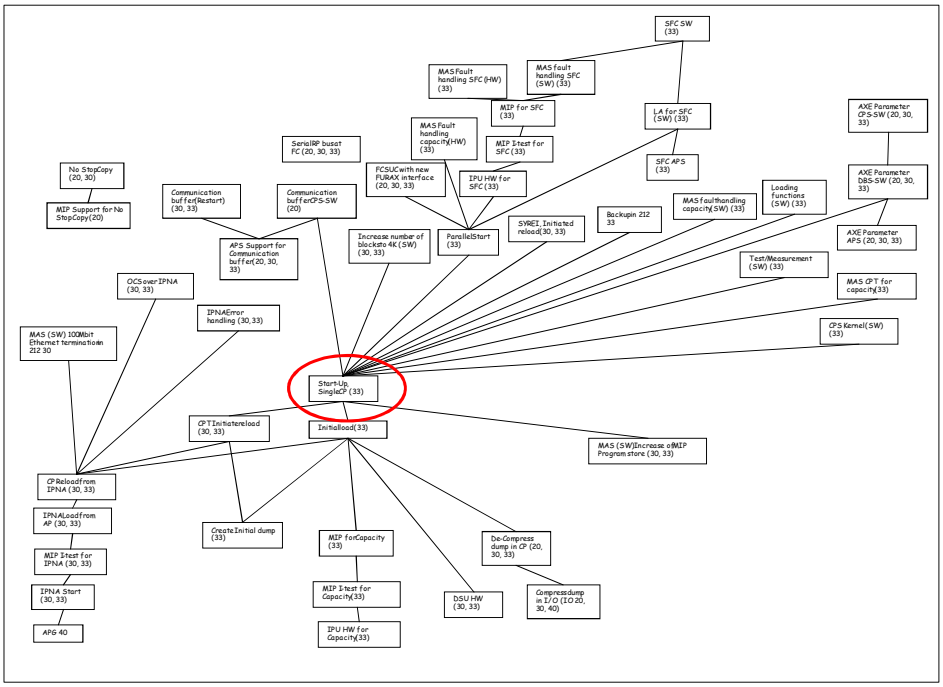

Fig. 2. An illustration of an Object in the Ericsson development activity – a telecom processor

The boxes, also called *anatoms*, (the details of which are less important here) should be read as capabilities provided by one or several modules in the system. The dependencies (lines) proceed from the bottom to the top of the anatomy. If a certain capability fails in the dependency chain, (for example, the encircled "Start-Up Single CP"), the whole system will fail. Since the system is developed and tested in the same order as the capabilities are invoked, the anatomy indicates, in a metaphorical sense, how the system "comes alive"; hence the term "anatomy".

The anatomy can be interpreted as a conceptualization of the object in the activity of developing the telecom processor – a contemporary mammoth hunt. Several motives can be envisaged such as making a profit by selling the system on a market, or simply providing communication capabilities. The gist of the anatomy is to create a common view of the object as a means for coordinating activities. Since most parts of a telecom system is realized by software – which is not physically visible – an easy to apprehend image such as the anatomy is indispensible. Moreover, as a mediational means, the anatomy itself must be jointly enacted by the actors in order to become useful. The mammoth must come out of the fog, so to speak.

3.2. Contextualization

Contextualization can be illustrated by the lifecycle of a product (see **Fig. 3**):

Fig. 3. The lifecycle of a product (courtesy: Siemens PLM Software)

From its inception to its disposal, the product passes through a number of different activities such as marketing, design, manufacturing, distribution, maintenance, and finally, scrapping. These activities are examples of activity domains. Although the product is recognized as a particular individual throughout its lifecycle, it will be characterized differently in each of the contexts. When marketed, properties like appearance, price, availability, etc., are relevant. When manufactured, the manufacturability of the product is in focus. When disposed, recycling and environmental concerns are emphasized, and so on. Although the object / product is the same in all domains, the motives differ, which means that dissimilar domain ideologies will emerge. In order to coordinate the entire lifecycle, an inter-domain ideology needs to be enacted. This process may go wrong in many ways. A classical example is problems that may occur in passing on a product from design to manufacturing.

