

Means for cooperative work and activity networks: An analytical framework

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Abstract. We present a model that links together individual actions, cooperative activities and activity networks, identifying three categories of means, respectively – means of work, means of cooperation and coordination, and means of networking. Finally we discuss the contribution of this framework for CSCW theory and practice.

Objective: Requirements for an improved framework

Activity theory (Engeström, 1987; Engeström, 1999a; Hedegaard et al., 1999) has been suggested as a suitable framework and methodology for CSCW and information systems since more than a decade (Bertelsen and Bødker, 2000; Bødker, 1991; Kuutti, 1991; Redmiles, 2002). A number of researchers have recently applied the framework in CSCW, mostly in the form developed by Engeström (Bardram, 1997; Bardram, 1998; Bardram, 2000; Engeström, 1999b; Kuutti, 1995; Kuutti and Arvonon, 1992; Tuikka, 2002; Turner et al., 1999).

Activity theory in general and Engeström's Developmental Work Research in particular emphasize that activity is a collective phenomenon, involving several actors. The studies reviewed above, however, tend to reduce activity into a set of actions by an individual – "the doctor's activity", "the patient's activity", etc. The analytical model does not guide the researcher clearly enough into studying the individual and collective aspects of work activities within the same framework. This leads to relatively weak support to designers of cooperative systems. There is a need for further development of the activity-theoretical

model, which has been taken as granted, virtually unmodified, by researchers for twenty years.

Any analytical framework in CSCW, in our mind, needs to meet the following requirements:

- (1) The starting point must be work activity as a systemic entity.
- (2) Technology, including computer-based technology, must be seen as a facilitator to work, embedded in the “work system”.
- (3) Both collective and individual aspects of work need to be included.
- (4) “Work systems” need to be studied in their organizational context.
- (5) The analytical framework must be based on sound theoretical basis.
- (6) The analytical framework must be applicable to both descriptive studies and practical development.
- (7) The analytical framework must support both technological development and developing the work practice itself.

Activity analysis and design (ActAD)

The activity analysis and development (ActAD) framework has been modified from Engeström’s original model, but aims at making the co-presence of the individual and collective aspects of work more apparent (Korpela et al., 2000; Korpela et al., 2002). The model starts from presenting the elements of a *mediated action by an individual person* (Figure 1, leftmost part) – the subject or actor, the object of the action, the instruments or means (both mental and physical) needed for the action, as well as the goal (Vygotsky, 1978). For instance, a carpenter applies a hammer and his skills on some planks and nails in order to construct the scaffolding for a building.

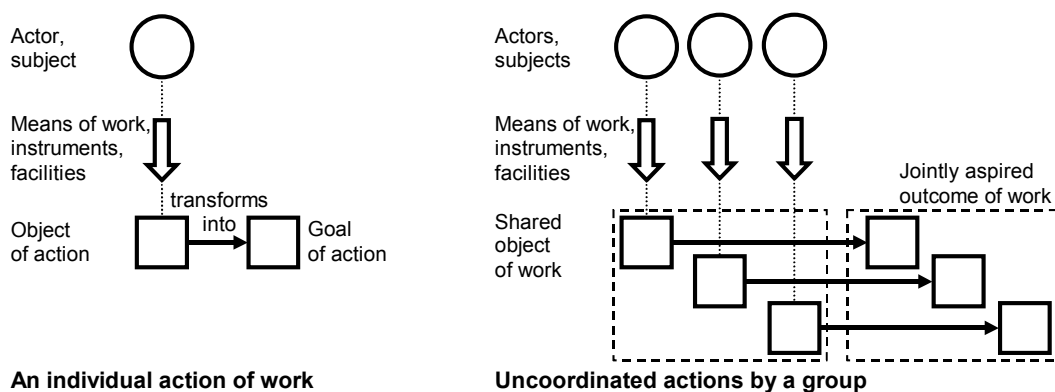


Figure 1. An individual mediated action and uncoordinated actions by a group.

