

CONTEXT ENGINEERING AND MODELING CHALLENGES

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Abstract

The authors previously proposed the Context Engineering (CE) approach to Information Systems Development (ISD) as a framework to organise ideas about previous development experience and to guide future research on specific ISD methods and techniques. The goals of the CE approach are: to achieve an understanding of the ISD as socio-technical phenomena within a cultural and historical envelope; to provide a framework of problems supported on the relation between context and mediators; and to use contextuality as a key to performing emancipatory movements.

Fundamental concepts are the notions of context as figure-ground and as autopoietic flux, of human activity as unit of contextual analysis, of the pervasiveness of mediation in human activity, of socio-technical networks as media and the hypothesis of a heterogeneous social engineering. A framework of development problems is presented along with a discussion of general and process related principles for the CE approach.

A fundamental challenge proposed in this approach is the modeling of context as central influencing aspect of development, and the need to find appropriate instruments – concepts, techniques, representations – for modeling context as part of the ongoing decision making processes in the flow of ISD development activities. Moreover, we need modeling approaches that enable participation and focus on socio-technical relationships as the fabric of reality .

Keywords: *Context Engineering, Context Modeling, Information Systems Development.*

1. THE CHALLENGE OF CONTEXT IN IS DEVELOPMENT

The process of IS Development has long been understood by practitioners as an opportunity for the transformation of work, if not its main motive. In this transformation we can identify a dialectics between an idea of organisation or context of intervention and the goals, roles, instruments, rules and practices, and their relations within the context of the intervention. Intentional formulation of the intervention presupposes some form of understanding about the target context and the role the IS may play on that context.

Context has long been a key issue in the engineering and design disciplines as a complex of conditions that must be understood in order to develop an artefact that must fit that context, achieving some set of goals while possibly changing some of the initial conditions. The requirements analysis phase in Software Engineering aims to elicit a set of conditions formulating the problem to be solved in a tractable and objective way and thus enabling some distance or isolation from the complexities of everyday changes. Yet, in IS Development there is more to requirements than elicitation. Depending on how radical we are about our philosophical background, we may understand requirements as being constructed on a daily basis by a social network of human and non-human actors. Requirements construction brings with it the question of stakeholders, i.e., requirements to whom and by whom. And we need not look much further to uncover the question of IT and organisational alignment. All this we can argue to be dependent on our particular understanding of what constitutes the organisational context.

At least since [Suchman 1987] we have learned not to trust plans and formal definitions of procedures for the real everyday activities. As she points out, plans are good enough as descriptions or rationalisations of human activities, but their role may be minimal during actual activity. Based on accounts of human action, she argues them to be situated in a running context. It would be difficult, if not impossible, to consider all the contingencies in an *a priori* prescription of the action, and some *a posteriori* rationalisation tends to overlook details that may have been crucial in the development of a course of action. Contextual information, being tacit, tends to be overlooked or unspoken as it is frequently understood as trivial or already shared as common ground. What does this mean for someone doing IS Development? Can we trust procedural or functional descriptions of organisations and individual roles as complete accounts for the real thing, thus ignoring variability and free will? Should we take them as fallible or auxiliary communicational constructs and try some form of development *in situ*?

Several recent reports [Kyng 1997] explicitly acknowledge the importance of context in design. Participatory approaches, as a development strategy, try to overcome, among others, the difficulties in understanding the usage situation. Ethnographic methods like *Contextual Design* [Beyer et al 1998] propose on site observation of the situation and its extensive documentation for later analysis and integration into a design phase, in a cascade-like approach. For dealing with contextual issues, there are also scenario-based techniques, used in diverse fields, from strategic analysis to system design. Those usually take the form of verbal accounts for typical or extreme situations. Scenarios may be combined with a participatory approach to modeling. Of course, all these assume a common understanding among the players of what constitutes reality, i.e. an ontological view shared by all participants that enables them to focus on designing the solution. But that understanding may itself be the focus of initial debate as, for instance, in the Soft Systems Methodology [Checkland, Scholes 1999].

