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# Proceedings of the Fifth International Workshop on the Language-Action Perspective on Communication Modelling (LAP 2000)

20 years of Language-Action Perspective:
Time to look back – time to move forward

14–16 September 2000
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# Preface

Information technology has seen radical changes in the last two decades with systems to support cooperation and communication playing an ever-increasing role. In today's society, communication is present in many different facets, e.g. face-to-face dialogues, telephone conversations, email messages, information exchanges of agents. Communication is the key to smooth cooperation. Individuals working in groups coordinate their actions through communication. The modelling of these communication aspects has been studied for more than two decades.

Since 1980 a new paradigm has evolved in the field of information systems which emphasises the importance of communication in an organisational context: The Language-Action Perspective (LAP). LAP was introduced by Winograd, Flores, and Ludlow who stated that human beings are fundamentally linguistic beings who act through language. It was argued that language is not only used for exchanging information as in reports, statements etc. but also to perform actions, e.g. promises, orders, declarations.

The conventional perspective on information systems stresses the contents of messages rather than the way they are exchanged. For example, data flow diagrams are used as primary design tools. In contrast, the Language-Action Perspective emphasises what people *do* by communicating, how language is used to create a common basis for communication partners, and how their activities are coordinated through language. Here, the focus is on the pragmatic aspects of language, i.e. how language is used in particular contexts to achieve practical goals such as agreements or mutual understandings. The LAP approach argues that as social action is mediated through communication, one of the main roles of an information system should be to support intra- and inter-organisational communication.

Twenty years of LAP are a good occasion for looking back to the beginnings and for assessing what has been done in the past. What assumptions are still valid? What needs to be adapted? More importantly, two decades of LAP are a good reason to move forward and assess what LAP has to offer for work in current lines of research such as E-Commerce, intelligent systems, or new system architectures. Why is LAP more or less appropriate in certain contexts?

These are questions relevant for the Fifth International Workshop on the Language-Action Perspective on Communication Modelling, LAP 2000, that was held from 14 September to 16 September 2000 in Aachen, Germany. Each paper submitted to LAP 2000 was reviewed by at least three members of the programme committee. Eleven papers were selected for presentation.

Furthermore, one invited talk focusing on semantics and communication acts was given by Ronald Stamper, Emeritus Professor of Information Management, University of Twente, The Netherlands. A panel discussing the workshop theme summarised the participants' visions for the future of LAP research. The workshop provided an interesting programme and a good mixture of areas in which LAP research is conducted, such as computer-supported cooperative work, knowledge management, formal methods, business process modelling, and philosophical foundations.

Mareike Schoop
*Chair of LAP 2000*

*Aachen, September 2000*

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# The Initialization of Conversations for Specification: A Context of Social Norms

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## Abstract

Virtual professional communities require a legitimate user-driven specification approach of their network information systems. The specification changes produced should be legitimate in the sense that they are not only meaningful but also acceptable to all members of the community. We regard specification processes as conversations for specification. A Specification Process Model is presented that is grounded in the theory of communicative action, and builds upon DEMO and the rational discourse represented in the Transaction Process Model. To initialize the conversations for specification, social norms play an important role. The RENISYS method is introduced which supports such contextualized conversations for specification.

## 1 Introduction

Collaborative work is increasingly being done in a distributed fashion, supported by commonly available Internet-based information tools such as mailing lists or web applications. We define the *virtual professional communities* in which such collaboration is to take place as communities or networks of professionals whose

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collaboration on activities required to realize shared goals is mostly or completely computer-enabled. The workflows of these communities are often supported by network information systems consisting of linked and configured standard information tools. The communal requirements and enabling information technologies typically evolve strongly, while the users ought to have an important role both as sources and as modellers of the system specifications. Active user participation in the specification process of such continuously evolving socio-technical network information systems is very important, since community members have the most detailed knowledge about when breakdowns in work arise and how they can be resolved [3]. To increase the efficiency and willingness of users to participate in system change processes, it must be known exactly for each specification process what users are to take part, and in which roles they are to be involved. To adequately determine the *relevant user group*, a *legitimate user-driven specification approach* is required. First, in such an approach, the community members are not just to provide specification knowledge, but also to control themselves the process in which this knowledge is actually produced, from the start of a change process to its conclusion, thus making the specification process truly *user-driven*. Second, these change processes must be *legitimate*, in the sense that any change that is implemented is semantically (and pragmatically) meaningful and also acceptable to all members of the community.
The rationale, characteristics of, and support for the legitimate user-driven specification process are described in detail in [4, 5], but are not our focus here. In this paper, we summarize how our approach, the RENISYS (**RE**search **N**etwork **I**nformation **SY**stem **S**pecification) method is grounded in the language/action perspective by facilitating conversations for specification. It is then shown how these conversations are to be initialized in a context of representations of some of the social norms grounded in the community.
In Sect. 2, we use speech act theory to describe specification processes in professional communities, by viewing them as series of related conversations. Although it provides an important starting point for specification process support, the conversational model in itself is insufficiently capable of handling rational discourse, because it does not pay attention to how to deal with questioning background assumptions. In Sect. 3, a Specification Process Model is built, drawing upon Habermas's theory of communicative action, Dietz's DEMO specification method, and Van Reijswoud's Transaction Process Model. A remaining problem, discussed in Sect. 4, is how contextual knowledge is to initialize these conversations. Our solution is to use representations of the social norms that guide the behaviour of a community, called composition norms, to link context and conversations. The context-based specification process model that makes use of these composition norms is introduced in Sect. 5. This model forms the basis for our RENISYS approach.

## 2 Conversations for Specification

The use of individual speech acts is insufficient to coordinate meaningful work-related communication. To do so, larger units of communicative interaction are needed, which are called *conversations*.

In this paper, we adopt a somewhat restricted view on conversations, seeing them as a series of interrelated communicative acts aimed at defining and reaching a goal [7]. Taking into account the purpose of this paper, we define a *conversation* as a self-contained unit of communication to accomplish certain specification objectives, like the specification of a new type of article submission process. Evidence for the effectiveness of predefined conversation models is ambiguous [1]. We therefore require a conversation to be only partially structured in the sense that main specification process entities are predetermined, although the format of the utterance acts in which these entities are defined is relatively free. There are many types of work-related conversations, one of which is the conversation for action, in which the goal is to coordinate explicit cooperative action [26]. This kind of conversation is the basis for the well-known Coordinator and ActionWorkflow modelling methods [10]. Fig. 1 represents a conversation for action as a state transition network [27, 26].

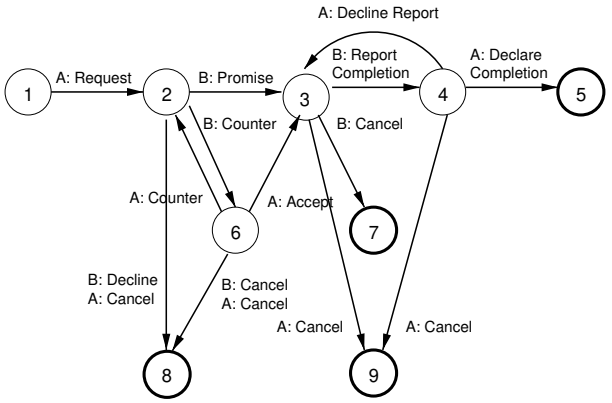


Figure 1: A State Transition Diagram of a Conversation for Action [26]

Many different types of conversations, but especially the conversation for action, can play some role in the specification process. We will illustrate the ideas presented in this paper by taking examples from specification processes related to an electronic journal publication process. We assume there is an electronic 'LAP-Journal', of which John is an author and Jane the editor.

The system specification process is triggered by breakdowns in work, in the sense of [27]. For example, a breakdown experienced by John could be that he finds the

editorial process of his submitted article taking too long.

As a consequence of the occurrence or anticipation of breakdowns, new semantic distinctions are always emerging. The generation and interpretation of these distinctions should be treated as an activity based on conversations that can be designed and facilited through the computer [26]. To do so, a conversation framework is needed that combines specialized as well as more general conversation patterns that can provide support for breakdown-initiated conversations [9]. We call such a conversation, which may be constructed out of a number of the abovementioned more or less structured conversations, a *conversation for specification*.

## 3 Constructing a Specification Process Model

An important limitation of Searle's original speech act theory is that it stresses the conversational role of the *speaker*, while ignoring the role the *hearer* plays in the success of speech acts. This makes it hard to know whether a hearer does something because he, fully informed and unpressured, accepts the speech act made by the hearer, or because he is, for example, insufficiently knowledgeable or forced in some way to accomodate the speaker. In virtual professional communities this would be a most undesirable situation, as legitimacy of the changes produced in conversations for specification is of the greatest importance. These communities require information system development methods that do take the hearer into account as well by facilitating rational discourse. Habermas's theory of communicative action provides a comprehensive conceptual framework in which to ground such methods that focus on the role of the hearer as well.

Sect. 3.1 gives our view on the theory of communicative action. One specification method which is partially based on this theory is the DEMO method. It is contrasted with RENISYS in Sect. 3.2. In Sect. 3.3, it is argued that there remains a need for conversation protocols that prescribe the conversational moves that actors are allowed to make. Van Reijswoud's Transaction Process Model is presented, which combines DEMO with the theory of communicative action to model the various conversational moves that occur in rational discourse. In Sect. 3.4, this model forms the basis for the construction of our own Specification Process Model, which is used to model conversations for specification.

### 3.1 The Theory of Communicative Action

In Habermas's perspective, actors who are willing to coordinate their actions consensually aim to achieve an understanding through a "cooperative process of interpretation aimed at attaining *intersubjectively recognized definitions of situations*[1]"

[1] My emphasis.

[25, p.39]. In our approach, such definitions are the result of conversations for specification.

Specification changes in virtual professional communities, by necessity are often compromises, because of the different interests represented and values and knowledge possessed by the various community members involved. Concretely, legitimacy is enforced by demanding that the procedures for compromise construction themselves are justified, or at least justifiable, through discourse. General criteria to be used in the construction of such procedures include procedural equality, participation, and non-manipulation. Based on these criteria, Habermas developed his *rules of discourse*, such as "each subject is allowed to introduce any proposal into the discourse". A summary of the rules is given in [25, p.56].

These rules are in line with the requirements of the specification discourse taking place in virtual professional communities. In this discourse, all validity claims should be open for discussion, since only agreements that are intersubjectively valid on all dimensions can ensure continued participation (ibid.,p.40) A basic tenet of the theory of communicative action is that ordinary language competence suffices to use the whole system of interrelated validity claims for the coordination of action (ibid.,p.39) . Thus, the users should be given the freedom to discuss (combinations of) validity claims, while they themselves decide which claims to discuss and how to discuss them. In this way, no formal representation of validity claims and their dependencies is necessary, nor desirable. Still, formally modelling the *conversational roles* that users play in the discourse process is most helpful in creating the right *preconditions* for successful informal discourse.

The theory of communicative action has its limitations as well. Habermas's classification of speech acts is useful for structuring dyadic communicative acts between speaker and hearer, but does not allow for handling larger communication contexts (including conversations) [1]. Furthermore, his category of regulativa, comprising both Searle's directives and commissives, is too broad to be useful in system development practice. For example, one often needs to know whether somebody is commanding (directive) or promising (commisive) something [1]. Therefore, we partially follow Verharen [23], who adopts the Searlean classification of speech acts, extended with Habermas's validity claims attached to the illocutionary acts. Contrary to Verharen's focus on claims to power, authority, and charity, ours is on the claim to justice, which we rename into a *claim to legitimacy*. Although both concepts have fairness and acceptability as their key elements, we prefer to use the latter. The term 'justice' has heavy connotations concerning the idea of protecting *against* wrong-doing, whereas 'legitimacy' has more of a positive, *constructive* flavour.

Summarizing, what we need is a natural language-like discussion facility based on a formal communicative action-grounded discourse coordination mechanism.

This provides us with a universal approach for facilitating legitimate user-driven specification, which is independent of the specific usage context in which it is taking place. Such a coordination mechanism should incorporate the rules of discourse, which help to approximate Habermas's 'ideal speech situation', in which discursive equality, freedom, and fair play are guaranteed.

However, and this is crucial: Habermas does not provide full prescriptions for how these procedures are to be interpreted. Instead, his rules of discourse need to be interpreted and operationalized by the actors being affected by them [25, p.76-77]. Thus, we need (1) to operationalize the conversations for specification while incorporating the rules of discourse and (2) find a way to select the relevant actors affected by a particular conversation. The first we do in the remainder of this section, the selection of the relevant actors is discussed in Sect. 4.

### 3.2 DEMO: a LAP-Oriented Specification Method

To understand how the language/action perspective can contribute to systems specification, Dietz's DEMO (Dynamic Essential Modelling of Organisations)-method is briefly reviewed. DEMO is a cross-disciplinary theory about the dynamics of organizations, as well as an organizational and information systems analysis method. It is based on both Searlean and Habermasian theory [7, 1]. DEMO was contrasted with the RENISYS method in [20]. Two main ideas of DEMO are adopted in RENISYS. First, in DEMO a distinction is made between actors and subjects. An *actor* is an entity defined by the set of actions and communications it is able to perform, and is realized by subjects. A *subject* refers to a particular person in some functional role. Second, the idea of a *transaction* as a basic unit of communication is used (Fig. 2). This is the core modelling concept of DEMO. Hierachically, a transaction stands between an individual speech act and a conversation. A transaction consists of three stages: the actagenic, action, and factagenic stage. During the *actagenic phase*, initiated by actor A, agreement is reached between actor A and actor B in an actagenic conversation about the future execution of an action by actor B. During the *action phase* this essential action is executed by actor B. In the *factagenic phase* actor A and B reach agreement in a factagenic conversation about the facts that have been accomplished as a result of the execution by actor B. Actor A is called the initiator of the transaction and actor B the executor. The behaviour of an organization is conceived of as the carrying out of a set of transactions. Every (essential) action is embedded in a transaction, and every established fact is the result of the successful completion of a transaction.

In RENISYS, a transaction is similar to a workflow at the operational level, and to a specification process at the specification level. However, there are also some differences between both approaches. First, in DEMO, an actor is often known as a process name, e.g. 'Planning Production' or 'Shipping', while a subject is iden-

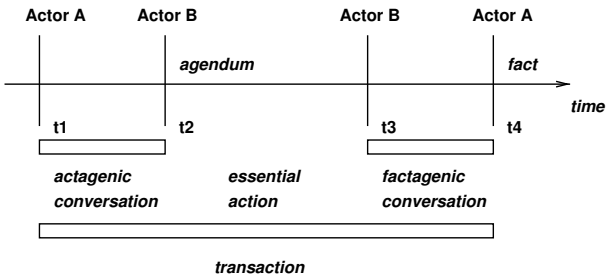


Figure 2: The DEMO Transaction

tified by a functional role, e.g. 'Logistics Manager' [21]. In RENISYS, however, the functional role is expressed by the actor entity, whereas a subject refers to an individual person. Second, a transaction in DEMO only has an initiator and an executor for conversation roles. The initiator has to approve of the result of the action performed by the executor. In RENISYS, however, a separate *evaluator* role is distinguished for this purpose. Third, RENISYS provides guidance for the specification process by means of its reference framework, in which various kinds of specification dependencies are represented. This framework links conceptual entities from the problem domain (goals and activities) via the human network (organizational structures) to the information system domain (information and communication processes and tools). Finally, DEMO does not take into account the existing information system when producing new specifications, it is not completely clear how the DEMO models are to be used in system design, and there is a lack of deontic or normative concepts [23]. RENISYS, however, provides explicit support for the evolution of analysis and design specifications by indicating which actors can legitimately make what specification changes, and who is to implement them.

### 3.3 The Transaction Process Model

It is often a problem for the hearer to classify the illocutionary force of an utterance made by the speaker. It must thus be made clear in any conversational state which (finite) set of *conversational actions* or *moves* are possible [27, 13]. In addition to the modelling techniques such as used in the conversation for action approach (see Fig. 1), theory-grounded *conversation protocols* are therefore needed that prescribe the allowed conversational moves for the participant whose turn it is to speak. One such protocol, aimed at modelling the mutual agreement dimension of conversations, is Van Reijswoud's Transaction Process Model (TPM) [22].