In practice it almost always takes several actions by several individuals to produce any useful service or product (Figure 1, rightmost part) – for instance, a number of carpenters, bricklayers and electrical workers etc. are needed to build a house. In activity theory, such a set of mediated actions on a shared object by a number of actors, directed by a (more or less consciously) jointly aspired outcome, is called an *activity* (Leontiev, 1978). It is important to notice that individual human actions can only be understood through the collective activity which they are part of. Instead of bunches of uncoordinated actions (Figure 1), work in practice consists of systemic activities (Figure 2) subordinating the actions in a purposeful way.

In addition to the instruments or means of the individual actions, other kinds of mediating instruments – ‘social infrastructure’ – are needed as well within an activity, as emphasized by Engeström (1987). The actions need to be oriented by *means of coordination and communication* (Figure 2) – for instance, a blueprint, division of labour, meetings, rules, etc. among a construction team.

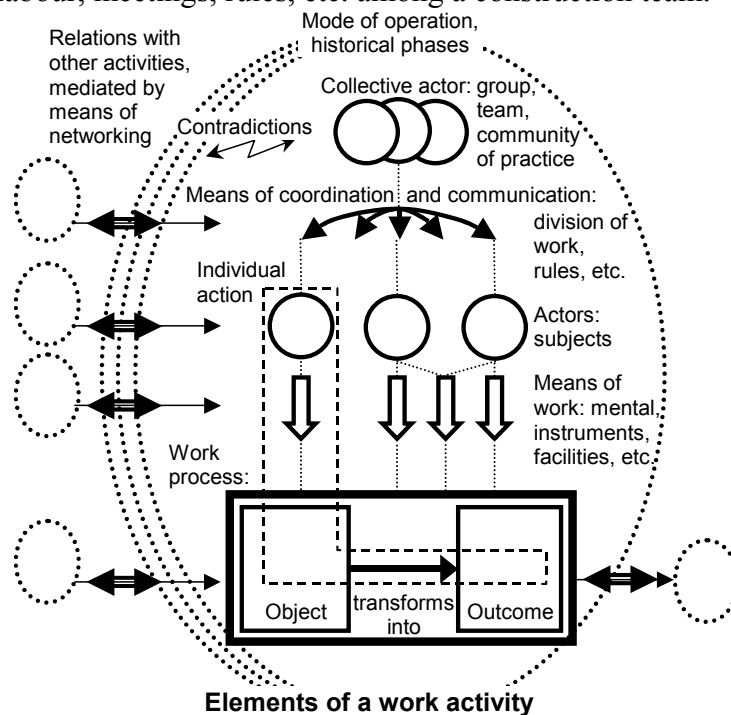


Figure 2. The structure and relations of a work activity as a systemic entity.

A work activity is a systemic entity (Engeström, 1987). There must be a relative fit between the elements of a work activity, a *mode of operation* (Figure 2). When an activity evolves over time, it moves from one relative fit to another, from one mode to another, in historical phases. Today’s house-building activity is quite different from what it was twenty or a hundred years ago, both in terms of

the elements (actors, object and means) and in terms of the systemic mode of the activity. Contradictions, imbalance between the elements and the mode, are the force driving the activity to transform.

Finally, activities do not stand alone. The elements of one activity are produced by other activities, and the outcome of one activity is usually needed in one or more other activities (Figure 2; Engeström, 1987). Construction workers do not cut and saw trees into planks on site any more, but buy planks sawn elsewhere in another activity. The relations between activities need to be mediated as well, by *means of networking* (Korpela et al., 2000). For instance, advertisement, contracts, transportation etc. are needed to link sawmill and house construction activities.

Discussion and conclusion

Compared with Engeström’s original model, ActAD includes both individual actions and collective activity explicitly intertwined in the same model, emphasizes the systemic mode, generalizes the means of coordination and communication, and introduces the means of networking (Figure 3).