Each other's understanding of what constitutes the nature of the object and of the context of our development work is central to what the actors involved can formulate as development goals. For instance, when people begin to recognise the social dimensions in development, quite different methods begin to emerge. The sociotechnical tradition, present in ETHICS [Mumford 1983, 1999] and in the scandinavian infological and trade-unionist approaches [Iivary, Lyytinen 1999], is a case in

point, although lacking the volume of experience we have with more technically oriented approaches. Recently, Kling and Lamb considered change in digital economy organisations, sociotechnically [Kling and Lamb 2000]. Reviewing previous work, Sawyer and Rosenbaum, distil a research basis for what they call social informatics [Sawyer, Rosenbaum 2000] and put to good evidence the role of context in development. Still, the social dimension in development may be recognised in many ways, promoting different conceptions of the object or motive for development and respective formative context, of the idealised methodological processes and of the phenomenon of development itself.

Ciborra [1999] builds a strong case as to the neglected concept and role of improvisation in organisational life and, consequently, on IS development. This author makes extensive references to many studies that reveal that improvisation, ubiquitous as it may be, is frequently overlooked in favour of planned action, and development efforts tend to focus, accordingly, on instruments for that kind of action. Lately, Ciborra, Monteiro [2000], Hanseth [1998], among others, produced several interpretative studies that recognised and even emphasised a less controlled view of development efforts and put forward a concurrent "drift" perspective, recognising development as a complex process of heterogeneous interactions, with less predictable outcomes. With this, comes a notion of installed base cultivation that views technological development within the context of an infrastructure that keeps evolving, and that is more akin to the idea of cultivation.

Bergman, King and Lyytinen [Bergman et al 2002] also talk of heterogeneous engineering, in the context of studying requirements engineering from a sociotechnical standpoint. They arrive at an evolutionary, two-way influence between problem space and solution space, fostered by heterogeneous influences and conditions. We think that all these studies stem from differing contextual views and, as such, reveal the importance of context and call for a better understanding of its role in development and how it influences the construction of our approaches. On the other hand, we think that there is an identified need for a new conception of IS development that recognises the issues raised by those studies.

2. THE PROBLEMS OF CONTEXT

In a seminal essay on "The Problem of Meaning in Primitive Languages", Bronislaw Malinowski (1923) elaborated two important themes that were to figure prominently in the study of context: 1. That language is embedded within a context of situation; 2. That Language must be conceptualised as a mode of practical action. Such a perspective on language as "an indispensable element of concerted human action" led him at a later date to articulate a view of meaning as something embedded within trajectories of action, and the word as a means of bringing things about, a handle to acts and objects. He also told us that "Meaning [...] does not come [...] from contemplation of things, or analysis of occurrences, but in practical and active acquaintance with relevant situations. The real knowledge of a word comes through the practice of appropriately using it within a certain situation." What we think this anthropological text means for the study of the engineering activity and the education of ISD professionals is a need for a firm grasp of the role played by context, or the lack of it, in communication and learning.

The concept of context resists a single technical definition and poses significant challenges as one proceeds from one research area to another. Sharfstein tells us about his working definition as that which envelops the object of interest and that by its relevance helps explaining it [Sharfstein 1989]. And adds that by definition context is what is relevant for what we aim to explain and excludes all other however near it may be found but that does not offer the required explaining power. The author proceeds explaining, making a difference between contextualism, relativism and scepticism in terms of the degree of argument and elaborates on what he calls the problem of context. A purely philosophical approach would be caught between an illusion that full knowledge of circumstances would enable perfect explanations, but, on the other, such omniscience would be logically inconceivable, since knowledge itself depends on limiting conditions that make it worth, and as such omniscience seems humanly improbable.