The TPM, itself based on DEMO, is a communication model that presents the possible conversational moves in a business communication process, thus providing a full understanding of the activity coordinating nature of the transaction concept. The model is represented as a state transition diagram, similar to Fig. 1, in which

the states represent *transaction states* and the transitions are caused by *transaction acts*. These acts are subdivided into two categories: communication acts and objective acts. A *communication act* is an utterance by a participant that causes a transaction process transition. An *objective act*, the purpose of the transaction, is the act that changes the objective world. Objective acts do not need to be further modelled, as the actual activities that change the objective world are not part of the communication process. Of course, they are embedded in this process, but the acts themselves are aimed at the *production*, not at the *planning* or *validation* of the results.

Whereas the state transition technique is generally applied to modelling the behaviour of objects in the object world, in the TPM it is used to represent the communication behaviour of subjects in the intersubject world. Besides being able to model successful communication processes, the TPM also allows for the representation of discussion and discourse, as proposed in the theory of communicative action. The model therefore consists of three layers. In the *success-layer*, a regular transaction process is described. The *discussion and failure-layer* allows for the discussion of validity claims. The *discourse-layer* contains discourse with the purpose of restoring background conditions. The discussion-layer can only be entered after communication in the success-layer has taken place, whereas the discourse-layer cannot be invoked before communication has occurred in the other two layers.

### 3.4 The Specification Process Model

The TPM can be applied in different ways. In [18], it is used to model actual business conversations, and thus needs to deal with such complexities as the distinction between strategic and communicative action and the reformulation of unclear statements. Similarly, Steuten makes an extensive study of the roles discourse analysis and conversational analysis can play in providing a foundation for the modelling of business conversations. Grounded in empirical data, both of her analysis approaches are concerned with the way in which coherence and sequential organization of real world-conversations are produced and comprehended [17]. However, this complexity is not needed in our case, as we only need to *generate* relatively simple potential conversational moves instead of to *interpret* complex natural language statements. Although the TPM forms the basis for the modelling of the conversation protocols needed in RENISYS, there are certain differences in terminology and application. We therefore use the term *Specification Process Model* (SPM) for the conversation model used in RENISYS. The main differences with the TPM are that the transaction is renamed into *specification process* and that the *evaluator* role is added. The purpose of the specification process is no longer an 'objective action', but a *definition process*. Communication acts and transaction states are renamed into the more precise terms *conversation acts* and *conversation states*. Other differences,

notably the different interpretation of validity claims, are discussed in [4], but are less relevant here.
In the SPM, we formalize conversations as little as possible, in order to provide flexibility and not to cognitively overburden users. Thus, although a user can start a discussion to, say, question the sincerity of another user's communication act, the initiator does not need to formally indicate why he does so. The reason for this is that RENISYS *enforces* the legitimacy of specification processes by only inviting those participants to take part in some conversation for specification who are justified to do so. Once they have been selected, they are free to discuss in the way they like. This is a new application of the TPM: whereas the latter is a model to *represent* conversations, RENISYS uses its SPM to *select* participants who are to take part in them. To illustrate the use of the SPM, we show the representation of a *successful specification process* to modify the editorial process type definition, as suggested by author John in the previous example. This representation is similar to those given in [22, p.95], showing four of the in total 23 conversation acts. A complete overview of all conversation acts making up the SPM is given in App.A of [4]. For each of these acts, it is discussed there which conversational roles can perform as speakers and hearers of the act. In this paper, we do not need to show them all, since we focus here on how to initialize the conversational roles, not on the actual conversation process in which these roles take part.

In the example, the sequence of conversation acts and definition processes is the following:

| *Act* | *Description* | Resulting State |
|---|---|---|
| **$CA_1$:** | I: $C_{legit}$[propose(directive)<mod_type_def(edit),now>] | Directed |
| **$CA_2$:** | X: $C_{legit}$[promise(commissive)<mod_type_def(edit),now>] | Committed |
| **DP:** | X: $DP_{legit}$[define(execute)<mod_type_def(edit),now>] | Executed |
| **$CA_3$:** | X: $C_{legit}$[rep_compl(decl.)<mod_type_def(edit),now>] | Decl.(Completion) |
| **$CA_4$:** | E: $C_{legit}$[decl._success(decl.)<mod_type_def(edit),now>] | Decl.(Success) |

Table 1: The conversation acts and definition process in a successful type creation process.

Here, the (legitimate) initiator asks the executor(s) to modify the existing edit process type definition. The executor (which can consist of more than one person) promises to do this, and later presents a modified editorial process definition to the evaluator(s), who, in this case, approves the proposed change.

## 4 Contextualizing the Conversation

One major criticism of the application of speech act theory in systems development is that it is not able to represent what people really do, as it is said to provide models

that are too rigid and simplistic to capture the complexities of actual work practices [1, 23].

Thus, in real social practice, the complex world beyond the representations must somehow be considered. In other words, it is not just important to produce definitions, but also to understand the *situatedness* of the conversations in which the definitions are produced, the way in which the definitions are represented and how they are understood by the people who use them [26, 2, 19]. Thus, a fundamental problem has not been addressed by the TPM (and by the SPM, so far): how to make the link between the specific 'social/organizational and work situations' and the conversations for specification? *Who are to be the initiators, executors, and evaluators of these conversations and what should be on their agendas?*

To this purpose, it is important that the *context* of the specification conversation is taken into account [2]. However, the idea of context in speech act theory is still relatively unexplored. Although it is recognized that each individual speech act is embedded in an abstract social context (e.g. conditions such as the propositional content and preparatory rules and the fact that the lifeworlds of communicants must be compatible), it is not yet very clear how exactly context is to be used in LAP-grounded systems development [23]. A major implication of the language/action perspective is that context interpretation cannot be fully automated, but to a large extent remains to be done by persons [8, 24]. These ideas are elaborated upon next. First, we describe the CHAOS system, a related approach that also strongly emphasizes the role of context in conversations, then we present our own conversation context model, after which we discuss the role of norms in our approach.

### 4.1 Related Work: The CHAOS System

A sophisticated approach to making the link between speech act-based conversations and context, the CHAOS system, is proposed by Simone and Divitini (1997). They distinguish four different types of context: operation, communication, organization, and linguistic contexts. In their view, communication in cooperative groups can become problematic because it is often difficult to keep the contexts of the cooperative work up-to-date and consistent.

Simone and Divitini claim that the LAP can be helpful to identify the events that characterize the evolution of the contexts in which communication occurs and takes its meaning. Similar to our approach, their CHAOS system does not let the computer make all required specification knowledge inferences. Instead, it provides the user with relevant information that is as much as possible contextualized by the communication processes that generated it, after which they leave it up to the user make the appropriate inferences. To accomplish this, a user model is applied which is not fixed a priori, but gradually defined by the conversations and commitments in which the user is involved. Using ideas like *ontological levels* (e.g. an entity is 'un-

der discussion' or 'existing'), *commitment life cycle* (e.g. a commitment is 'taken' or 'done'), and the *partiality of shared knowledge* (knowledge is either 'consciously shared knowledge', 'shared knowledge' of which users are unaware that they share it, and 'private knowledge'), mechanisms have been developed that allow possible inconsistencies among the knowledge of group members to be discovered. These mechanisms allow for the most appropriate context, depending on a particular user's needs, to be found.

Although both CHAOS and RENISYS acknowledge the important role that contexts play in the conversation process, this role is a very different one. In both approaches, only the relevant set of people is to be involved in the sharing (and creating) of organizational knowledge. However, the main focus of CHAOS is on dealing with the effects of the partiality of knowledge sharing, instead of providing full support for communicative action, which is the main concern of the SPM in RENISYS. In the CHAOS approach, the context of the commitment at the time of its definition can be reconstructed. It remains the responsibility of an individual user with a pending commitment to determine if this context is still valid. If not, then the evolution of the knowledge objects can be presented to the user, including the (partial) views that other users may have on them. Although the approach does have the notion of 'privileged users' having the authority to provide information about the status of objects and actions for which they are responsible, there is no mechanism for ensuring the legitimacy of specification changes. It is left up to the individual users interpreting contexts during commitment definition, not to communal norms, to determine who else to involve.

On the other hand, RENISYS does not need to incorporate complex partial knowledge sharing mechanisms to deal with ambiguities. It assumes knowledge definitions to have global scope as they can only be made by legitimate actors. This scope does not mean that every actor needs to be aware of the current status of all entities. The specification mechanism of RENISYS handles breakdowns by focusing on the identification of the relevant actors to be involved in specification discourse. Once a conversation for specification has started, the related definitions (i.e. definitions of concepts used in the definition under debate) can be presented and informally discussed. We assume that such an informal group discussion allows for a clear identification of the meaningfulness and acceptability of the definitions, while at the same time foregoing much of the cognitive overhead required by knowledge representation-intensive approaches like CHAOS.

### 4.2 The RENISYS Conversation Context Model

We now define the meaning of context in our approach (Fig. 3). It consists of two parts, the external and the internal conversation context.

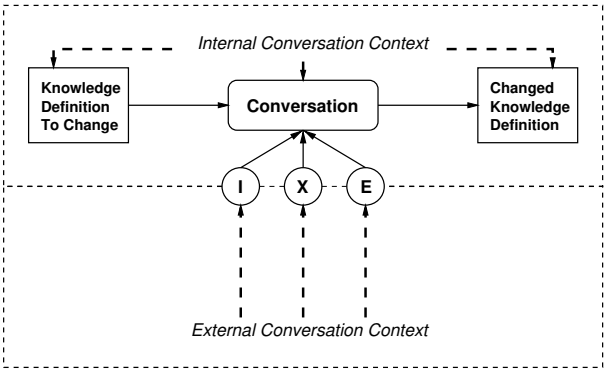


Figure 3: Contexts and Conversations

***Definition 1***

- **internal conversation context:** the knowledge definitions which are related to the knowledge definition being changed.

- **external conversation context:** the knowledge definitions needed to select the users who can legitimately be involved in a particular conversation for specification.

□

The internal conversation context gives meaning to the definition being changed, as it situates the definition in a web of semantically related definitions, that are already meaningful to and accepted by the community. For example, the definition of the editorial process may include links to the submission and review workflows, and to submitted and edited papers as input and output objects, respectively. Each of these concepts in turn have their own definition. The external conversation context, which is used to determine the relevant users to involve in definition change processes, is related to Taylor's 'institutional context'. He sees each speech act as being part of an indefinite series of interactions. The sum of past speech acts creates an institutional grounding for currently acceptable actions. Current speech act-based methods, such as DEMO, however, largely ignore this role of the institutional context in an ongoing work conversation [19].

In order to model internal and external conversation contexts, different kinds of *specification knowledge categories* are necessary. We distinguish four such categories [6, 4]: *type definitions* determine the ontological meaning of concepts (e.g. a mailing list is an information tool that resends received mails), while *state definitions* capture states-of-affairs (e.g. Jane is the list owner of the LAP-Journal mailing list). Furthermore, there are two kinds of norms, *action norms* and *composition norms*, which regulate operational and specification behaviour, respectively. We describe the properties of these norms later in this paper.

### 4.3 From Power to Norm-Based Authority

Conversations for specification, taking place in a basically egalitarian virtual professional community, are a prime example of a democratic 'open discussion' approach necessary to define problems and solutions [28]. However, democracy is more than just discussion. Ultimately, somebody must be in a position of *authority* to coordinate the discussion and to make decisions. There are two ways for an actor to obtain such authority. The first one is based on *power*, as a result of structures of domination. Here, an actor has command over either persons or objects. The second way is by means of *norms* that actors use to sanction their own conduct and that of others. As virtual professional communities do not have pre-existing structures of domination, our focus is on norms as sources of authority.

A general definition of a norm is a principle of right action binding upon the members of a group and serving to guide, control, or regulate proper and acceptable behaviour[2]. This definition states that a norm is an instrument that can be used to identify which behaviour of a particular actor is just from the point of view of the other members of the group to which the norm applies. Norms can act both as affordances and as constraints: on the one hand they describe socially acceptable behaviour, on the other hand they can also be used to identify behaviour that is not allowed. Norms, by permitting and constraining actions, can thus be used to guide the work of groups and evolutionary system change [15, 28].

Crucial to successful network information system development is the continuous *evolution* of the *norm-based authority* structures. Contrary to a power-based authority, which cannot easily be challenged, norm-based authority should be a relative one, which can always be questioned and changed. There are two reasons for addressing authority issues gradually rather than radically: first, the communication within a group continuously grows in size and diversity, and second, the group participants require time to understand the implications of the mechanisms developed [12]. As the evolution of authority structures in network communities is grounded in a unique social context, an important question is how this work and organizational context can be linked to the process of changing the norms, in such a way that these norms continue to reflect the interests and social values of the various participants. Current system development approaches, however, pay little attention to the process in which the norms that govern these systems are being established [23]. However, such sophisticated norm definition mechanisms, grounded in the context of work, are needed for a virtual professional community to (continue) to function.

[2]Webster's Dictionary:`http://www.m-w.com/dictionary.htm`

### 4.4 Norms in RENISYS

The legitimate user-driven specification process was said to result in specification changes that are both meaningful and acceptable to the members of a virtual professional community. In our approach, we use ontological definitions to ensure the *meaningfulness*, and normative definitions to guarantee the *acceptability* of specification changes, distinguishing both action and composition norms:

***Definition 2***

- **action norm:** a norm that describes the acceptable *operational* behaviour of some actor.

- **composition norm:** a norm that describes the acceptable *specification* behaviour of some actor.

□

Thus, action norms regulate the work that the community is to carry out, whereas composition norms define who is to be involved in the changing of the socio-technical system in which this work is done, including changes in the composition norms themselves.

| **Process Level**<br>**Deontic Effect** | *Action Norm* | *Composition Norm* |
|---|---|---|
| *Permission* | 'a researcher *may submit* a paper' | 'the scientific board *may create* a new *type* of editorial process' |
| *Responsibility* | 'an editor *must assess* a submission' | 'a list owner *must modify* the list registration initiation *norm*' |
| *Prohibition* | 'a reviewer *may not review* his own paper' | 'a list member *may not terminate* the list owner *status*' |

Figure 4: Examples of RENISYS Norm Categories

To illustrate the basic structure of the RENISYS norms, an informal example, drawn from the journal publishing domain, of each *norm category* (classified by the deontic effect and the operational versus specification process level dimensions) is given in Fig. 4.

The use of norms in RENISYS is partially inspired by the MEASUR research programme, based on Stamper's semiotic theory of systems development [15]. Elements adopted in RENISYS are the distinction between ontological and normative knowledge, the deontic effect classification of norms, and the recognition of informal norms. There are some important differences as well, though. RENISYS does not support the complete traditional information system development process as

MEASUR does. Instead, we have adopted, simplified, and extended some of its core ideas, notably on ontologies and norms that are useful for our particular purpose of legitimate user-driven specification. Differences include: the action/composition norm classification and a different subdivision and representation of ontological and normative knowledge [4].

# 5 RENISYS: Supporting Contextualized Conversations for Specification

We have now described the two main components of our framework for a context-based legitimate user-driven specification process: a *specification process model* and a *context model* which can be used to situate conversations for specifications. However, we have not yet explicitly integrated the two components into a complete framework for handling breakdowns. This model is outlined in Fig. 5.