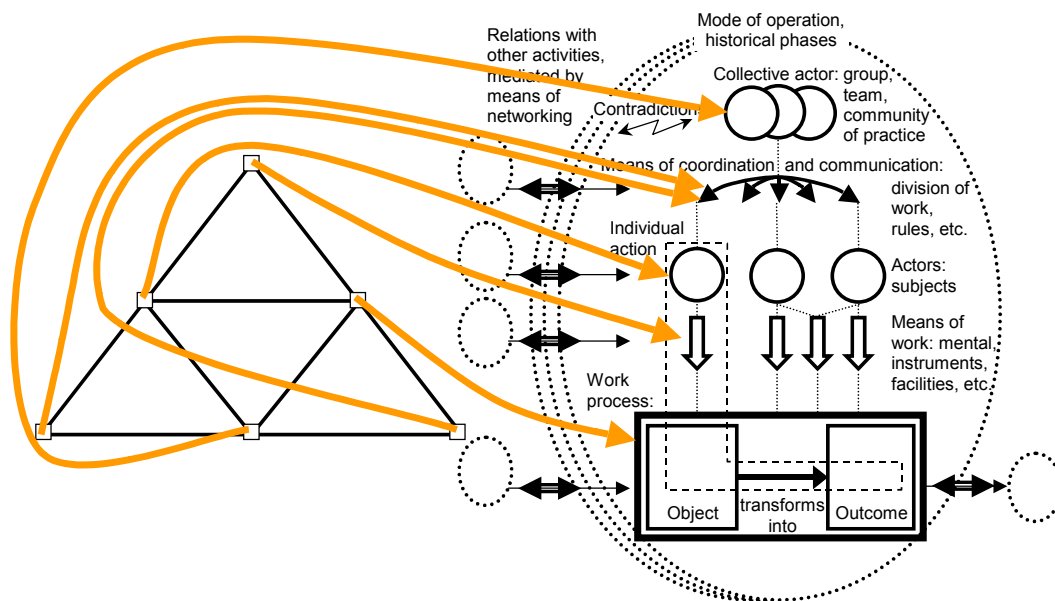


Figure 3. The transformation between “Engeström’s triangle” and the “ActAD oval”.

In the above we have purposefully avoided mentioning computer-based information and communication technology (ICT) among the means. If ‘work’ is indeed the primary unit of analysis (Alter, 1999; Alter, 2001; Alter, 2002), networks of purposeful activities of work are to be analysed first in their entirety,

including all kinds of means that they subsume. It is only within such a holistic framework that the current or required new ways of using ICT as means in work practice should be analysed.

However, while ICT is becoming increasingly ubiquitous, it is one of the most important kinds of means in and between many information-laden activities. The need for new information-technological means is one of the most common drivers for change in work, and information systems projects one of the most common forms of change (Korpela et al., 2002). Therefore it is feasible to further develop ActAD into a specialized methodology for ICT-facilitated work development: Activity analysis and design with information systems (ActADIS). It seems particularly attractive to relate an action within an activity with a use case in Unified Modeling Language UML.

According to the model, ICT can be used as a means in three different ways – as a means of work in individual actions, as a means of coordination and communication between actors in an activity, and as a means of networking between activities. The first kind of means is the focus of human-computer interaction (HCI) studies, the second one that of CSCW, and the third one is mainly studied by information systems (IS/MIS), as Grudin (1994) has pointed out. However, the scopes are overlapping. From the viewpoint of supporting work activities by ICT, all three kinds of means are needed and therefore both HCI, CSCW and IS viewpoints should be applied in most developmental endeavours.

The ActAD framework is an attempt to address the need for an improved analytical framework as specified in the beginning of the paper. We ask the ECSCW'03 AT workshop to assess the framework against the objectives, both as a research methodology and as a practical systems development methodology in CSCW.

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