3.3. Spatialization and temporalization

Examples of spatial structures in the organizational context are information models, object-oriented models, data models, product structures, conceptual models, and the like (see **Fig. 4**):

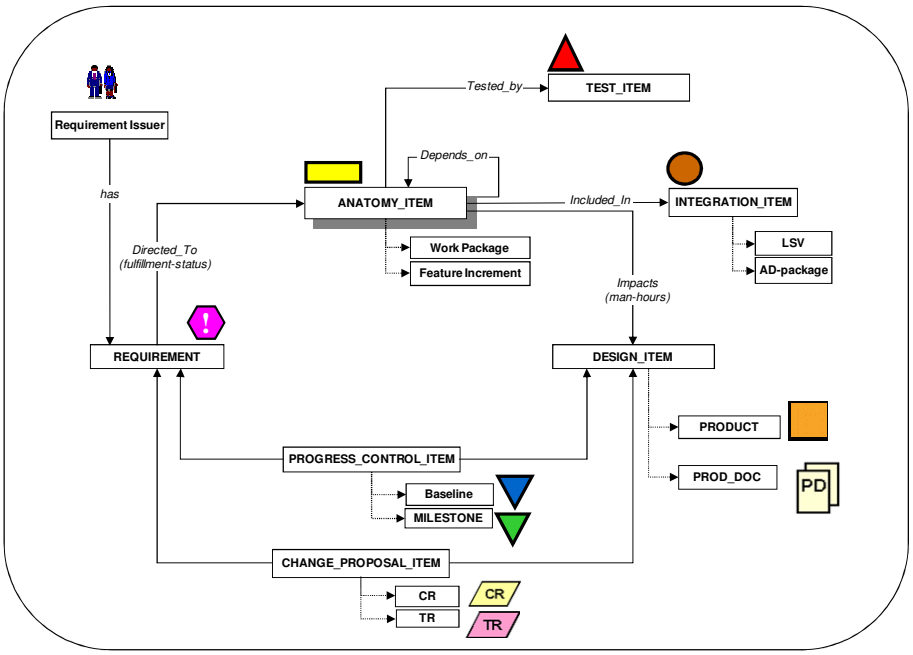

Fig. 4. An information model – a manifestation of spatialization

The image shows an information model for coordinating the development of the 3rd generation of mobile systems at Ericsson around year 2000. The model represents the common understanding of what actors in one particular domain considered relevant information elements for managing coordination. The enactment of this model, and its implementation in an information system, was a long and tedious process spanning several years [1].

Likewise, examples of temporal structures in organizations are business process models, interaction diagrams, event diagrams, use cases, etc. (see **Fig. 5**):

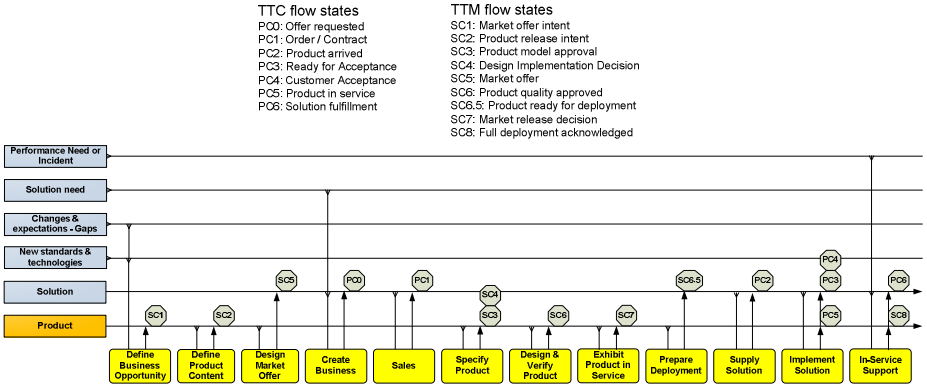

Fig. 5. A business process model – a manifestation of temporalization

The important insight here is that the information model (spatialization) and the process model (temporalization) are two separate dimensions / modalities; yet tightly interrelated[2]. For example, the information element "Product" appears in both modalities.