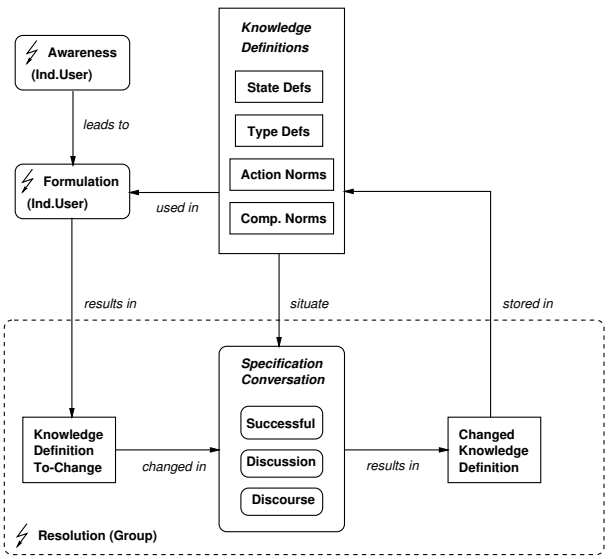


Figure 5: A Context-Based Conversation for Specification Model

The specification process starts with an individual user becoming *aware* of a breakdown in his work or supporting information tools. In the previous example, author John was unsatisfied with the slow response to his submitted paper. Presented with the existing knowledge definitions that are related to this breakdown, the user *formulates* the breakdown by identifying those definitions that need to be changed. In the example, John suggested that the editorial workflow process is to be redefined. The breakdown is *resolved* by the executors legitimately changing each such a *problematic knowledge definition* by an appropriate conversation for

specification.

For example, the editorial process type definition may be modified to include an 'acknowledge submission received' process. To find out which users to involve in the initiation, execution, and evaluation of the specification process, for each of these definitions, a set of *applicable composition norms* is calculated (for each combination of user and composition). A *composition* is either the *initiation*, *execution*, or *evaluation* of the *active specification process* in which the problematic knowledge definition is to be changed. There are three types of specification processes: *creations*, *modifications*, and *terminations* of knowledge definitions. As each combination of specification process and knowledge category requires a differently supported *definition process* in which the actual changes are made, there are twelve definition processes [4]: one to 'create action norms', another one to 'modify state definitions', etc. Again, we do not focus on the procedural aspects of conversations for specification in this paper, but on their initialization. The dynamics of these definition processes are therefore not discussed here.

In [5], the algorithms to do the complex conceptual graph calculations required to determine the applicable norm sets are presented, involving generalization hierarchies of norm graphs. Here, it suffices to say that for each user and composition (i.e. user Jane and composition 'execution of editorial process type definition modification') of the active specification process, a separate applicable norm set is calculated. The norms in these sets can have conflicting *deontic effects*, e.g. one saying that it is forbidden, another one that it is permitted for user Jane to execute the modification of type definitions of the edit process. To handle these conflicts, a norm conflict resolution mechanism is needed. Ours uses a slight variation of standard dynamic deontic logic [11]. An example of how conflicting norms could apply to the same user is that Jane, who is the journal editor has these two norms in her applicable norm set for the execution of the edit type modification process: a general norm saying that it is forbidden for editors to change their own editorial processes, as well as a more specific norm saying that it is permitted for *journal*-editors to be involved in the changing of such workflows.

For each applicable norm set, its *resultant deontic effect* is calculated, which says if it is permitted, required, or forbidden for a particular user to either initiate, execute, or evaluate the particular specification process in which the problematic knowledge definition is to be changed. In the example, the resultant deontic effect would be that it is forbidden for Jane to modify edit-type definition processes, since prohibitions have precedence over privileges in our logic:

$$\mathbf{de_r}(D_{CN_APPL(Jane,Exec_Modify_Type(Edit))}) = Forb$$

Once the resultant deontic effects for all applicable norms sets have been calcu-

lated, the sets of initiators I, executors X, and evaluators E for the current conversation for specification are known (see Fig. 3). Using various techniques to support conversational moves in the spirit of Van Reijswoud's TPM, which are explained in detail in [4], a rational discoursive specification process for the selected users in their prescribed conversational roles can now be enabled. These procedural aspects, however, deserve a detailed explanation for which space is lacking in the current paper, which limited itself to sketching how these procedures can be initialized.

## 6 Conclusion

In this paper, we focused on how to initialize the conversational roles of the conversations for specification which are necessary for the legitimate user-driven specification of network information systems. The conversations themselves are based on a rational discoursive Specification Process Model. The initialization of the conversational roles (the initiators, executors, and evaluators of conversations), on the other hand, is dependent on the composition norms that define the specification behaviour of community members. The RENISYS specification method operationalizes this legitimate user-driven approach. It has been implemented in a prototype web-based tool, which we intend to upgrade to a robust version in the near future. Then, we plan to refine and extend theory and method using the tool in a range of realistic cases.

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# A Language Action Perspective on Knowledge Management

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## Abstract

In the past few years there has been an intensive debate about knowledge management and organisational learning. Knowledge and improvement of knowledge is considered being crucial for performance and development of organisations. Nevertheless, knowledge management is still a quite vague notion, and is sometimes presented from a quite narrow view. In order to clarify and conceptualise knowledge management as an organisational phenomenon I will present my view of organisations' knowledge practice, including its relation to the core practice. This is done with inspiration from the language action perspective. I also want to highlight that the phenomenon of knowledge management to a high degree is about organisational communication and the handling of linguistic utterances.

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# 1 Introduction

Recently, notions like knowledge management (KM), organisational learning (OL), and intellectual capital (IC) have attracted tremendous attention. The time when organisations mainly were seen as physical entities whose primary purpose were to transform raw material into tangible products is history. In our contemporary society physical resources are considered being of minor importance for creating and sustaining competitive advantage. Instead, it is the IC in general and knowledge in particular that is considered being *the* assets in order to reach sustainable competitive advantage (see e.g. Drucker, 1995; Nonaka & Takeuchi, 1995; Quintas, Lefrere & Jones, 1997). Knowledge management is regarded as the critical element of a business strategy that will allow organisations to develop their ability to handle new markets and opportunities (Koulopoulos & Frappaolo, 1999). This emerging recognition of knowledge as an organisational asset has laid the ground for new, knowledge-based practices and theories of management. However, even if there is a lot written about knowledge management, the notion itself is still quite obscure. For practitioners it could be hard to understand *what to do* in order to manage and leverage knowledge within the organisation. It could also be difficult to realise *which consequences a knowledge perspective has* on the organisation as a whole.

One question of concern is which the implications are of seeing knowledge as an organisational asset? Comparing intangible assets, like knowledge, with tangible assets (e.g. machines, land) they can hardly be treated as having the same properties. Another question is what needs to be considered when trying to manage knowledge? Knowledge *per se* is something that is developed in the minds of the knower, e.g. within human beings. If one co-worker has developed some knowledge, how can this knowledge be transferred to other individuals?

Traditionally knowledge has been equalled to power (Allee, 1997). Due to the fast and constant changes that occur in society, knowledge is now said to become obsolete very quickly. As a consequence, it is no longer any use to hoard and keep knowledge to oneself as an instrument of power (ibid). For organisations this has the following implications: First, the importance of having the ability to continuously *develop* new knowledge. But that is not enough, organisations also need the ability to *disperse* and *reuse* useful knowledge that has been developed in the organisation. The latter ability will prevent organisations from "inventing the wheel" by taking advantage of earlier experiences. As Quinn, Anderson & Finkelstein (1996) and Allee (1997) say, knowledge is one of the few assets that grow when it is shared. Nevertheless, I do not fully agree with the opinion that knowledge no longer can be used as an instrument of power. Allee (1997) seems to describe a kind of ideal and desirable condition, but I doubt it works like that in the reality.

Another question concerns how we can address knowledge management as an organisational phenomenon? What does knowledge management involve? How is it related to the knowledge used and needed in organisations, and what kind of relation does KM have to the core business (practice)?

The *main purpose of this paper* is to contribute to an increased understanding of knowledge management as an organisational phenomenon. This involves a description and clarification of the relations and the constituent parts that knowledge management bring about. To that end, there are some certain issues that need to be considered. First, there is a need to apply a holistic approach to the way we look at knowledge management. Otherwise there is a risk that knowledge management activities will not achieve desired benefits. Second, there is a need to clarify the relation between the practice of knowledge management and the core business (i.e. the production of goods and services). The primary reason for this is to clarify if knowledge management should be integrated with the core business, or if it should be treated as a separate part, and which relations these practices have.

I will use the language action perspective as a source of inspiration. I believe this perspective could be used to facilitate an amplified understanding of knowledge management. I will present a somewhat alternative approach to knowledge management, and also emphasise the significance of communication when organisations aims to take charge of and develop the co-workers knowledge.

The paper is divided into four parts. This introduction aims to give the reader a background and purpose of the area of interest. Next section comprises a discussion around different aspects of knowledge in organisations. The discussion is mainly built around existing KM-related theories, which are used in order to outline my view on the particular issues. I have selected some, according to me, relevant and current notions[1] that have been used as guidelines for the investigation. The third part of the paper comprises a presentation of my view of knowledge management. In both the second and the third part I will use empirical examples as illustrations. The examples come from two case studies[2] that I have carried through during the last year. In the fourth part I will sum up my discussion and make some final conclusions.

# 2 Knowledge in organisations

## 2.1 Knowledge as an organisational asset

Knowledge makes people able to perform different organisational tasks. In this way we can say that knowledge is what makes organisations work. Thus, the

[1] These notions include knowledge management, organisational learning, and intellectual capital.

[2] One of the case studies concerns a IT consultant firm (requested to be anonyms), and the other one concerns a paper mill, Duni Paper Mills, Kisa. Those are referred to as the IT-firm and Duni.

existence, use, and importance of knowledge itself are not new. What is new, according to Davenport & Prusak (1998:12), is the recognition of "knowledge as a corporate asset". Drucker (1995) amplifies that by saying that "knowledge is *the* only meaningful economic resource". Nevertheless, even if knowledge is a critical organisational resource this view sometimes leads to a quite narrow perspective. Hereby I would like to emphasise that organisations' entire ability comprises more than just knowledge.

Viewing knowledge as an asset implies efforts to utilise, improve, deploy, and quantify knowledge in the organisation. Edvinsson & Malone (1997) take this so-called asset-based view a step further and describe how organisations can measure their IC[3]. Examples of measurements of the human capital are: employee turnover, IT-literacy of staff, time in training (days/year), and average duration of contract. In a similar way, Sveiby et al (1989) describe how to measure the intangible capital of organisations.

However, the measurements proposed both by Edvinsson & Malone (1997) and Sveiby et al (1989) are not easily handled. We can for example not take for granted that investments in employees' education automatically lead to an increase in IC. In the same way we need to question if a specific education actually will enlarge the ability of the organisation to perform and deliver value to customers. Acquired knowledge might for example not be practicable in the specific work situation, or an employee might not be able to understand how to apply it to his/her particular tasks. I do agree that there is a need for the stock market and other interested parties to acquire more appropriate figures of the "real" value of organisations. But just because knowledge is seen as an asset of organisations does not imply that knowledge either can or should be measured. Still, it sometimes seems like knowledge is viewed as an asset that is easy to externalise and quantify.

Nevertheless, it would be fruitful to find ways to *evaluate* knowledge in some way. The overarching challenge for knowledge management is, according to me, to develop, utilise, and exploit knowledge in order to approve the performance of organisations. This presupposes that the knowledge available is actable and relevant for the business. Hereby, I suggest the focus is on evaluation of the *usefulness of knowledge* instead of trying to measure knowledge *per se* or different investments in knowledge acquisitions.

Another restriction is the risk of disregarding the individuals. Without humans there will not exist any knowledge and thereby no organisational performance. I would like to emphasise that it is humans that develop and carry knowledge in their minds, at least initially. Of course, knowledge can, for example, be expressed and manifested in textual descriptions, products, artefacts, and so on. However, it

[3] One of the main components of intellectual capital is the *human capital*, which is described as individual capabilities, skills, experience and the like. The other one is *structural capital*, which is described as embodiment, empowerment, and supportive infrastructure of human capital. (Edvinsson & Malone, 1997)

is always human beings that are the initial founders of the underlying knowledge. It is also humans that make it possible to utilise knowledge which have been developed. Furthermore, in organisations there are seldom one single co-worker that carries through all organisational tasks. It is rather a number of employees that together create value, in terms of goods and services, for the organisation's clients. This implies the need for a *human* and *social-based perspective*, which in turn denotes the importance of *communication*.

Theories on "organisational learning" pay a great attention to the individuals and behavioural aspects (see e.g. Senge, 1990; Argyris, 1991). However, to some degree this is done at the expense of other parts of the organisational ability. Once again, I would like to emphasise the importance of a holistic approach. Attention needs to be given to both *knowledge, descriptions of knowledge, routines, and artefacts*, which all are parts of the organisational ability (for a deeper discussion see Goldkuhl & Nilsson, 2000b).

## 2.2 Knowledge definitions

Knowledge is often seen as a quite abstract and unclear notion, which of course does not simplify an explanation of its meaning. Nevertheless, when talking about knowledge management it is important that we make clear what we mean regarding its central ideas. I will therefore look into some explanations of knowledge that is presented in the literature. My purpose is to use some existing definitions in order to clarify my own position.

One of the most common concepts of knowledge, which is found in the KM literature, builds on Polanyi's (1966) distinction between explicit and tacit knowledge. Explicit knowledge refers to knowledge that can be articulated in formal language and transmitted across individuals formally and easily (Nonaka & Takeuchi, 1995). Allee (1997:45) exemplifies this by declaring that "explicit knowledge is conveyed through documents, images, and other deliberate communications processes". This property, i.e. the possibility of being transmitted through documents and the like, makes me wonder if explicit knowledge is the same as information[4]. Notions like "explicit knowledge", "codified knowledge" (Allee, 1997; Davenport & Prusak, 1998), and "encoded knowledge" (Blackler, 1995) do at least indicate an intimate relation between explicit knowledge and information. Mårtensson (1999) explicitly takes this stance and equals "explicit knowledge" with "information". She also stresses that explicit knowledge (information) is not knowledge. Unfortunately, there is a tendency of contradiction in Mårtensson (1999). She (1999:18) says for example "knowledge can be divided into tacit or explicit knowledge, i.e. information". In this way, she actually states

[4] In this context by information I refer to structured data that aims to deliver different kinds of messages to the receiver.

that knowledge can be both tacit knowledge and information (explicit knowledge). Thereby, she does not succeed in distinguishing the difference between knowledge and information, which was something she aimed to do.

To continue with the notion of tacit knowledge, this is described as personal and context-specific knowledge, which is hard to formalise and communicate. In other words, tacit knowledge is difficult to articulate with a formal language (Nonaka & Takeuchi, 1995). Davenport & Prusak (1998:70) even say that tacit knowledge is "almost impossible to reproduce in a document or database". Still, it is argued that tacit knowledge is the most important kind of knowledge, and one aim of Nonaka & Takeuchi's (1995) theory of organisational knowledge creation is to transfer tacit to explicit knowledge.

Even if many authors (see e.g. Nonaka & Takeuchi, 1995; Davenport & Prusak, 1998) comment on the notion that tacit knowledge is not made explicit easily, this is seldom profoundly analysed. It seems like tacit knowledge is seen as something that resides in the brain of human beings, while explicit knowledge is something that is independent of any subjective holder. In this way explicit knowledge could be placed on an equal footing with Popper's (1979) view of objective knowledge. However, knowledge without any holder appears to have been reified, and the fundamental question is if we really can call that knowledge? Another question is if it is enough to just talk about those two forms (tacit and explicit) of knowledge.

We might need to go back to Polanyi (1966) and Rolf (1995), who both are talking about focal respectively tacit knowing. The focal knowing is what we are consciously focusing on, while the latter one is a form of background knowledge that helps us to direct our perception. Both these functions of knowing are something that cannot occur without a knowing subject. However, individuals can express what they know by using linguistic or pictorial descriptions. Weigand, Hoppenbrouwers & de Moor (1999) are talking about explicit knowledge in the terms of *text*. The authors accentuate that "text is not knowledge, it is of course just a representation" (ibid:2). Even if a textual description of knowledge is not knowledge *per se* they do have an important role in organisations (Taylor, 1996). One fact of the written is that it can be detached from the author and the specific recipients, hence having a degree of autonomy (Derrida, 1988). This is not possible for an oral speech act, which instead demand the presence of both the speaker and listener. However, two, according to me, important issues concerning descriptions of knowledge (texts) are that they are a *remaining* result of language acts, as well as a remaining result of individual's explanations of their knowledge.