From the Latin *contexere* [Dilley 1999], which means weaving or joining together, alluding to a process of weaving words to produce elaborated speech, the search for context would be the establishing of connections between elements enabling the construction of explanations for a situation. Dilley tells us that context has long been a key concept in studies of language and anthropology. And adds that for a time its use remained mostly tacit and, in the attempt to produce contextualized versions of their knowledge, several authors from cultural anthropology forgot about the nature of context itself and considered it static, clear and self-sufficient, even self-evident, requiring no extra duelling. Fabian, in [Dilley 1999] says those studies reveal the underlying positive view of context. Yet, context is itself an apprehension subject to interpretation prior or after that of the contextualized object. The context is itself a choice and, when explicit, a human construction. Context is thus part of the problem in the way that we chose to interpret our own rules. There are thus, at least, two approaches to context in anthropology: thinking about it as connections to be established by the interpretative act; and thinking about it as object of study, itself subject to analysis. Dilley cites Wittgenstein's word of advice, not to seek for the meaning of context but for the uses of the concept.

Introducing a set of studies of the role of context [Goodwin, Duranti 1992], Goodwin and Duranti refer to several understandings of context and its use. The most common would be the dichotomy between focal event and context. Focal event is the object or event of interest to be explained and context the environment that is brought into the explanation. The context is thus a frame that surrounds the event being examined and provides resources for its interpretation. The notion of context thus involves a juxtaposition of two entities, a focal event and a field of action within which that event is embedded. A relationship between two orders of phenomena that mutually inform each other to comprise a larger whole is absolutely central to the notion of context. From a comparison with the relationship between organism and environment, from cybernetic theory, a parallel is drawn on the problem of delineating where the system ends and where the environment begins, that is what is the context that informs a certain behaviour. Making use of a Bateson's metaphor (1972) of a blind man with a stick crossing the street, the authors expose a number of issues central to the analysis of context. First, the importance of taking as a point of departure for the analysis of context the perspective of the participant(s) whose behaviour is being analysed. What analysts seek to describe is not what they consider context, but rather how the subject himself attends to and organises his/her perception of the events and situations that he is navigating through. Second, the metaphor illustrates how what a participant treats as relevant context is shaped by the specific activities being performed at that moment. Continuing, Goodwin and Duranti, explain how "one of the great difficulties posed in the analysis of context is describing the sociohistorical knowledge that a participant employs to act within the environment of the moment". Moreover, "in so far as participant's articulation of their environment is shaped by the activities of the moment, the context that is relevant to what they are doing changes radically when they move from one activity to another". "The dynamic mutability of context is complicated further by the ability of participants to rapidly invoke within the talk of the moment alternative contextual frames". This is one of the key insights from Gumperz notion of contextualization cues.

Concluding, such phenomena demonstrate the importance of, "first, approaching context from the perspective of an actor actively operating on the world within which he or she finds him- or herself embedded; second tying the analysis of context to study of the indigenous activities that participants use to constitute the culturally and historically organised social worlds that they inhabit; and third, recognising that participants are situated within multiple contexts which are capable of rapid and dynamic change as the events they are engaged in unfold". Within social situations a key constituent of the environment are other human beings, who are active agents with their own plans and agendas. People become environments for each other. Of the themes being addressed in [Duranti, Goodwin 1992] is the capacity for human beings to dynamically reshape the context that provides organisation for their actions within the interaction itself. The dynamic and socially constitutive properties of context are inescapable. "Each additional move within the interaction modifies the existing context while creating a new arena for subsequent interaction". Moreover, as strategic actors, individual participants can actively attempt to shape context in ways that further their own interests. In so far as

the processes to which context is relevant are social and interactive, one party's proposals as to what should constitute operative context might fail to achieve ratification by others. Miscommunication and active challenges to a proposed redefinition of the situation are possibilities. In brief, context is viewed as a socially constituted, interactively sustained, time-bound phenomenon.

3. CONTEXT AS HUMAN ACTIVITY

In "Through the Interface", Bodker [1991] first used Activity Theory (AT) as a theoretical framework for dealing with context in Human-Computer Interaction and design. Blackler refers to the AT historical perspective as essential for understanding the transformations on activity systems [Blackler 1995]. Kuutti [1991, 1996] has since argued in favour of taking activity as the basic unit of analysis to understand the coherence of individual actions in the larger social context, useful in IS development. Later, [Kuutti 1999] argued the relevant role Activity Theory can play as a basis for a critical view of information systems.