3.4. Stabilization

In a large and distributed organization like Ericsson, design centers around the world have certain autonomy to evolve locally in the manner they themselves find the best. At the same time, there must be some enterprise-wide common rules about how to approach customers, take heed for compulsory legislative norms, purchase materials, and so on. In **Fig. 6**, two examples of such stabilizing elements at Ericsson are shown; rules for how to identify products and documents:

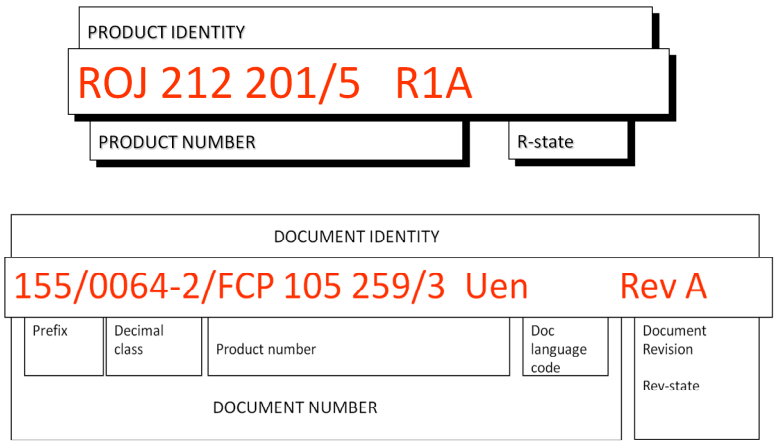

Fig. 6. Rules for identification – a manifestation of stabilizing elements

As can be seen, the particular way rules are manifested at Ericsson (and, for that matter, any other organization) is idiosyncratic. For most people, they are completely unintelligible. In order to make sense of these rules, they need to be enacted by actors in the Ericsson activity domain.

3.5. Transition

Transition is, in short, the complement to contextualization[3]. In organizations, we find an abundance of transitional elements such as contracts, agreements, interface

[2] In the vocabulary of the ADT, these dimensions / modalities are *dialectically* related; meaning that the modalities (the parts) constitute an inseparable whole, which in turn constitutes the modalities (parts) [1].

[3] The term "transition" is derived from the lexical definition "passage from one state, stage, subject, or place to another" (Merriam Webster, 2008).

specifications, mapping between different article codes, conversion between analog and digital signals, compilers for software languages, and so on. The division of labor raises the issue of how different organizational units shall work together. Differentiation and integration of work are opposites that somehow need to be reconciled [5]. An example of this from Ericsson is shown in **Fig. 7**:

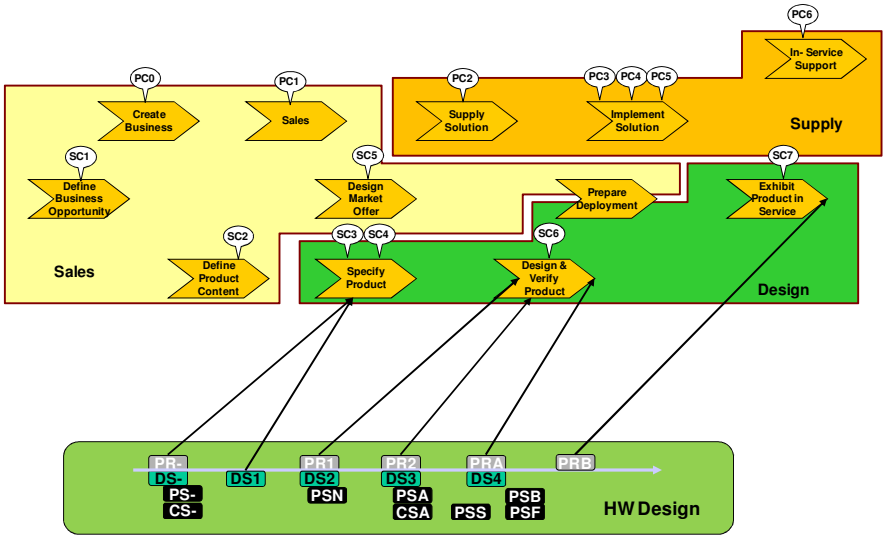

Fig. 7. Mapping between states – a manifestation of transition

The figure is an illustration of how four activities – Sales, Design, Hardware Design, and Supply – are coordinated in terms of information element states. In particular, the figure shows how states in the activities "HW Design" and "Design" are mapped onto each other: PR- and DS1 are mapped to SC3 and SC4; PR1, PR2 and PRA to SC6; PRB to SC7. Such "mapping rules" between states in different activities are examples of organizational transitional elements.