I suggest that it would be fruitful to talk about at least three forms of knowledge: One form is the tacit knowledge that is more or less unconscious, highly because it has not been articulated and is taken for granted by the knower. A second form is explicit knowledge that the holder is aware of. Due to the awareness, the holder has the possibility to verbalise and expose the specific knowledge. In addition, there is an opportunity to express the knowledge in the

form of texts and illustrations. Knowledge expressed in text represents the third form which I call "externalised knowledge". This form of knowledge is descriptions of knowledge, which stands more or less apart from the initial knower and the situation in which the knowledge was created. Furthermore, we need to consider that some knowledge (knowing) is on a subjective level, while some knowledge is inter-subjective.

We could also talk about knowledge as manifested in objects. For example, the goods and services an organisation is manufacturing represent knowledge of the organisation (Wikström & Normann, 1994). Through the production processes knowledge is manifested in products that are delivered to the clients. This manifestation of knowledge in objects is not only valid for products that are delivered to clients. Knowledge can also be manifested in instruments that are used in the business. One example of instruments is IT-artefacts that are used to support organisations' information processing, manufacturing, and transportation (Goldkuhl & Nilsson, 2000b). Knowledge manifested in objects play an intrinsic role in and for organisations.

However, within the scope of knowledge management it is the *tacit, explicit, and externalised knowledge*, together with *subjective* and *inter-subjective knowing* that are of most importance. I would say that it is those forms and levels that need to be managed in order for organisations to have the ability to produce instruments and deliver qualified products to its clients. Figure 1 shows these forms of knowledge, the two ontological levels of knowing, together with some empirical examples. The examples are derived from the case study at Duni and are used as illustrations. However, the stated examples are not considered being unique for one specific dimension (see the squares). In addition, I want to highlight that externalised knowledge differs from the other two forms of knowledge. Externalised knowledge is just descriptions of knowledge, as well descriptions of subjective and inter-subjective knowing.

| | | *The ontological levels of knowing* | |
|---|---|---|---|
| | | Subjective knowing | Inter-subjective knowing |
| *Forms of knowledge* | Tacit | How to get the right paper quality | Institutionalised routines |
| | Explicit | How to drive a paper machine | A common understanding of the language used in the organisation |
| | Externalised | Individuals' privately used checklists | An organisation's stated and written values and norms |

Figure 1: Different forms of knowledge and levels of knowing.

One remaining issue to clarify is how externalised knowledge can be distinguished from information. I regard descriptions of knowledge as something else (more) than information. In order to refine this issue I believe it is fruitful to take advantage of language action theories. Searle (1969) describes twelve criteria for categorising speech acts. One of those is the speech act's *illocutionary point* which determines the main pragmatic function of the speech act. Another interesting criteria is the *expressed psychological state* of the speaker which refers to the speakers attitude to the prepositional content of the speech act. When a person intends to expose and transfer knowledge she/he can do that through oral or written utterances. In the IT-firm there are a lot of written descriptions of norms, models, methods and the like. Many of them are individual, but there are also a great many common descriptions. For example, some of the co-workers have developed and described a project model that is suggested as a working model for the consultants. The model is based on the developers' knowledge and experiences. The illocutionary point of dispersing the model is to facilitate the work for other co-workers by providing the externalised knowledge. The expressed psychological state is a belief that this is a good working model to use and a wish that the co-workers will use the model. The model itself could be said to be a kind of "directive speech act" (Searle, 1969). My point is that descriptions of knowledge (e.g. a working model or a paper presenting research findings) should not be equalled with information. By exposing knowledge descriptions the intention is to share knowledge, not just to distribute information.

### 2.3 Managing knowledge

In order to create knowledge Nonaka & Takeuchi (1995) have put forward a model for knowledge conversion. The four modes of knowledge conversion are socialisation, externalisation, combination, and internalisation[5]. Those four modes together constitute a never-ending spiral of organisational knowledge creation, which is seen as a social process between individuals. Among the modes, externalisation is regarded as the key to knowledge creation. The reason for that is that externalisation is said to create new, explicit concepts from tacit knowledge. The result of the externalisation process is conceptual knowledge, i.e. tacit knowledge has been transformed into explicit knowledge. The externalisation process is triggered by dialogue and often driven by the use of metaphors and analogies (ibid). Still, in the end it is the knowledge of focus that ought to be described, but it is not clear how this can be done.

[5] Socialisation means transferring tacit knowledge between actors, externalisation means making tacit knowledge explicit, combination means combing different kinds of explicit knowledge and get new explicit knowledge, and internalisation means embodying explicit knowledge to tacit knowledge (Nonaka & Takeuchi, 1995).

I would like to emphasise that the phenomenon of knowledge creation and in particular the externalisation process is dependent and enabled through different kind of speech acts. Furthermore, in several cases the acquisition of knowledge comprises different kinds of *oral* utterances. Knowledge can also be acquired through *written* utterances (e.g. books and articles), observation, and other ways that do not involve any specific verbal communication acts. However, without the dialogue between the knower and the knowledge receiver, it might be difficult for the receiver to interpret the meaning of the knowledge as intended by the initial knower. By this I mean that verbal communication is most often facilitating the knowledge acquisition process. Nevertheless, despite how the knowledge acquisition is enabled (orally or through written statements) it is a matter of *communication acts*.

In the IT-firm an important part of the learning takes place in the dialogue and through collaboration. Concerning the learning through dialogues, most of that occur in an *ad hoc* based manner. It is mainly in the corridor or during the coffee breaks the co-workers talk about what happened in different projects. The dialogues could be both storytelling and questioning. Most of the respondents stressed that those informal conversations, no matter the character of the dialogues, are an intrinsic source of learning and reuse of knowledge developed by others. One limitation of this kind of *ad hoc* based knowledge exposure is that it is restricted to the individuals that are present at the specific time.

The learning through internal collaboration is quite limited. A great deal of the business is performed in projects, but the consultants work highly self-governed when fulfilling their different parts of the project. This kind of independence when carrying through the individual tasks has resulted in the co-workers having different ways of working. They use, for example, different methods and ways of reporting in the course of the projects. To some degree there are also differences in the language used. Those fragmented approaches are not good, neither for the teams themselves, nor for the clients' impression of the company. Several clients have expressed a frustration about the firm's "different faces". I would say that these heterogeneities are partly caused by the absence of more formal and structured experience dialogues within and between teams. As a consequence, the co-workers are not taking real advantage of each other's knowledge, they fail in reusing fruitful knowledge in a proper way, they are "reinventing the wheel", the possibility to develop a common language is restricted, and so on. In addition, the organisation as a whole may fail to secure ideas and potential ways for developing the business. However, the consultants work very close to the client and hereby a lot of learning take place in the dialogue and collaboration with the clients.

Turning back to Nonaka & Takeuchi (1995), they are emphasising the importance of amplifying knowledge that is created by individuals. It is through the organisational knowledge creation process subjective knowledge can be dispersed to a group level, organisational level, or even to an inter-organisational

level. The process is driven by organisational intention, which is defined as an organisations aspiration to its vision, goals, or standards (ibid). The intention of organisations must be transferred to the employees and thereby create individual and strong commitments (cf. Polanyi's (1958) thoughts concerning commitment as something underlying the human knowledge creation process).

I would say that for individual knowledge to be approved and amplified to inter-subjective knowledge depends particularly on two conditions which influence how a receiver comprehends knowledge that in some way is exposed to him/her: The first condition involves the intention and commitment of the knowledge exponent (cf. Searle, 1969). The knowledge exponent needs to represent some level of authority and trustworthiness (cf. Habermas' (1984) validity claims). Otherwise, there is a risk that others will not accept the exposed knowledge. Referring to the project model in the IT-firm it was considered being useful and valid for the project leaders. However, the model was not applicable to the consultants' work. Therefore, they had modified and adjusted it to their specific situation. The second condition is the social context in which the co-workers participate (cf. institutionalisation, Berger & Luckmann, 1966). The specific social context determines to a high degree which background knowledge, preferences, and pre-understanding the individuals have. In the IT-firm different teams have e.g. different working methods and concept definitions, which complicate communication and collaborations, as well as knowledge transfers.

Even if a major part of learning takes place through the core practice there is a great need for talking about knowledge and experiences. Hereby, communicative actions play an intrinsic role for organisations to be able to manage knowledge. Linguistic utterances are a way to articulate and externalise knowledge by the use of language. As stated above, utterances can be made orally or in writing. If we look into knowledge expressed in writing this is a description of knowledge. Levitt & March (1988) say that organisations can encode, store, and retrieve experiences which the co-workers have gained. However, the meaning of a text should not be limited only to descriptions, statements, or reports (cf. Austin, 1979). Linguistic utterances also have an illocutionary force (ibid) in the meaning of being recipes, advices, guideline, or the like. All utterances involve both a propositional part (the content) and an illocutionary part (the action) (Searle, 1969).

Nevertheless, informal and arbitrary communication is not enough, even if these kinds of conversations are very fruitful. Organisations also need to develop lines of actions that stimulate to a communal discourse of gained experiences, thoughts, and knowledge. Through those kind of speech acts organisations have a great opportunity to on the one hand develop relevant, inter-subjective knowledge, on the other identify knowledge that is lacking. Both these occurrences are important in order to implement a successful management of knowledge.

## 2.4 Which kinds of knowledge need to be considered?

It is quite common to define which kinds of knowledge that are needed in organisations. Göranzon (1990) and Josefson (1991) build their view of knowledge on Nordenstam (1983), who talks about theoretical (declarative) knowledge, practical (know-how) knowledge, and familiarity (social, praxis based) knowledge. Practical knowledge and familiarity knowledge are mainly equalled with tacit knowledge, while theoretical knowledge is considered to be explicit. This categorization has been criticised by both Rolf (1995) and Molander (1996). Molander gives several examples of practical and familiarity knowledge that is not tacit at all, but highly explicit. Goldkuhl & Nilsson (2000a) are also sceptical concerning this division, and mean that the categorising in different homogenous knowledge volumes should rather be seen as different functions of knowledge.

I do agree that the meanings of the mentioned kinds of knowledge are important for organisational performance. However, in the scope of managing knowledge these kinds of categorisations might be too abstract. As an alternative and hopefully more actionable categorising, I would like to suggest the use of "how-", "what-", and "why-knowledge". To give some examples of the proposed kinds of knowledge I will refer to my study of Duni.

Duni is an organisation that has taken advantage of the suggested breakdown of knowledge as a part of the development of the business' knowledge management. The categorising is shown to be both understandable and actionable. Examples of how-knowledge are knowledge about how to drive the paper machines and how to change the flux of water. How-knowledge also includes norms, guidelines, and the like. What-knowledge is for example knowledge about what kind of paper quality is demanded. This is what I call a kind of assignment-based knowledge, i.e. knowledge related to orders, projects, etc. Why-knowledge is at Duni highly related to the understanding of how different conditions influence the end product. To this I would like to add that why-knowledge could also be related to knowledge concerning mission statements, goals and so on.

In order to develop a good knowledge base within the organisation, Duni has externalised subjective knowledge of the co-workers. So far, Duni is well on the way considering externalising what-knowledge and to some degree even how-knowledge. A waiting challenge for Duni is to connect those two knowledge types to externalisation of why-knowledge. This is not an easy task to carry through; nevertheless, it is of importance for the workers. One reason for that is that the machine drivers work on different shifts and there is not always a person to ask if the drivers have questions. It would simplify if the drivers could find answers to at least some of their questions by searching in texts that might be indexed in some way in a computer-based program. This indicates the importance of access to externalised knowledge.

An additional issue is if all or just some specific knowledge should be considered within knowledge management. Nonaka & Takeuchi (1995) mean that organisational knowledge creation is about amplifying individual knowledge to common knowledge. This implicate that *all* knowledge used in organisations should be focused. This is a major mission and it might be a little bit superfluous. I suggest that the practice of knowledge management concentrates on the knowledge used and needed in the core business, i.e. for the production of the goods and services. This focus is applied at Duni and covers the most critical knowledge that need to be managed, i.e. not the knowledge used in supporting activities like cleaning, financing and the like.

# 3 A framework for Knowledge Management

## 3.1 A model of generic practice as a basis for increased understanding

Due to the fact that knowledge is something that always is in use and continuously is developed in organisations, one can wonder if knowledge management should be considered as something that is there all the time, i.e. integrated with the other business activities. In a way it is, but I would say that a phenomenon like knowledge management requires a degree of awareness. I mean that there could hardly be said to exist true knowledge management in an organisation if the knowledge is just managed in an arbitrary, unstructured, and informal manner.

In order to clarify my approach to knowledge management, I will take advantage of Goldkuhl & Röstlinger's (1999) model of "Theory of Practice" (ToP), see figure 2 below. The main reason for me to choose this model is that the included categories are well-suited to my view of knowledge management, and the fact that ToP is an expanded language action model (see discussion in Goldkuhl & Röstlinger, 1999). In addition, I consider the ToP to be a good basis in order to increase the understanding for and describe KM from a holistic approach.

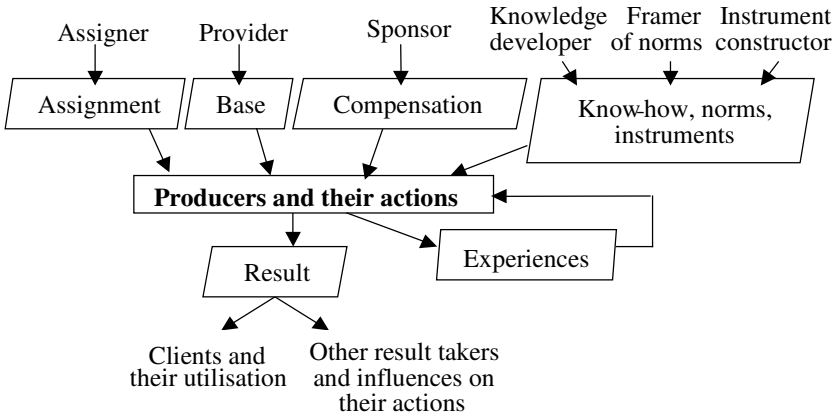


Figure 2: The model of generic practice (Goldkuhl & Röstlinger,1999:20).

### 3.2 A model of organisations knowledge practice

I will use and expand the ToP model by applying a more obvious KM perspective. I will also make some minor modifications of the model. By referring to the above discussion concerning different levels of knowledge, I will separate artefacts (in the meaning of manifestations of knowledge in objects) from other forms of knowledge. In my model "knowledge" includes subjective knowledge, inter-subjective knowledge (e.g. norms), and externalised knowledge (e.g. texts). Furthermore, the experiences gained through the producers' actions are an important form of learning by observation and trial-and-error. However, those experiences needs to be taken care of and that is one of the critical tasks for the knowledge practice. Figure 3 illustrates my model, which is followed by a description.

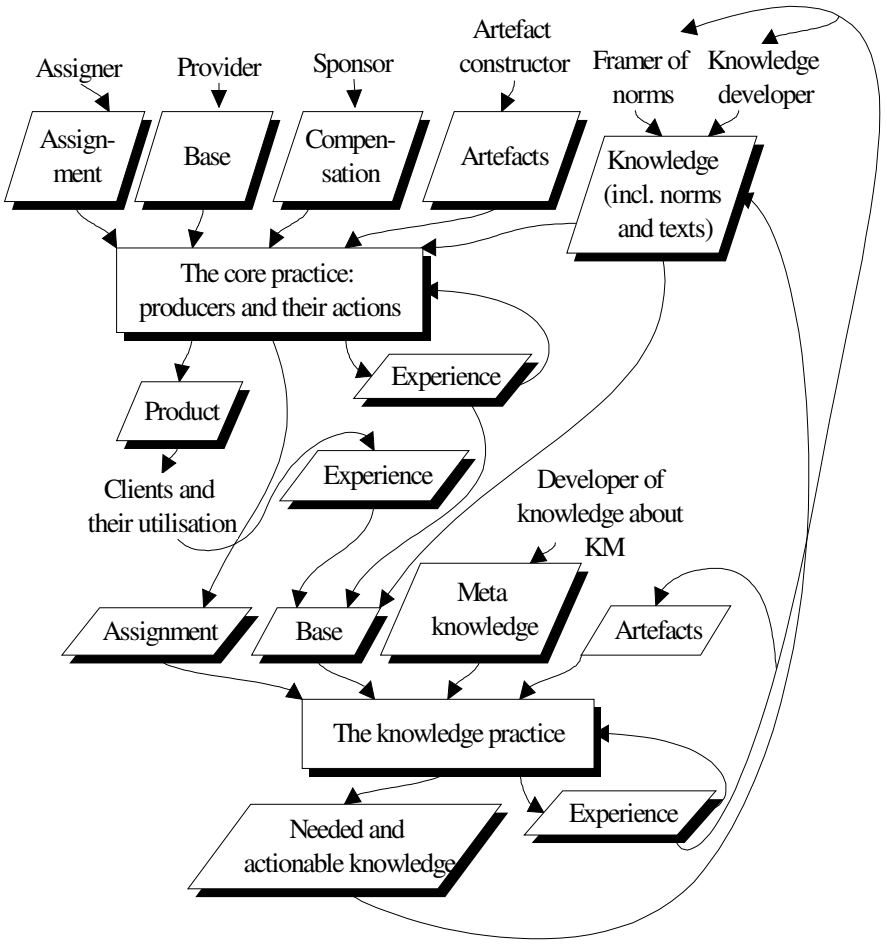


Figure 3: A holistic model of organisational knowledge practice.