Engeström's model of the activity [Engeström 1987], an extension of the original subject-object instrumental mediation originated in the study of language and signs [Vygostky 1978], by explicitly considering the community dimension, reveals a richer set of relations and respective mediators. This model can be used as a guide for the analysis of different types of mediations in individual and social human activity. The artefacts, considered as instrumental mediators enabling their user to relate to the object of interest, and thus to achieve an outcome, are now accompanied by social rules governing the subjects relation to the community and by a division of labour organising the relation of community and object of the activity. These are the three prime relations that can easily be brought into explanations about every human activity and in particular for the multidisciplinary of ISD [Almeida et al 2002].

But Engeström's contribution does not stop there. He goes on to explore the relations and possible contradictions between the elements of activity systems and between activity systems. He exposes another construct that can be useful to interpret what goes on in organisations as change takes place through development efforts. With the Cycle of Expansive Transition we can build understandings about organisational learning as transitions in activity systems as change occurs to adjust to or try to solve contradictions. The author has further elaborated to consider a methodological proposal for achieving the transformation of work as Developmental Work Research, of which a later form can be found in [Engeström 1999]. Remembering the materialism of the mediations of human activity underlying this theory, we can then understand why ISD can be viewed as a case of Expansive Learning. If we understand organisations as activity systems, then we can interpret organisational transformation through cycles of expansive transition, by which individual activities are transformed and adjust within the context of neighbouring activities, possibly in ways not anticipated. In the process, we can draw some conjectures about the assumptions frequently made in and about IS Development methods and why they supposedly so often fail, like assuming the deterministic nature of the process and the outcome, ignoring changes in motives and goals, ignoring actors, human and non-human, ignoring the multiplicity of disciplinary agencies involved. In sum, ignoring the influence of the current context in the formal, material and effective constitution of the ISD intervention, the current form of activity that is the context within which the intervention will be interpreted.

4. CONTEXT AS HETEROGENEOUS SOCIAL NETWORK

A perspective of context as social network offers the ability to build understandings of the context for action based on interactions between actors. Actor-Network Theory (ANT) offers a language base for those wishing to exercise explanations of social phenomena supported on relationships between actors as the constitution of the actors themselves. ANT enables the exploration of both micro- and macrosociologies of the actor as network and of the network of actors, as a minimal ontology for an ethnomethodological approach [Latour 1999]. ANT enables the analysis of sociotechnical contexts

that views technology not as neutral to human values and interests but as influencing relations of power and of people with their environment [Callon 1991]. Latour [1991] explains the use of the sociotechnical network as a model of the ensemble of relations that influence but do not determine a program of action. This body of knowledge grew from diverse sociological studies of science and technology in diverse domains and fits a basic terminology that have enabled the construction of elaborate explanations of sociotechnical development events. The central concept is that of the actor or author of inscriptions that get translated by other actors. By considering the actor as a network or center for translations that get influenced by the relationships established with that node and their direction, this "theory" opens the ground for heterogeneity. Both human and non-human actors may influence a program of action by their translations of each other's inscriptions. Neither a pure human voluntarism nor a technological determinism is assumed, but only the interplay between actors will or inscribed interests will account for the emergence of complex social reality. The force and interpretative flexibility of newer inscriptions within previous alignments influence their translations. Alignments may provide stability regions or translation regimes that foster specific translations and programs of action.

Akrich [1992] talks about inscriptions and translations in the context of design. Inscriptions refer to the way designed artefacts carry with them patterns of use that foster specific programs of action. From the standpoint of the designer, these instruments are vehicles of his/her expression that will intervene socially when inserted in sociotechnical networks. An engineer becomes also a sociologist, moralist and politician, although apparently involved in mere technical matters. Latour [1991] tells us that trajectories of development can not be viewed in a single social context. One must try to understand the simultaneous production of "text" and "context". Any division between a social component and a technical or scientific production is necessarily arbitrary. The same author argues that the only non-arbitrary division should be between successive versions of statements (i.e. technical objects) more or less loaded with inscriptions and translations. And that we should learn to follow and document them.