3.6. Mediation

A most obvious manifestation of mediating means in organizations is information systems. A particular kind of such systems is ESs, which can be regarded as a coordinative tool; a means to coordinate actions between actors in the same activity domain, or between different domains (see **Fig. 8**):

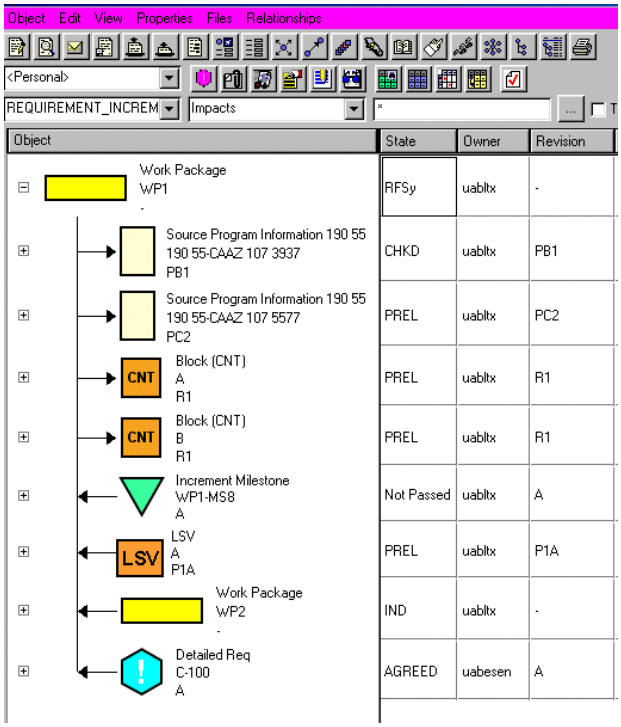

Fig. 8. Information systems - mediational means manifesting various activity modalities

Contextualization is evident from the fact that the information shown is based on the information model in **Fig. 4**. Only such items that are relevant in the domain are visible. Spatialization is shown, among other things, in the relationships between items as indicated by the arrows. Temporalization can be noticed from the states of the items, since actions change the states. Stabilization is evident in the Ericsson specific way of naming items. Transition is not immediately visible in the image, since it shows the context of one domain only. In other domains, similar manifestations will appear; manifestations that are relevant for that particular domain.

4. Enterprise Interoperability

In the ADT perspective, interoperability is taking place between activity domains. Thus, interoperability is concerned with the activity modality transition. The most tangible manifestation is quite naturally the technical means implementing interoperability, for example, the interfaces between two ES data bases.

However, according to ADT, all modalities must be considered in EI. This means first of all that the data passed through the interfaces must be interpreted by the actors in the domains in such a way that a transition is possible. This can be achieved in several ways. For example, a common understanding of certain transitional terms and

concepts can be developed. This is an awkward undertaking that usually requires quite an effort from the actors. Another way is to establish rules for translating terms between domains, as shown in the example in **Fig. 7**. Since rules are manifestations of stabilization, it can be seen that this modality is also at play in transition. The same can be observed about the other modalities. For example, an interaction diagram (a manifestation of temporalization) is a way to define the data flow in the interface.

Moreover, since each domain by necessity develops its own, domain-specific ideology, it is not possible to achieve a total common understanding between domains. This applies, in contrast to widespread thinking, also internally in an organization, simply because different domains work on different work objects (see **Fig. 3**). Thus, it is necessary to achieve a balance between intra- and inter-domain aspects.

5. Conclusion

As the two examples of the mammoth hunt and the Ericsson telecom development practice show, the same structures are at play in both situations. This is a strong indicator of underlying, fundamental human faculties for acting in the world. In the ADT these faculties are represented by the activity domain and the activity modalities.

If the ADT turns out to be valid, it will have profound impacts on the way we think about organizations and ESs. Human aspects such as sense-making and common understanding are included together with technology into a common framework. The activity domain is perceived as the core construct of organizations, which provides a common way of interpreting all organizational constellations; from a team to collaborations between extended enterprises. Mediational means such as ESs may be devised in accordance with the activity modalities. Interoperability between domains are regarded as manifestation of transition, which enables a necessary broader view of interoperability than as just technology; an interpretation that is necessary to tackle the enormous complexities when introducing ESs in and between organizations.

Thus, the ADT provides an alternative theoretical framework for making analytical and constructive inquires into ESs in general and EI in particular. Since the ADT is a novel approach, it needs to be more researched, in particular with respect to the alleged claim that the activity modalities are innate predisposition for coordinating actions[4]. In addition, the theory needs to be further validated in practical settings outside the Ericsson context. In conclusion, this contribution addresses many question in the CFP, but in particular the following one:

- Why is research in the proposed field important in relation to enterprise environments?

[4] Some preliminary results are reported in [4], where also a research program is suggested for this task.

6. References

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