In order to describe the model I will use the IT-case as an illustration. I will not go into details with the core practice of the IT-firm. Instead the focus is on the knowledge practice. Nevertheless, I will start by giving some explanation to the core practice, its prerequisites, and results. The *assignment* is the result of an agreement between the IT-firm and the client of what the contract will include. The *base*, for the part of the organisation I have studied, is mainly a standardised and adaptable information system, together with the client's present infrastructure. The client *finances* the practice by paying for the supplied goods and services. The producers use *artefacts* in their daily work, mainly for contacts and search for information. The *knowledge* needed comprises partly knowledge about the system's functionality, partly knowledge related to the client's specific business. There are also a number of norms, visions, working models, and methods that need to be considered. Some of those are subjective (e.g. subjective working models and checking lists); others are inter-subjective such as reward systems and rules for internal charging. The *result* of the core practice is an implemented and suited system at the clients business. As a *by-result* the producers gain experiences, which is an important basic for developing new knowledge. Those experiences are brought back to the core business through the producers themselves. Some experiences are also subjects for informal talks and thereby spread to other co-workers. However, there is a great need to more deliberately reflect on and transfer those experiences to those workers who need them.

Continuing with the prerequisite for the knowledge practice, the *base* for refinement and evaluation is partly experiences gained through the core practice, partly knowledge as prerequisite for the core practice. However, organisations also have to pay regard to the clients' experiences of the business relationship including the feedback and evaluation of the product delivered. Within the IT-firm this need has been observed, and the firm have therefore in mind to carry through a comprehensive research concerning the clients' attitudes to and comprehension of the business relationship. From a KM-perspective there is some specific norms that also deserve attention. The IT-case showed for example that there exist some impediments to give time to activities like proper projects evaluations and experience discussions. The main obstacle is that the team members to a high degree are driven by chargeable hours. It is by chargeable hours the individuals have the chance to raise their monthly payment. This reward system has become a reason for not spending time on structured and planned experience dialogs. Still, a great many of the respondents expressed the need of more formal project evaluations, in addition to the informal discourses during the coffee break and the like. In turn, this might require some incentives in order to have the team members reserve time for knowledge management activities. In the long run, both the individuals and the organisation, as a whole will most likely gain from that.

Another prerequisite is *meta knowledge*. This refers to knowledge about how to perform a knowledge practice. This kind of knowledge is not very well developed

within the IT-firm. Even if the firm's management and other co-workers say that their most important resource is knowledge, knowledge is handled in a quite arbitrary way. There are no visions or guidelines for the internal knowledge management. However, the firm has noticed the need for a more obvious approach to knowledge management.

To highlight the fact that it is not sufficient to handle knowledge in an arbitrary way, I would like to stress the need for an *assignment* in order to carry through activities in the knowledge practice. By assignment I do not mean that it must be formal. However, there has to be a commitment and understanding of the usefulness of a conscious management of knowledge, both from the perspective of the management and the individual co-workers. Otherwise, there is a risk that knowledge management activities will not be given the priority they deserve. In the IT-case it is apparent that the consultants do not give priority to knowledge-related activities. One reason is that the consultants are very much driven by new projects, time, and the reward systems. The initiatives the co-workers do take concerning exposing and transferring knowledge is through story telling during coffee breaks and when they ask their colleagues about a problem or the like.

Concerning *artefacts* and infrastructure to facilitate the knowledge practice there are databases, intranet, Internet, mailing groups, and so on available for the workers in the IT-firm. However, those supporting instruments are not used very much. The co-workers mean that the internal indexing system and the searching possibilities are too limited, and it takes to much time to search on the Internet. In addition, several respondents questioned *why they should give their knowledge away for free*. This kind of statement clearly indicates that the workers do not see the point in sharing knowledge with others. Instead they actually use knowledge as an instrument of power (cf. discussion in part 1). Several efforts to put up mailing groups and databases in order to facilitate knowledge transfers and make externalised knowledge accessible have failed due to the restricted use by the workers. To overcome this problem, the most important issue is for the IT-firm is to show the advantages by sharing knowledge and thereby, among other things, avoid inventing the "wheel" over and over again.

For the knowledge practice, I have identified some *central activities* that I consider being of particular importance. A major part of learning and developing of knowledge do take part within the core practice. However, those experiences and knowledge need to be taken charge of. This calls for activities like *articulating*, *reflecting*, and *conceptualisation* of knowledge. Dialogues and common reflection are activities that are highly needed in the IT-firm in order to improve its management of knowledge and to develop shared mental models. To implement proper project evaluations is one starting point for the IT-firm. In addition, there is a need to improve some artefacts so they will be more suitable for supporting knowledge related activities. In turn, this requires that subjective

and inter-subjective knowledge is *systematized* and *externalised* so they easily can be *accessible* for the ones who needs them.

However, the above stated activities are not enough. There is also a need for *clarification of vision, strategies, and guidelines* for the knowledge practice. This might call for some changes in organisations' current norms (see the prerequisite "knowledge" for the core practice). For example, the IT-firm needs to look into its reward system and see if it requires any modifications. An important issue for the management and other principals is to make clear to the consultants the need oˇ and benefits by sharing knowledge with each other. Another important issue is *planning* for knowledge-focused activities. This is also related to the evaluation of knowledge used and needed in the core business. In the IT-case I reconstructed the project activities together with each respondent. The reconstruction was then used as a basis for identifying the knowledge needed for the activities, the existing and needed descriptions of knowledge (externalised knowledge), and the norms and other prerequisites that directed the activities. This procedure made it possible to identify the knowledge that exists respectively is lacking, and how different prerequisite influences the consultants' actions. The reconstructions have proved to be a good starting point for planning, evaluating, and developing actionable knowledge.

To sum up some critical activities within the knowledge practice there is a need for: strategic and tactical management of the knowledge practice; planning for the knowledge focused activities; acquiring knowledge from outside (through e.g. partnership, collaborations, external courses, and texts); reflecting on subjective and inter-subjective knowledge; and make knowledge available for those who needs them by the use of e.g. seminars, artefacts, and internal courses. This does not mean that those activities are the only ones that ought to be noticed; there might be other activities that also need to be included.

However, the stated activities postulate the need for communication between co-workers. If the activities mainly are performed individually, organisations will that the

organisation needs to modify some of its norms, develop new knowledge which cannot be developed completely internal in the organisation, or develop new

artefacts to facilitate the knowledge practice. Organisations also need to utilise the experiences from the knowledge practice in order to develop the same.

## 4 Conclusion

This paper presents a model of organisations' knowledge practice and its relation to the core practice. One aim with the model is to show that knowledge management requires a holistic approach. For example, it is not enough to just pay regard to knowledge as an important organisational resource. Organisations also need to consider artefacts, routines, and descriptions of knowledge that are critical parts of the organisational ability. To that end, it is of importance to understand the relationship between core practice and the knowledge practice. There might e.g. be norms (externalised knowledge) that are good for the core practice but impede the knowledge practice (as the reward system does in the IT-firm). The knowledge practice is closely related to the core practice, as the knowledge used and need in the core practice is the intrinsic base for the knowledge practice. However, knowledge management is not about measuring the intangible assets of organisations. It is more about evaluation of the usefulness of knowledge and development of actionable knowledge. Reconstructing activities in the core business facilitate the identification of the knowledge used and needed in the same. This procedure smooths the identification of partly knowledge that exists and needs to be reflected upon, partly knowledge that is lacking and needs to be developed.

I have described the model by using the IT-case as an illustration. Thereby, I could for instance identify parts that are lacking in the IT-firm (e.g. vision and guidelines for KM, meta knowledge, incentives to priority knowledge focused activities), and norms that facilitate the core practice but impede the knowledge practice (e.g. the reward system). I believe that the model is a good starting point in order to gain a better understanding of what KM involves and how it is influenced by and influences the core practice.

I have underlined the fact that knowledge is related to human beings. Therefore, organisations need to apply a human perspective on knowledge management. However, a strict individual perspective is not enough. Most organisational actions are based upon coordination and teamwork, which in turn involve a perspective of socialisation and communication. In the core practice the actors gain experiences and develop new knowledge through their different actions. These experiences and knowledge needs to be articulated, reflected upon, and shared between the co-workers. This is one of the critical issues for KM. This also shows the need for communication, both orally and through written utterances, and that knowledge practice to a high degree is about organisational communications and handling of linguistic utterances.

I have also come to the conclusion that the most important forms of knowledge are tacit, explicit, and externalised knowledge. Those forms of knowledge can be both on a subjective and an inter-subjective level of knowing. For example, knowledge expressed in texts functions as a reminder or instruction for individuals and has an illocutionary force that organisations should take advantage of. I have also suggested that how-, what-, and why-knowledge are the kinds of knowledge that need to be focused. To that, I have proposed that the knowledge practice should focus on knowledge used and needed in the core practice.

There will always exist subjective knowledge in organisations. Nevertheless, organisations need to strive for making *relevant knowledge* accessible to all those who *needs* it. Thus, one important aim for knowledge management is to amplify subjective knowledge (knowing) in order to have the co-workers sharing the same understanding. In order to do that dialogues, including e.g. communal reflection, articulation, and evaluation of knowledge are intrinsic procedures that ought to be comprised within organisations' knowledge practice.

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# Dimensions of Coordination

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## Abstract

Cooperative work is coordinated by means of many different media and codes: by means of oral or written language, by means of diagrams and maps, and by means of dedicated computer systems. The purpose of the paper is to set up a small set of dimensions that can be used to characterize and compare the different ways in which coordination is achieved.
The paper focuses on the relation between oral and artifact-based coordination. The former is often replaced by the latter when coordination complexity exceeds the limits of oral coordination, but the artifacts must still connect to the oral communication surrounding it. Therefore it is relevant to investigate the similarities and differences between the two distinct means of coordination, and to look for a general framework, encompassing both means of coordination that enables us to understand how they may work together. We set off from two field studies: One of oral coordination as performed aboard the world's largest container carrier and one of a coordination artifact used in a software development project. We conclude by proposing five dimensions for classifying media and codes for cooperation. One of them relates to the medium: *Persistency.* Two are semantic, since they relate to the *reference* of the representations: *Aktionsart (*P*rocess vs. State),* and *Theme (Field of Work vs. Work Arrangement).* The last one is pragmatic since it concerns the use of the representations and their interaction with the environment*: Locus of Agency (User, System* and *Environment).*

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## 1. Introduction

The coordination of complex cooperative work is an intricate matter that can impose a severe workload on the cooperating actors—so much so, in fact, that the magnitude of coordination work can become a general obstruction to work effectiveness, flexibility, or even safety. In such cases computer-based coordination support systems are often engaged as a means of reducing the degree of complexity involved in coordinating the complex cooperative work.

There are many studies illustrating the rich and seamless nature of coordination performed by co-located actors (e.g., Harper et al., 1991; Heath et al., 1993). All these studies show that the coordination of cooperative work can sometimes be achieved effectively and effortlessly simply by means of our everyday modes of interaction. Other studies have shown however, that oral interaction becomes increasingly labor intensive and sometimes even inadequate as a means of coordination in high complexity cooperative work (Carstensen and Sørensen, 1996; Schmidt and Simone, 1996). The latter studies highlight the need for artifacts that support the actors in coordinating the complexly interdependent cooperative tasks which, when carried out by means of oral interaction, tend to generate a very high coordination workload. When designing computer systems with the objective of reducing the magnitude of coordination work, it will therefore often be necessary to 'transform' coordination work from the medium of oral interaction to artifact based interaction—this transformation is neither trivial nor well understood.

The paper investigates the relation between spoken and artifact based coordination. We report on two field studies: a study of maritime operations aboard the worlds largest container ship where coordination is primarily performed by means of oral interaction, and a study of software engineering where the coordination relied heavily on artifacts. We will analyze the means of coordination used within the two work settings, and we will propose a number of dimensions along which oral and artifact based coordination can be characterized and compared in order to elicit similarities and differences.

## 2. Communication as coordination

The maritime operations with which we will be concerned in the following were observed during the most recent in a series of field studies concerned with time-critical cooperation and coordination as performed by the crew on board some of the world's largest container carriers. We have spent a total of four months on board three container carriers calling on 35 harbors on four continents. The field work has generated a rich data material comprising a large number of video recordings, interviews, and technical documentation on the vessels in general and the instruments on the bridge in particular.

The data presented below stem from a European roundtrip performed on board the carrier M/S Sally Mærsk during spring 1999. The fragments of communication that will be analyzed in the paper have been transcribed from video recordings.

Fig. 1. Sally Mærsk approaching the habor of Algeciras

### 2.1 The need for coordination in maritime operations

Maritime operations are characterized by significant variations in the need for coordination. While operating in open waters the vessel is steered by one officer who will perform most tasks in solitude; he is alone on the bridge most of the time, and ship-to-ship and ship-to-shore communication is infrequent. However, when the vessel approaches a harbor and enters coastal waters, operations become highly cooperative. When operating in and around the harbor the master (captain), chief officer, helmsman, and pilot are working on the bridge; two groups of three and four actors—commanded by the first and second officer, respectively—are positioned on deck; the pilot station, vessel traffic management service, and dockers are located ashore and communicate via VHF; tugboats and other vessels operate in the immediate surroundings of the Sally Mærsk and will at times become part of the cooperative work arrangement involved in maintaining safe operations.

Cooperation grows in line with rises in work complexity. When the vessel moves from open waters through coastal waters on to the waters in and around the harbor, work constraints become increasingly tight. Basically, maneuvers have to be performed with an increasing degree of precision, while there is less time to make the navigational decisions.

The tighter work constraints are reflected in the ways the actors communicate and coordinate. In and around the harbor area—where work complexity peeks—communication is almost exclusively about work and proceeds according to highly structured patterns of interaction. It is this type of coordination that we shall be concerned with in the following. The theoretical basis for the analysis will be

drawn from empirical and theoretical work on work communication (Andersen, 1997). We shall characterize instances of work related communication by means of the key concepts*, focus, background*, and *protocol*.

## 2.2 Focus and background

Consider the following situation. The Sally Mærsk is inbound for Rotterdam. There are four actors on the bridge, master, chief officer, pilot and helmsman. The auto pilot has been discharged and steering is performed manually. All are silent, then the pilot speaks: *starboard twenty*. The helmsman speaks: *starboard twenty*. And all are silent again.

| | | |
|---|---|---|
| 1 | Pilot | Starboard twenty |
| 2 | Helmsman | Starboard twenty |

Fragment 1: Rudder command

In any communicative situation, some features are taken for granted, whereas others are the topic of discussion. We shall say that the former constitute the *background*, the latter the *focus* of communication[1]. Background information is either not expressed at all, referred to via unstressed pronouns or definite nouns that recur identically during the conversation, or referred to via certain backgrounding constructions, such as adnominal adjectives and clauses.

In the communication between the pilot and the helmsman, the background information is completely left out. The pilot does not state who is the receiver of his command (the helmsman) nor which action is to be done (turning the wheel); he does, in fact, not state that it is a command at all.