For those interested in trajectories, for each technical trajectory there is a symmetric trajectory in context, corresponding to the transformations on the relationships from diverse actors with the focal object. Such an exercise would consider a set of relationships of variable geometry in interaction with an object also of variable geometry. Both suffer transformations in a historical process. Against visions of society or object as immutable, ANT proposes a view of a path of innovations where all actors co-evolve. This dissolution between what changes and the environment in which it changes makes more flexible what can and can not be done, realisable. That difference becomes a matter of positioning on a developmental trajectory. Irreversibility becomes a matter of alignment of interests between human actors and intermediaries. Nothing is intrinsically realistic or unrealistic because social reality is not a finite state but a phenomenon always requiring maintenance.

5. GOALS FOR A NEW ISD APPROACH

ISD Approaches [Iivari et al, 1998, 2001] can be described as an intermediary understanding between paradigmatic underpinnings and specific method proposals. ISD Approaches are classes of methods that map areas of similar methodological thinking, i.e. methods sharing goals, guiding principles, fundamental concepts and principles for the ISD process, but deviate, for instance, in trying to solve specific situations or in selecting main concerns. Goals are what this class of methods tries to achieve. Guiding principles refers to the nature and role of the process, of the object, of the subject and the relation to the instruments of practice. Fundamental concepts refer to the basic ontology behind the understanding of the operative reality. Principles of the ISD process refer to the principles organising the method activities.

With this in mind, and considering the role of context in development, we began considering the synthesis of an approach to ISD within the Neo-Humanist paradigm that we could find useful for the interpretation of our own practice. This synthesis [Roque et al 2004] was guided by a set of goals that

we will now present, while leaving for later the discussion of general principles, main concepts and process principles. Within the previous discussion of challenges and paradigms we have considered that a new approach proposal should have the following **goals**:

- Enable us to frame the ISD activities, supported on the relation between context and mediators of the activities that mould that context.
- Achieve an understanding of the ISD activities on the proposed framework, viewing IS development as a social-technical phenomenon within a cultural and historical envelope.
- To deal explicitly with contextuality in ISD as the key to performing emancipatory movements.

Our goal of achieving a framework supported on the relation between context and mediators in that context stems from an understanding of mediated human activity, which is common to some theories of human behaviour and social organisation, and central to Activity Theory. Especially if we begin to understand the activity as a fundamental contextual unit and pay close attention to the mediating relations, pervasive in organisational life. The mediations in those relations can be viewed as the technical target of development efforts. Yet, in those mediators there are several disciplinary traditions represented, e.g. informatics, law, management. So, both a social and technical understanding of their interplay is needed to begin thinking about ISD as an interdisciplinary effort. A framework for an approach aiming at emancipatory movements should deal with this interdisciplinarity within a cultural and historical envelope. More than that, it should foster an explicitation of the differing contextual views in order to enable open discourse about ISD. For a better understanding of these goals we need to go further in our understanding of the diverse conceptions of context and contextualization in action and language use, which in turn are the centre of our concerns while analysing organisational discourse and action about IS.

It is in the context of the previous discussions on context that we wish to pose the hypothesis of a new approach to ISD as a form of social engineering. As social actors wish to produce socio-technical inscriptions we envision context as media. That media is constituted by social relationships that we intend to shape by intervening in the material mediators supporting those relationships, or constitute their expressions. These media may span from computational, psycho-sociological, organisational, managerial, or any other disciplinary tradition.

Thus, should we, as ISD practitioners, be able to re-center our attention on developing the relations that make up each actor-network in our context, as well as the network that delineates the context itself, with all its consequences? We think this perspective promises to be more inclusive than that of any purely technical and objective one, as that of designing computational artefacts. This sense grows as we acknowledge the diversity of forms of mediation that make up actual social networks and that can be the target of this development. To summarise, this conception is based on some **fundamental concepts**:

- A view of context both as a dynamic figure-ground dichotomy and as an autopoietic flux of interactions that shapes understandings.
- The pervasiveness of mediation in human activity and mediators as development targets.
- An understanding of the role of human activity as unit of context, for sense making or interpretation of each other's actions, and of expansive learning as a model for the process of transformation.
- Socio-technical networks as media and relationships as the fabric of reality that the developer aims to influence and shape.

- Heterogeneous social engineering as an old phenomenon and now a new conception of development.

We then conceive of a form of engineering, of social nature, that operates on the relationships that constitute a heterogeneous socio-technical network, on a historical and cultural perspective of its development. With its interventions, new forms of activity could emerge that are the ultimate goal or intention for the transformation.

6. THE CONTEXT ENGINEERING FRAMEWORK OF MOVEMENTS

With its focus on context, the *Context Engineering* framework divides our development concerns into six main activities: diagnostic, innovation, creation, evaluation, adaptation, generalisation, and a consolidation phase. When interpreted as the basis for a method to manage contextual change, these activities may be understood as six movements or "operators" to be juggled in a planned or contingent manner. Either way, the main contribution of this framework may be that of bringing to the fore the importance of explicitly dealing with the formulation of context as an intersubjective understanding of the situation underlying the development, i.e. how the actors involved see their context as a common ground. Building on these assumptions, we propose a set of activities to represent the essential movements within that framework.

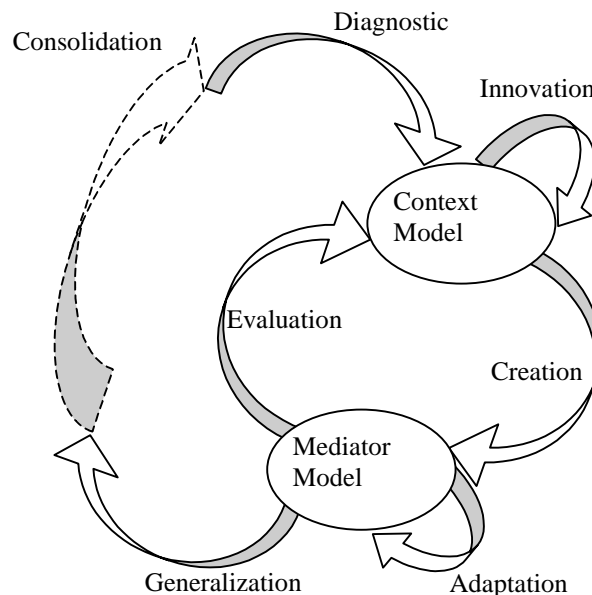


Figure 1. The Context Engineering Framework of Movements

This framework intends to bring to evidence the dialectical relationship between particular conceptions or models of context and its role on the formulation of interventions, through mediators such as computational artefacts, practices, rules, etc. This diagram reflects yet the typical source of the information used in each activity, as its starting point, and the main product, at its arrival, here expressed as models of context and of mediators. As the model of context represents our socio-technical whole, each mediator is a focal part of that whole brought to the fore for specific disciplinary action, within that context.

These activities aim at work with both Context and Mediator models as microcosms to understand the impact of the introduction of mediators in communities of practice, along the actual development of those mediators, acting as classes of methodological movements available to IS practitioners. By working with models of both context and mediators, this framework demands rapid and cheaper iterations to continually evolve and account for the pace of changes in organisational environments.

Each IS development process could be a combination of these activities on a sequence unique for each particular situation that derives from the specific demands of the situation and actual evolution. Considering the possibility of different development rhythms between mediators and or situations and their interdependence can raise interesting research questions. The movements can also be viewed as a matrix of research challenges requiring more detailed work.