Particular combinations of backgrounded and focused information types define specific communicative functions. The communicative functions can be defined in a very precise manner by considering a typical sentential schema used to interpret actual utterances[2].

---

1 Focus and background is well-known concepts in linguistics. They describe the information structure of the sentence, cf. the *textual metafunctions* in Halliday (1994). Bødker (1996) uses the notion of focus as a general tool of work analysis.

2 The approach is mainly inspired by Halliday (1994). According to Halliday, utterances must simultaneously fulfill three main types of functions: *ideational* (how should we structure the topic?), *interpersonal* (how do we interact?), and *textual* (how do we make the text cohere?), cf. note 1. The schema tries to capture the combination of functional features that are relevant in the data. *Ideational* functions: the schema only covers *Doings*, i.e. material processes implying a change of state. The structure *Subject (Actor) + verb + Object (Goal)* derives from the process type of Doings. Halliday's five other process types are not covered. The adjuncts *Manner, Time* and *Place* are added since they turned out to be important in the data. *Interpersonal* functions: A slot for *tense, aspect* and *modality* is included since we are concerned with co-operation, i.e. regulation of interpersonal relations. *Textual* functions: the distinction between *background* and *focus* is a textual function. It is included in order to describe the reduction of complexity so important in

| *Subject* | *Tense Aspect Modality* | *Verb* | *Object* | *Manner* | *Time, place* |
|---|---|---|---|---|---|
| Someone | do | acting on | Something | in some way | sometime |

Schema A. The basic sentential schema.

A sentential schema consists of a set of slots following one another in a more or less fixed sequence. Each slot can be filled with a particular kind of linguistic material, e.g. nouns, verbs or adverbials. Such sets have been called *paradigms* since Saussure's days. In the following diagrams we shall shorten "Tense, aspect, modality" to TAM.

Below a set of communicative functions are defined by different combinations of background and focus (boldface) paradigms (the data is from the Swedish Postal Giro, cf. Holmqvist 1989; Andersen 1997, pp. 379 ff.):

| **Someone** | should begin | acting on | Something | in some way | **sometime** |
|---|---|---|---|---|---|

Schema 1. Work distribution: *who* should begin doing it *when*?

| Someone | **is** | acting on | Something | in some way | now |
|---|---|---|---|---|---|

Schema 2. Supervision: *is* she doing it?

| **Someone** | **has** | acted on | Something | in some way | now |
|---|---|---|---|---|---|

Schema 3. Worker Reporting: *has she* done it?

| Someone | **has** | acted on | **Something** | in some way | now |
|---|---|---|---|---|---|

Schema 4. Object Reporting: *has* it been done to *it*?

| I | should | **act on** | **Something** | in some way | now |
|---|---|---|---|---|---|

Schema 5. Work coordination: *what* should I do now?

| She | should | act on | Something | **in some way** | sometime |
|---|---|---|---|---|---|

Schema 6. Instruction: *how* should she do it?

| Someone | **has** | acted on | Something | **in the correct way** | sometime |
|---|---|---|---|---|---|

Schema 7. Control check: *has* it been done to *it in the correct way.*

If we consider the rudder command communicated between the pilot and the helmsman in terms of the basic sentential schema, only the *manner* slot is focused

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complex work settings. Thus, the schema is an assemblage of features that are expected to be important in cooperative, physical work of the type we are dealing with. The schema may not be able to extract important features of other types of work, e.g. work mainly consisting of communicating – "sayings" in Halliday's terms.

(Schema 8) the rest of the slots are backgrounded. Thus it belong to the instruction type.

| *Subject* | *TAM* | *Verb* | *Object* | *Manner* | *Time, place* |
|---|---|---|---|---|---|
| Helmsman | should | turn | the wheel | *Starboard twenty* | Now, at the helm stand |

Schema 8: Instruction. Helmsman should turn the wheel *in some manner* now at the helmstand

The purpose of using background and focus paradigms is to reduce complexity. If the utterance is to specify an action that can be performed, then all paradigms must contain exactly one member that connects to work operations. One cannot make the ship sail "some" course. The course must be "001°, 002°, 003°, etc.". So the purpose of the conversations is to fix all focus paradigms to exactly one of these. But if we can choose between, say 10 items in each slot, there are $10^6$ possibilities to choose from, and we will never get around to do anything before the ship is grounded. Formally speaking, the technique of backgrounding reduces complexity exponentially.

The oral coordination in our data illustrates the importance of flexibility in the distribution between foreground and background paradigms. Paradigms, initially in the background during a conversation, may suddenly be brought to focus. In fragment 2 the shift from background to focus is performed by the master as he realizes that the pilot is in the midst of a dangerous misunderstanding.

| | | |
|---|---|---|
| 1 | S.Atlantic | Sally Mærsk, the Sealand Atlantic [VHF] |
| 2 | Pilot | Sally Mærsk [VHF] |
| 3 | S.Atlantic | Yeah, good afternoon Captain, are you **turning to port** now, are you, over ? [VHF] |
| 4 | Pilot | Yes, I'm turning **slowly to port**, yes [VHF] |
| 5 | S.Atlantic | Okay, we, we are, we will be steering our course of about two nine zero, and we will stay to the north of you, if that is agreeable with you [VHF] |
| 6 | Pilot | yeah fine, I will be following the deep draft route outside [VHF] |
| 7 | S.Atlantic | Yeah, and can you give us **a red to red** passing, please, **port to port** [VHF] |
| 8 | Pilot | **port to port**, yeah fine okay [VHF, talking to the Sealand Atlantic] |

Fragment 2. Focus on parameters.

The fragment is from an approach to the Harbor of Rotterdam where the Sally Mærsk has been forced to perform a 360° turn in the deep-draft fairway some five miles from the harbor entrance. The maneuver is critical because no vessels can pass her while she is sideways in the canal. Traffic conditions are cleared prior to the maneuver. Yet, just after having initiated the turn, the Sally Mærsk is contacted on the VHF by the outbound Sealand Atlantic that will meet with Sally Mærsk in the narrow canal.

The assumed background action is "passing head-on" and the focus paradigm contains two members, *red to red* and *red to green*, from which they have to

choose. Sealand Atlantic chooses *red to red* because this is the normal choice. However, since Sally is turning port, the action will not be "passing head-on" but "overtaking" where *red to red* is a wrong choice.

Sealand Atlantic knows that Sally is turning port, but has not realized the consequences. The pilot does not realize the error either, but the captain does. He begins to focus the modality paradigm (how *can* we) and the previously backgrounded action slot (he will *overtake* us probably) and the Pilot quickly realizes his error *(not possible)* — although he does not admit to it!

| | | |
|---|---|---|
| 1 | S.Atlantic | Standing by zero two one six[VHF] |
| 2 | Pilot | okay [VHF] |
| 3 | Master | who was that? |
| 4 | Pilot | the outgoing ship, Sealand Atlantic, she want to pass **port to port** |
| 7 | Master | How, **how can** we do that? [pass the Sealand Atlantic port to port] |
| 8 | C. officer | (...) |
| 9 | 1. officer | Yes |
| 10 | Pilot | We are steering around slowly, slowly |
| 11 | Pause | |
| 12 | 1. officer | I presume he means that he will … |
| 13 | Master | Yeah, but **how can** he ... (...), he **will overtake** us probably .... |
| 14 | Pilot | Yeah, I don't know |
| 15 | Master | ...yeah, no, so um, **port to port** |
| 16 | Pilot | Sealand Atlantic, the Sally Mærsk [VHF] |
| 17 | S.Atlantic | Sally Mærsk, Sealand Atlantic [VHF] |
| 18 | Pilot | Um, you want to pass us on our **starboard** side, on the **north** side? [VHF] |
| 19 | S.Atlantic | Roger, Ill like to ...I, I heard you were **turning** to your **port** to go back in, I (...) in with the drencher, otherwise we are going **red to red**, over [VHF] |
| 20 | Pilot | I think **red to green** with us [VHF] |
| 23 | PilotSt | Sealand Atlantic ,Pilot Maas [VHF] |
| 24 | S.Atlantic | Pilot Maas [VHF] |
| 25 | PilotSt | The, the Sally Mærsk is **turning** to **port**, so you can proceed her north of her, over [VHF] |
| 26 | S.Atlantic | she is gonna **turn to port**, okay thank you, thank you, Sally Mærsk [VHF] [notice that the Sealand Atlantic thinks they are talking to the Sally Mærsk— when they are in fact talking to the Pilot Station Maas Approach]. |
| 27 | Pilot | yeah (...) **port to port, red to red not possible** |
| 28 | Master | that is **not possible** |
| 29 | Pilot | his **red** side to our **green** side |

Fragment 3. Shift of focus from parameters to modality.

Fragment 3 is a good example of how important it is that speakers are able to re-focus what was previously a background paradigm. On the one hand, it is necessary to reduce complexity by backgrounding information, but it is risky too if the backgrounded information is not valid.

## 2.3 Protocols

As is well-known, communication is realized as a sequence of utterances governed by certain turn-taking rules of the form: Questions are followed by answers, commands are repeated (fragment 1), etc. However, as in the case of oral commands other events than communicative ones are governed by conventions; physical events are governed too.

Ronald Stamper and his collaborators (e.g. Chong & Liu 2000) claim that such rules — or *norms*, as they call it — are a vital ingredient in the proper functioning of work organizations. They set up two main types of norms, *behavioral* norms and *intrinsic* norms, comprising *evaluative, perceptual*, and *cognitive* norms. Course commands (like fragment 1) are examples of behavioral norms that have the form:

- If <condition> then <agent> is <obliged|permitted|forbidden> to perform <action|speech act>

Intrisic norms like 'If someone hinders me doing something (e.g. berthing) then I *expect* him to notify me when the coast is clear (the berth is free)' has the following general form:

- If <condition> then <agent> adopts <an attitude> towards <some consequences or proposition>

Norms in our data are *heterogeneous* since general and specific norms are mixed; they are *semi-conscious* since some of them are written down and others are verbalized when they are broken; and they are not designed as a system, but have *evolved* through history.

| | | |
|---|---|---|
| 1 | Master | And call out when you are on the new course, K, right (…), when it's there you say one one five – then we know it's there |
| 2 | Helmsman | I did say so last time |
| 3 | Master | Well, I just did not hear it |
| 4 | Helmsman | (..) |
| 5 | Master | okay (...) that's fine – keep up the good work |

Fragment 4: Violating a rule.

The existence of norms in oral coordination of maritime operations can be verified in four ways: they can be abstracted from regularities in the data, they are taught explicitly during training; and some norms occur in the ship-owners manuals; and they are verbalized when they are violated:

Fragment 4 also indicates another important aspect of the observed norms, namely that they are self referential: The master *tells* the helmsman to *call* out.

### 2.4 Characteristics of oral coordination

The examples given above can be summarized into the following observations regarding oral communication and coordination:

- In oral communication, information is distributed in *background* and *focus* paradigms. This enables the actors to reduce complexity of their interaction.
- Coordination communication consists in closing the focus paradigms so that one executable member remains.
- Communicative functions can be defined by *combinations* of background and focus paradigms.
- Oral communication allows *smooth changes* between focus and background paradigms, enabling speakers to question tacit assumptions.
- Norms are *semi-conscious*, i.e., normally not conscious, but can be verbalized and discussed in case of violations. Formulations can also be found in maritime education and in ship-owner's manuals.
- Norms do *not form a system*, but are a set of concurrently working, heterogeneous, and relatively autonomous guidelines that have evolved through time.
- Protocols can communicate about themselves (are *self-referential*).

A special subset of norms are those concerned with regulating cooperation between two or more persons. We shall use the term *protocol* to denote a coherent set of norms of this type. All the preceding examples of norms belong to a protocol.

## 3. Artifact based coordination

In the following we will turn to a field study of artifact based coordination conducted at Foss Electric, a Danish manufacturing company developing, producing, and marketing equipment for e.g., measuring the compositional quality of milk.

The study to be discussed here concentrated on the software development in one large project: The S4000 project. It was a highly complex design project. It included facilities earlier provided by several instruments, measurements of new parameters in the milk were included, speed was to be improved significantly, and it was the first product with an Intel-based 486 PC built-in.

The software complex contained more than 200.000 lines of C-code and was organized in approximately 25 modules distributed in 15 different application. The S-4000 project involved more than 50 different people and lasted approximately 2 1/2 years. During the last 18 months the software design group had a stable size of approximately 8-10 designers, each having rather clear roles related to the design and implementation of one or more specific modules.

The most import roles related to the testing and correction activities included: (1) Software designers responsible for designing, implementing, maintaining, and correcting bugs in one or more of the software modules; (2) A group of three software designers called the *Spec-team* responsible for diagnosing reported bugs and deciding how to handle each of the bugs; (3) A Platform master responsible for managing and coordinating all the activities involved in integrating the outcome of one working period (called a "platform period"). He was, among other things, responsible for verifying the corrections of the software made by the designers, i.e., control that the reported bugs had been dealt with; (4) A Project plan manager responsible for maintaining a project plan spreadsheet; (5) Testers testing of the software embedded in the S4000 instrument; And (6) the central bugs file Manager organizing and maintaining the central bug file, a binder containing copies of all reported bugs and organized according to their status. It is interesting to notice, that there was no software group manager during this one and a half year period.

Early in the S4000-project, the software designers realized problems in coordinating, controlling, monitoring, and handling the testing activities. As a counter measure to these problems the software engineers invented and used a standardized bug form (figure 2) that all testers had to fill in whenever they identified an error (a bug). Subsequently, the findings from the study of the paper-based bug-report form formed the basis for a illustrative prototype implementing a computer-based bug-report form. In the following we will present the paper-based bug-report form and the subsequent computer-based bug-report form as cases of coordinating artifacts.

### 3.1 The paper-based bug-report form

The development and correction work was organized in phases called "platform periods". A platform period was typically 3–6 weeks work followed by one week of integration. All the work and the plans were structured in relation to these periods. For each period a designer was appointed Platform Master responsible for collecting all information on updates and changes made to the software, and for ensuring that software was tested and corrected properly.

When a bug was identified, the tester filled in a form and sent it to the spec-team. The spec-team diagnosed the problem and decided which developer should fix the problem. The responsible designer was notified (by receiving a bug form), and estimated the correction time needed. When the problem was dealt with, the designer notified the Platform Master who could then verify the corrections.

At any state, the binder contained a copy of the form in its current status. The binder had seven entries reflecting the status of a specific bug: (1) Non-corrected catastrophic bugs (copies); (2) non-corrected essential bugs (copies); (3) non-corrected cosmetic bugs (copies); (4) postponed bugs (originals), (5) rejected bugs

(originals); (6) corrected bugs not yet verified (copies); and (7) corrected bugs (originals). For each of the seven categories were the forms filed chronologically. The entries played a central role in stipulating the coordination by providing all involved designers and testers access to the state of affairs in the testing.

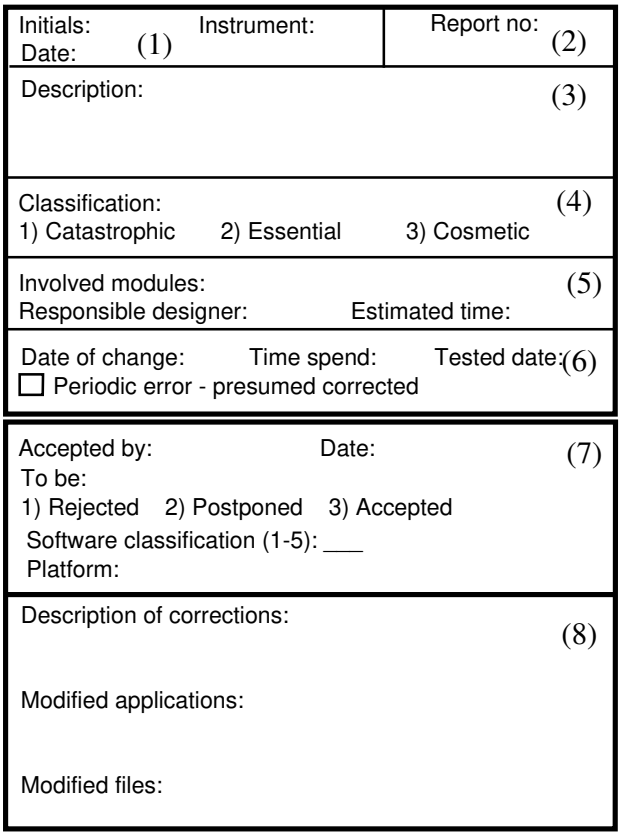


Fig. 2. A paper-based bug-report form annotated with the procedure followed when using it. CFM is central file manager and PM is Platform Master. The form is a sheet of A4 paper printed on both sides. The figure illustrates who fill in the information in the form.

The work plans were organized in a large spread-sheet containing information on: which tasks are to be accomplished and a reference to a detailed description of the task, the estimated amount of labor-time per module for each task, the responsibility-relations between modules and software designers, the relationships between the tasks and platform periods, and the total planned work hours per platform period for each software designer. The work plans were maintained by the Platform Master and a member of the spec-team.

The usage of the forms and the procedures can also be viewed as information flows between the involved roles and actors. Figure 3 illustrates the flow between the six different roles involved in coordinating the software testing and correction activities. In many situations the involved actors undertook more than one role.

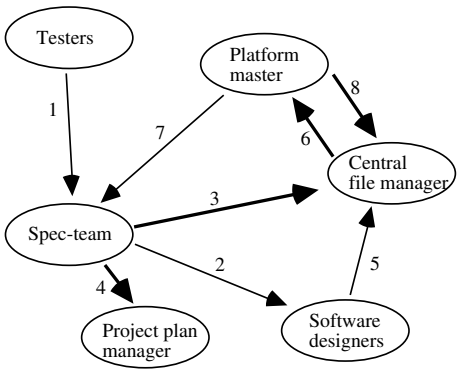


Fig. 3: A visualization of the roles involved in the software testing of the S4000 project, and the information flow between them.

The information flow described in figure 3 concerns only the stipulated (through organizational procedures) flow of the bug form mechanism. The thick arrows (3, 4, 6, and 8) indicate, that the flow is often a bunch of forms sent. The thin arrows indicate, that the forms are typically sent one at the time. Other types of information are frequently exchanged between the actors and there might be situations were one of the actors choose not to follow the stipulated information flow.

### 3.2 The computer-based bug-report form

BRaHS[3]—the computer-based bug-report form—was designed in order to illustrate certain principles for computer-based coordination support which had been derived from the study of the paper-based bug-report form. The design of BRaHS focused on illustrating how the registration of bugs (including an improved classification of bugs) could be handled, how overall requirements for flexibility (of the flow protocol and the structure of the form) could be reflected in the user interface, and how a protocol can be made visible and accessible to the users of the system. BRaHS was designed to support distributed registration of bugs, and automatic routing (forwarding and passing on) of report forms to the next actor (role) in the *tester* → *spec-team* → *designer* → *Platform Master* chain. BRaHS implemented a changeable workflow protocol, and provided facilities enhancing the overview of bugs, the status, etc. To fulfill the requirements, the following overall functionality was designed and implemented in BRaHS:

- Log-in procedure where the user identifies himself to the system and specifies the role(s) he assumes when interacting with the system.

[3] Bug reporting and Handling System, designed and implemented by Thomas Albert and Peter Carstensen. See Carstensen (1996) for a full presentation of the BRaHS system.

- Facilities for registering information about bugs. Both the testers, the spec-team, and the designers enter information about a bug.
- Facilities for specifying the classification of a bug.
- Procedures that automatically routes the form to the next actor in the workflow when a user indicates that his registration is finished.
- A graphical representation of the workflow protocol, and access for the users to make certain changes to the protocol.
- Facilities to search for bugs associated with certain characteristics, and facilities for browsing information on registered bugs.
- Procedures to select the current project, and to define or change the actors, modules, roles, instruments, etc. involved in a particular project.

BRaHS was implemented as a client/server structure using Borland's Delphi as the application development and runtime environment. The system runs on a Windows platform.

### 3.3 Characterization of artifact based coordination

It can, of course, be questioned whether the bug form mechanism has genuinely "eliminated" coordination complexity. The coordination to be conducted is as complex as always, but it can appear simpler to the actors through improving the representations of the work domain, by enforcing a specific behavior of the actors involved, by "automating" certain activities of the coordination, and by establishing a division of labor minimizing the need for coordination. The claim here is, that the bug form mechanism supported the coordination of software testing and correction by providing several of these things:

- The bug form provided a standardized information structure by means of which all bugs were described. By allowing the diagnosis information to be included in the form in a standardized pre-structured manner, the mechanism made it easier for the spec-team to find the relevant information. The classification of the bugs made it easier for the spec-team to deduce the testers' perception of the problem reported. The form can thus be seen as improving the representation of the field of work (the bugs) by establishing a "common standardized language". This makes it easier for the actors to interact. "Standardized languages" are, of course, problematic too. They constrain the actors, it takes time for the actors to become familiar with them, and they need to be maintained.
- The standardized format of the form, furthermore, supported the work of re-porting, both from tester to spec-team, from spec-team to designer, and from designer to platform master. This is because it forces a specific behavior on the

actors. Through a specific surface representation the form freed the actors from considering which information to include.

- The bug form mechanism also supported the coordination activities by stipulating the work flow for handling the reporting, diagnosing, and correcting process. Although it was not completely automated, the pre-specified flow minimized the need for communication and interaction among the actors when handing over the form (and thus the obligations) from one actor to the next. The pre-specified flow (the embedded protocol) afforded support through constraining the actor: He could just apply the pre-specified routing without further considerations.
- Finally, the bug form mechanism was a central tool for establishing a well-understood and well-defined division of labor. By establishing different roles, and very clearly defining their responsibilities, the mechanism reduced the need for communication and interaction among the actors. All actors in the reporting, diagnosing, and correcting process knew exactly, what their obligations were. When they had dealt with their part of the treatment, they could just pass on the form, and others would take care of the rest. Their need for coordination was reduced.

Coordination activities, like monitoring the state of affairs and negotiating classifications, allocations, etc., were supported by the bug form mechanism too. The establishment of the central file (the binder), including all registered bugs and their current status, made it easier to get a coherent picture of the state of affairs. Although the testers and designers found it difficult to achieve an overview from the content of the binder, the benefit was that they only had to search in one place. Furthermore, the standardized information structure in the forms, and the standardized index of the binder, made it easier for the actors to find the relevant information, for example the classification and status of a bug or the number of not-yet-corrected category 2 bugs. Finally, the bug form mechanism, and its related mechanisms made classifications and resource allocations visible and accessible to the actors. The classifications and allocations became easier to discuss.

## 4. Dimensions of coordination means

If we compare the coordination *functions* performed orally in maritime operations to those being stipulated by the paper- and computer-based bug-report forms we find a high degree of equivalence. Parts of the bug-report can be analyzed as a medium for conducting a sequence of coordinative communicative functions with different focus and background paradigms. In addition, the focus paradigms in one function becomes background in the following. As shown in Schema 9, the verb is always backgrounded to *correct;* (1) focuses on the module identification, (2) on

modality (*should/should* not be corrected *(rejected/accepted)*, time *(now/postponed)* and manner (classification of bug: *how* should the correction be done*?*), and (3) focuses on the subject (*who* is going to do it). Finally, (4) is concerned with aspect (*has* it *been* done) and manner (has it been done *in the proper way*).

| *Subject* | *TAM* | *Verb* | *Object* | *Manner* | *Time, place* |
|---|---|---|---|---|---|
| 1. Someone | should | correct | **which module** | in some way | sometime |
| 2. Someone | **should/ should n't** | correct | the module | **in which way** | **when** |
| **3. Who** | should | correct | the module | in that way | at that time |
| **4.** Someone | **has** | correct**ed** | the module | **in the proper manner** | at some time |

Schema 9. Coordinative functions in the bug-report in terms of foreground / background focus paradigms

If we compare Schema 9 to the different combinations presented in Section 2.2 we can see that (3) is Work Distribution (Schema 1), (2) is a variant of Instruction (Schema 6) where modality is focused too (should/ shouldn't be done), and (4) is Control Check where tense/aspect (has it been done?) and manner (here "correctly") are focused.

difference is that the computer-based bug-report form is an active means of coordination—it performs automatic routing—whereas all routing is performed by the actors in the cases of oral and paper-based coordination.

In the following we will propose a set of analytical dimensions relevant for a more general and structured comparison between different means of coordination. Before we do this, however, we shall describe a computerized means of

coordination from the maritime domain. The example (Fig. 4) is from the VTS station at Bremerhafen. It is used by the pilots to prevent ships passing each other at dangerous bends of the river Elb.

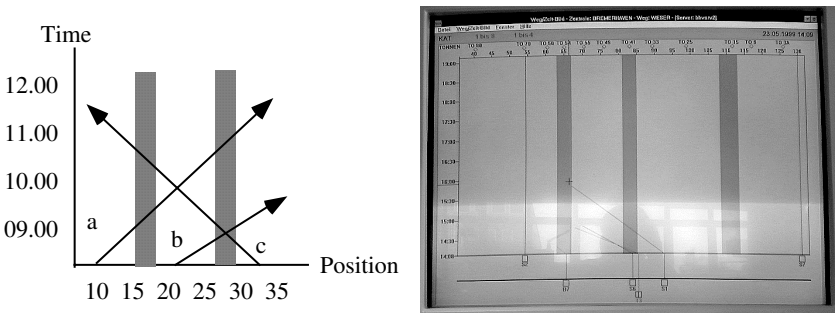


Fig. 4. Display used by the pilots at the Bremerhafen VTS station.

The y-axis represent time and the x-axis position along the river (in the actual systems, *tonnes* were used as units of measurements). The vectors represent the ship's future positions extrapolated by means of the present speed, and the shaded areas represent the sections of the river where encounters are prohibited. Vectors pointing left are ships sailing upstream, those to the right are downstream ships. The simple rule is that vectors crossing each other inside the shaded areas are prohibited, so *b* and *c* must be warned of each other, but no one else.

The example illustrates two things: (1) its reference is different from BRaHS int that it primarily refers to the field of work (the positions of the vessels) overlaid with representations of the coorperative work arrangement (the shaded sections denoting "two vessels may not be here simultaneously"). (2) The field of work changes the system in the sense that sensors automatically updates the vessel positions on the screen-image. The reason for this difference lies in the two domains: whereas the software system does not change except when the designers are active, in process control, the field of work changes autonomously without interference of the bridge personnel.

We now have described a set of means for enhancing cooperation: oral communication, the paper-based and the computer-based bug-report, checklists, and the Bremerhafen system. Although they share a common usage—enhancing cooperation within a common field of work—they are also quite dissimilar. How can we characterize their similarities and dissimilarities?

We have just touched upon an important *semantic* dimension, namely the *reference* of the representations: do they primarily refer to the work arrangement or to the common field of work? We shall call this distinction the *Theme* of the representation. The paper-based bug-report and the pilot-system primarily refer to the common field of work and presuppose cooperative protocols not explicitly described in the medium, whereas in the computer-based bug-report the work arrangement is also represented in the system. Oral communicative functions includes both varieties: in *Work Distribution, Supervision, Worker Reporting* and

*Work Coordination*, the cooperative arrangement is focused, whereas the tasks and work objects are emphasized in *Object Reporting, Instruction*, and *Control Check.*

Thus, coordination may be achieved primarily by means of information about the field of work or primarily by reference to the cooperative work arrangement. Simple cooperative work can often be coordinated exclusively by reference to the state of the field of work. The coordination of complex cooperative work will however benefit from mechanisms which make direct reference to states or processes to be achieved within the cooperative work arrangement. Put another way: in complex cooperative work the actors will have difficulties coordinating the cooperative activities simply by observing the changing states in the common field of work. In order to reduce the coordination complexity they need means which explicitly stipulate the course of coordinative action.

Another important semantic dimension is that between references to *processes* and *states*, traditionally called *Aktionsart*. *Control Check* and parts of the bug-report refers to a state of the work-object, whereas oral *Instruction* and the pilot system (and, for that matter, maritime RADARs and VMS systems) refer to both states and processes in the field of work (the maritime systems primarily records states, but extrapolate future events and can make a history plot). The computer-based bug-report and the oral *Work Distribution* refer to processes in the work arrangement (protocols), whereas the oral *Worker Reporting* refers to a state in the work arrangement (*has she* done it?).

A third important dimension of the media is *persistency* that sets oral communication apart from all the other examples. By a *persistent* medium we mean a medium that maintains its information over longer periods of time. In *ephemeral* media, information is lost almost instantly and must be recorded elsewhere[*].

A more detailed classification is probably needed in reality: although it is true that oral communication is ephemeral, it can be recorded on tape, and this in fact done to VHF-communication in some ferries in order to provide legal documentation in case of accidents. In some cases, only parts of the representations are ephemeral, while others are persistent. For example, RADARs always offer a persistent representation of the present state which the crew can inspect at any time. However, it is possible to switch on a "history" facility so that the vessels' positions remain on the screen as a track of trailing dots. The decision as to which representations are to be persistent and which ones ephemeral is an important design issue (Andersen & May, to appear).

A fourth dimension relates to the *pragmatics* of the representations, i.e. their use and interaction with the environment. We shall term the dimension *Locus of Agency.* In our cases there are examples of three loci of agency: in the *user*, in the *system* and in the *field of work.* In principle, all combinations are possible but we

[*] A similar discrimination has been proposed in Schmidt and Simone (1996)

have only found a few. For example, in all examples, the user is a locus of agency. There are no fully automated systems.

In the pilot system, the *field of work* is an additional locus of agency (the screen is continually updated via a network of RADARs placed along the river), and this is definitely not the case in the BRaHS system that has no access whatsoever to the software system constructed. On the other hand, the BraHS *system* is itself a locus of agency: after a field in the form has been filled in the protocol actively suggests who should work on the form next, and the protocol also implements a default flow structure that ensures that the report is actually routed to the chosen actor: However, the user has still the final word. Finally, in the oral or the paper-based media, the *user* is the sole locus of agency, since the user himself must create the representations as well as execute the tasks denoted. The maritime computer systems are somewhere in-between: they only notify the user of possible conflicts of cooperation, but do not offer suggestions of possible actions. However, advisory collision avoidance systems are presently being designed where the maritime protocols—the rules of the road—are implemented.

## 5. Conclusion

In this paper we have argued that there is a common set of concepts that apply to any means of coordination, irrespective of medium. These concepts include textual functions, such as focus and background, interpersonal functions, such as communicative function, norms and protocols, and ideational concepts, such as work arrangement versus field of work. We have furthermore suggested that a four-dimensional grid, *Persistency, Aktionsart*, *Theme*, and *Locus of Agency,* can be used for characterizing and comparing the examples we have detailed knowledge of.

We believe that this line of research is useful for two reasons:

- Means of cooperation often change medium in the course of time. For example, in the software example, similar functions were performed orally first, then by means of written forms, and, possibly, in the future, by means of a computerized coordination mechanism. Creating the latter often means changing, supplementing, or replacing the former.
- Computerized coordination mechanisms must still function together with oral and paper-based means of coordination. The designers will not stop talking to one other nor writing notes, even if they adopt a BraHS-like system.

In the first case, a shared set of concepts may make it easier to make a systematic change from expressing coordination in one portfolio of media to doing it in another one; in the latter case, a shared classification system may help designers

evaluate how well a computerized coordination mechanism will work together with the other media surrounding it.

## 6. Acknowledgements

The research documented in this paper could not have been conducted without the invaluable help of numerous people at Mærsk Sealand and Foss Electrics. We would like to thank the companies for their generous hospitality and valuable comments. We thank Steven Verjans for useful comments. The research has partially been funded by the Center for Human-Machine Interaction (The Danish National Research Foundation). All errors naturally remain the responsibility of the authors.