CE proposes to understand ISD not as an *a priori* defined process, but as a contingent flux of improvisation. When we propose the context engineering framework we think of it as a possible mapping of the action oriented problems in explicitly duelling between context and media. We do not propose them as an algorithm for performing development. In fact, although we think that an immediate instantiation of the framework is possible with currently known techniques, it could easily drift towards a more conventional view of methods. We think that we do best to recognise the adaptation that goes on in real life. Practitioners may use this framework for guidance to think about where they are and what they have done at a moment in development and consider what next move they wish to take to further their development goals, contingently. Since we understand ISD to be a complex phenomenon its result could be understood as an emergence and our actions only attempt to influence what emergence we would like. Not the design of emergence, but of what we guess to be its underlying conditions. And that's one reason why we talk about engineering the context.

7. MODELING CHALLENGES

If we view Information Systems as sociotechnical phenomena we will need to model not only the social interaction between human actors but also their interaction with artefacts and that influence the emerging organisational patterns of behaviour and the socio-technical constitution and genesis of those collective patterns of behaviour that we chose to understand as the object of ISD.

If we recognise the materiality in the diverse forms of mediation, in helping shape human action, we will be driven to consider and model the middle ground between human voluntarism and technological determinism. Neither human action is the expression of free will, independent from their technological infrastructure, nor will the artefacts fully determine the outcome of human actions. Both carry action programs with them but also some degree of flexibility to translations in actual circumstances.

If we understand Information System Development as an instrument for emancipation and not an end in itself, we will then be driven to consider the goal for active participatory involvement of the diverse actors in development and their capability to express their particular contextual positioning. For that we need modeling concepts, techniques and representations that do not create obstacles but contribute to enable effective communication, cooperation and empowerment. At some time or other the "users" will become not only participants but also practitioners of their own development, as they acquire the instrumental languages involved. This can be witnessed with personal productivity tools. As practitioners, we usually let the situation select the instruments and not the other way around.

Models, as languages, and their use, are expressions of intersubjective understandings. If we want to pursue the goal of emancipation through IS development, then we think we have to find ways for the diverse actors, conceptors, effectors and users of technology to materially express their views and build their own relationships with the media and the process. For that, we think of models as expressions of intersubjective understandings: the common ground that enables the collective constitution of meanings and interpretations. We think this view of models remains a challenge, as currently the previous sharing of technical languages is still a requirement, and there can be barriers between disciplinary traditions.

Moreover, we need to model to make the intersubjective constructions explicit and debatable. (Some would say interobjective - that's a philosophical question we chose not pursue here.) We think of models as expressions of past, present or future realities, as currently accessible referents to absent social localities, as shrink-wrapped versions of the "real phenomena", but as yet possessing the relevant relationships and dynamics we wish to acknowledge and deal with. When built on top of

shared languages, models enable the construction of intersubjective, explicit and debatable understandings. Then we can think of user requirements construction and alignment, whatever our positioning may be.

We need to build models of the mediators to enable early context experiencing and the process participative. Interpreting our own experience, we identified several situations where the early availability of model mediators enabled a fast return to the context of development and the effective expression by interested actors of their interests and tacit knowledge [Polanyi 1974] that escaped previous conversations. In these conversations, with actual artefacts and procedures, on a microcosm that legitimates more active speech, we uncover relationships and actor-networks that were dormant or unspoken, enabling effective user requirements to be expressed.

Finally, an important role for modeling in ISD is to enable evaluation of intended transformations. This is possibly a bigger challenge. If we can think of development as a way to achieve transformations, some of which via computational artefacts, and if we can find a way to value those transformations in relation to what they enable further, then we will have more reasons to rethink development beyond technical artefacts - e.g., if we consider the value associated with learning to perform some activity or use some technology and the kinds of new developments paths that open before us. That can motivate bigger transformations.

We have experienced eliciting and modeling aspects of context with the help of such tools as Paper Prototyping, Value Net mapping, building activity models based on Activity Theory concepts, mapping socio-technical relationships and transformations with Actor-Network theory constructs, mapping collaboration patterns and protocols with UML diagrams, etc.

We are interested in developing and exploring contextual techniques that enable participation while contributing to significantly reduce the time needed to understand and model development situations. We are currently working the aspects of context modeling within four contexts: online collaborative learning, enabling participation in e-government, managing contextual information in make-to-order business networks, enabling collaborative production of independent multiplayer online games.

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