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# A Functionalist Approach to Conceptualisation

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## Abstract

We present an ongoing PhD project exploring a functionalist approach to language and conceptualisation. Aiming to contribute to better and more flexible functional specification of information and communication systems, we take a new direction within the LAP, viewing linguistic entities as *communication tools*. Rather than focussing on representations as such, we are primarily interested in ways to effectively select and guide the *processes related to the creation, fine-tuning, and use* of explicit conceptual tools. We see formal and informal use of linguistic tools as complementary. A preliminary applied-theoretical framework of conceptualisation is introduced. We also briefly discuss the conceptual case domain that will be explored in forthcoming work: that of *'communication about work'*, a domain related to CSCW.

## 1 Introduction

The Language Action Perspective (LAP) on specification and design of Information and Communication (IC) systems as put forward by [Winograd and

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Flores, 1986] has put communication between humans at the centre of functional system design. Fifteen years on, we have gained much insight into the pragmatic patterns constituting organizations and business processes, and how these patterns may be used in the specification of computerized IC systems. However, for the broader LAP to be carried through with a satisfactorily pervasive effect on ICT, there is a need for a more comprehensive theoretical basis, covering various if not all semiotic levels: physical, empiric, syntactic, semantic, pragmatic, and social [Stamper, 1993; van Reijswoud, 1996; Hoppenbrouwers and Weigand 2000].

The LAP has already opened our eyes to social aspects of communication; we now see growing opportunities for linking up the social with the linguistic dimension. Acknowledging the fundamental, driving role of pragmatics in the analysis and support of communicative action, we present a pragmatics-driven, functionalist approach to language (in its broad, semiotic sense) and to how language relates to IC systems specification and use. Our focus will be on the semantic and syntactic levels. The aim of our project is to provide not a theoretical analysis of conceptual structures involved, but a framework for understanding and guiding conceptualisation in operational environments.

As our framework should (eventually) go beyond theory and contribute to better management of concepts and conceptualisation in IC systems specification and use, in the next stage of our project we will apply our ideas to several detailed case studies in the general domain of *communication about work*, placing our project in context of CSCW. This does not imply that we aspire to put ourselves at the core of CSCW research. Our focus remains on communication, conceptualisation, and concept management, yet communication about work in context of CSCW is a relevant, inspiring, and challenging conceptual domain to test our ideas in. As the project is in progress, we are as of yet unable to present domain-oriented results and therefore can only present the outline of our effort, our preliminary framework, and research set-up. The paper should therefore be read mostly as a position paper. We expect to present results from the case studies in later LAP workshops.

## 2 Basic Underpinnings

In our approach, which for a large part combines insights from research in the areas of Functional Grammar (or FG) and the LAP, semantics ultimately serves pragmatic goals. Functional Grammar [Dik, 1989] is a linguistic paradigm aiming to describe and explain all aspects of language structure in functionalist terms, i.e. from the point of view of *language use*. Our work mostly draws from FG with respect to the role of the lexicon in FG [Olbertz et al., 1998] and FG's general approach to linguistics. Detailed matters of syntactic, semantic, and pragmatic structure as covered by FG are less central to our current investigation.

Our basic idea, when expressed through metaphor, is that languages are *communication toolkits*, and so are, ultimately, IC systems. In a similar vein, then, all concepts, rules, and capacities involved in linguistic processes are *tools*: rules of grammar are communication tools, as are words [Weigand and Hoppenbrouwers, 1998]. Conceptual tools usually come into existence because people agree (explicitly or implicitly) on using them as such, though sometimes norms and rules are imposed by some authority, and sometimes they are made explicit (definition); *texts* and *context* also play an important role [Weigand et al., 1999]. Therefore, grammatical and lexical structures are considered to be reflections of *communal rules and norms*, and are essentially elements of 'background'. This means that they are normally left implicit, and may become subject to articulation and discussion/discourse as a result of breakdow˝ or anticipation thereof.[1] Conversation about language necessarily involves *meta-communication* [Hoppenbrouwers and Weigand, 2000].

We focus on the language-based toolkit consisting of a set of conceptual tools most commonly referred to as *signs*: symbolic representations (elementary as well as complex) carrying meaning. We are interested in the goals that signs and sign systems serve (or should serve) in IC systems, and even more in the processes through which such signs are created and selected. Such *conceptualisation processes* lie at the heart of our project. We are mostly concerned with conceptualisation of *explicit, purpose-specific, and controlled symbolic representations*, not with matters of cognition or psycholinguistics; we approach the human mind/brain for the most part as a 'black box'. However, since IC systems are often used in highly specific situations, we emphasize the importance of *contextual* aspects of concept use and interpretation, subscribing to the idea that language is a 'vehicle' evoking context-specific *interpretations* in the human mind that lead to some sort of adjustment in an individual's 'mental picture of the world'. Language as such is believed to communicates 'deltas', [Dik, 1989], whereas mental representations or thoughts inside the 'black box' are believed to be conceptually much richer and more complex than the mere vehicle of linguistic semantics, and quite likely also different in nature [Harder, 1996].

Interpretation may be an individual matter, but communication is fundamentally social, and so is, therefore, the instrument of language. Both the individual and social view are important in understanding language use [Clark, 1996]. Meaning is socially constructed, while also requiring (coordinated) action by individuals. Common ground between individuals is vital, but so is the active process of cooperative formulation and interpretation in conversation. Thus, there exists a field of tension between the need for generic, broadly applicable communication tools ('common language': optimally social because many people share the

[1] This is the case even though there have, of course, been numerous systematic efforts to compose complete grammars and dictionaries. Yet even dictionaries and grammars are mostly used in matters involving breakdown.

language) and the need for the highly specific, flexible tools aimed at use in very specific contexts (as seen in, for example, many IC systems supporting communication in small groups). Generic description of concepts (as in a regular dictionary or a high-level ontology) is only a small part of the semantic story, and to support the use of language in action requires a more dynamic and situation-specific approach to semantics.

As conceptual domains (and related IC systems) get more complex, it becomes increasingly impossible to predict and formalise in advance all conceptual representations (elementary and complex) used in communication about them. It is therefore to be expected that in an increasing number of cases, on-the-fly discussion about language and concepts (meta-linguistic discussion/discourse) should be supported by IC systems for successful handling of breakdowns [Hoppenbrouwers and Weigand, 2000]. We therefore take a *process-oriented* position to concept management and focus not so much on specific concepts or conceptual representations, but rather on *conceptualisation*: the process of creating or selecting explicit conceptual representations in order to fulfil particular communicative goals. This involves basic questions such as: Which type of conceptualisation is best used in context of which communicational purpose? Does it, in some particular situation, suffice to re-use concepts taken from some closed set, or is it necessary to create or fine-tune concepts? Can the set of concepts needed be predicted beforehand, or should there be possibilities for run-time adjustment of the conceptual framework? Which techniques can best be used for the creation or selection of concepts in a particular situation? How do formal and informal use of language complement each other, and how does such use relate to the types of concepts and conceptualisation employed? (For discussion of some fundamental underlying issues, see [Weigand and Dignum, 1997]).

Though our aim is improvement of functional IC system specification, as we see those systems (in some respects) as extensions of linguistic communication we put central in our perspective the complementary interaction of IC systems and 'natural' communication. A rough but generally useful distinction made in discussions about IC systems and language is that between 'natural' language and 'constructed formal' (or 'artificial') language [Winograd and Flores, p107]. However, we are confronted with a communicative continuum stretching from 'no communication' ('thrownness'; sufficient common ground for coordination without linguistic communication), via natural language (e-mail, digital documents) and semi-formal language (normalised sentences, diagrams, pseudo code, user interfaces), to formal language (logical languages, programming languages). In view of the plethora of language usages and conceptualisation involved in IC systems specification and use, we need a more differentiated classification. We hope to achieve this by shifting the focus from 'language' to '*language use*': there is informal use of language, and formal use of language, and if a language is designed for formal use, it may be called a 'formal language', but

yet it may also be used informally or have some informal aspects in use. Likewise, natural languages such as Dutch may well be used with a high degree of formality.

We cannot make assumptions about the relation between formal and informal language use without some workable definition of what we mean by 'formal use'. Acknowledging that these matters touch upon age-old philosophical and ontological questions, but having the space nor the ambition to engage in lengthy discussion here, we stipulate that in our present discussion, formal use of language (sign systems) implies rational, mechanistic, and 100% predictable response to the use of symbols (given that all input to and the state of the agent are known). Such use implies the existence of a formal, context-free semantics. Informality is introduced where strictly rational symbol manipulation is abandoned for some form of *interpretation*: symbols are given some 'internal meaning' which is not necessarily rational, mechanistic, or predictable. This implies that symbols are informally used if, in communication with some agent (human or artificial), the 'communicative effect' of certain symbols cannot be known except insofar it is observed in action (possibly, communicative action) taken by that agent. The agent itself is (partly) a black box. Communication with such an agent requires all parties involved to be prepared, in principle, for linguistic breakdown, and possibly for meta-linguistic discussion/discourse. However, it is quite possible for informal communication to be very effective indeed if *experience* or *certification* has shown parties involved that communication is usually *trustworthy*. Nevertheless, the handling of linguistic breakdown should in principle be reckoned with in all non-formal communication. Note that in some situations there is of course ample reason to stick to formal structures, in which case the boundaries of formal language use should be clearly drawn and well guarded.

## 3 Conceptualisation: A Preliminary Framework

Above, we sketched the basic ideas underlying our work: conceptual/linguistic items are 'tools'; making such tools explicit (e.g. in a dictionary) is not the same as using them in context; conceptualisation may focus on communal pre-definition as well as contextualised clarification; formal and informal communication are complementary and may both be the aim of conceptualisation. Our eventual goal is to construct a workable framework which helps us determine what kind of conceptualisation may help for which aspect of IC system specification and use. Below, we sketch the preliminary outlines of such a framework, the development of which is still in progress. Its main ingredients are the following:

1. An overview of basic domains and goals in functional ICS specification and use
2. A set of differentiating properties of conceptualisation types
3. A typology of conceptualisation on the basis of these properties

4. A mapping of conceptualisation techniques onto the typology
5. A list of preferred conceptualisation properties for basic roles and goals

These ingredients should eventually (i.e. when worked out in sufficient detail and tested in real cases) provide us with the necessary analytical means to gain insight in the communicational needs of particular domains and goals in IC system specification and use, the preferred properties and types of conceptualisation associated with them, and with concrete conceptualisation techniques involved in actual operational conceptualisation. We hope to extend this set-up in future, working towards a general framework for well-balanced, communication-driven *concept management* in IC systems development and maintenance. We realise all too well that any basic framework will be too generic in nature for successful application in real cases. Therefore, we will in the near future apply and further develop the framework in a CSCW context (see section 5), adding the detail needed for operational exploration and validation of the framework.

Let us turn to the preliminary framework. A central notion in our account of conceptualisation is the difference between, on the one hand, active and explicit construction (mostly deliberate) of the language system as a set of communal agreements, and actual use of that system on the other, which requires active selection of symbols, interpretation, and thus creation of shared meaning *in context*. IC system specification most directly involves the first aspect, but the language engraved in a system should be strongly guided by how its concepts are going to be used. This implies that at a fundamental level of functionality, to look at operational language use is more important than and differs from, for example, getting an expert user to make explicit (perhaps even formalise) the conceptual structures that are 'solidified' versions of concept-evoking symbols as used through the operational system.

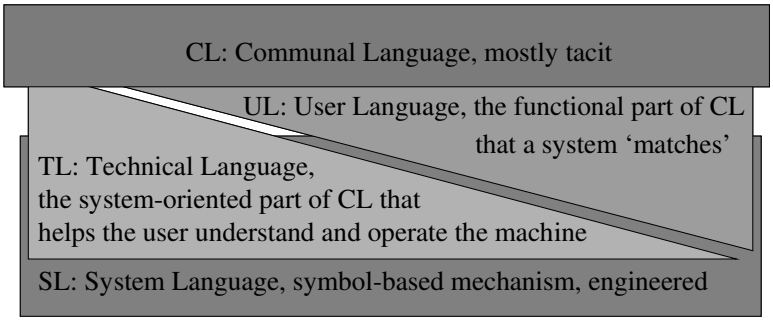
In view of the above, several commonly used roles in system specification and use could be analysed in terms of the kind(s) of conceptualisation most typically associated with them. For example, the traditional 'functional analyst' role can be expected to be associated with quite different forms of conceptualisation than the 'user' role or the 'programmer' role. Further detailed analysis of the matching between roles and conceptualisation types may render considerable insight, but concrete cases are needed for supply of real roles; regrettably, we have to let this interesting subject rest for now.

Four main domains of language use are involved in IC systems. As we have seen, the system is (or should be) an extension of the language domain in which it is used. The 'User Language' (UL), the conceptual system used by users but reflected by the system, should therefore be a sub-language of the Communal Language (CL). CL denotes language used outside the system, in pure human communication; it may be transmitted as a string by the system, to which it is 'opaque'. Assuming that the system only supports or deals with part of the

concepts used in conversation in the CL domain, UL hinges around a carefully selected subset of concepts from CL. Syntax is usually only marginally taken along; lexis is central.

CL and UL are the domains that relate to the primary communicational functionality of the system. However, two other domains are also part of the system domain, and need to be considered as well because they might (and often do) blur the picture. First, there is Technical Language (TL), that covers concepts related to control of the system mechanism, not primarily to communicate with another system user. It is therefore a system-oriented language which may be metaphorically related to CL, but only to make system understanding easier. Finally, there is the System Language (SL), which is formal by nature. Arguably, it is not so much a language but part of the system machinery: it is the code which determines which and how symbols are manipulated within the computational system. UL and TL denote languages used by users in system context: 'tokens the system recognizes'; they are usually subsets of CL, but may be very task-specific. UL and TL are the linking pins between CL and SL. CL and UL are primarily aimed at causing an interpretative effect in a user. SL may touch upon CL in that it may share some labels with it: UL and TL. We will further be concerned with CL and UL alone.

HUMAN WORLD (MIND/BRAIN/COMMUNITY)




SYSTEM WORLD (MECHANICS)

Further specific goals of CL and UL again depend on the goals within the functional domain, and though this is arguably the most interesting and challenging level of analysis, we can only enter into it in our later case study and will refrain from further discussion here. For now, we can only claim that a carefully maintained coherence should exist between CL and UL, and that formal aspects of UL (related to it being tied up with SL) should not interfere with informal aspects of UL related to it being a functional part of CL.

Below we present seven parameters of conceptualisation related to central issues in our framework. Surely, more parameters could be lined up; we have selected what we believe to be the most salient parameters. We deliberately leave

out most properties related to kinds of representation language (there is an enormous number of those), trying to keep a high-level, process-oriented view of conceptualisation. Note that the parameters are mainly focused at conceptualisation in system specification, and that references to 'language use' concern expected use of conceptual items in view of their consequences for conceptualisation.

**Implicit versus explicit concepts**. As mentioned before, we limit our focus to communication through explicit symbols and attempt to guide and account for choices made for particular kinds of explicit conceptualisation. With 'explicit' we mean: not only used, but named as part of a language or system, e.g. in a dictionary, data structure, conceptual model, etc. The question whether a certain case of language use would benefit from being made explicit in this sense is a valid one for each linguistic item under analysis.

**Creation versus selection**. Conceptualisation goes beyond creation of new concepts; the use of existing concepts is of course much more commonplace, but it very often involves some active selection of the concept, plus fine-tuning to the specific situation it is used in, down to matters of interpretation in context. The balance between the given and the new, creation, use, and re-use is central in our view on conceptualisation.

**Historical, pre-concocted, or on-the-fly creation**. Roughly spoken, concepts are created either (i.) through previous, historical breakdowns in the community ('natural growth'), (ii). in response to anticipated breakdown, or (iii). to 'solve' actual breakdown. These 'modes' require different forms of conceptualisation.

**Generic versus specialised use**. This distinction concerns how common or specialised the domain-specific knowledge is that is used in interpretation. Note that 'specialised' does not equal 'formal'. Also note that 'specialised' is a much better term here than more commonly used antonym of 'generic': 'specific'.

**Communication-oriented versus engineering-oriented use**. Are we focusing on the functionality of getting a machine to work or on getting communication between agents to work? This matter is related but not similar to the choice between formal and informal language use; it emphasizes that care should be taken that the goal of the conceptualisation effort is clear, given the consequences this has for further choices made. This parameter is linked to the notio˝s of CL, UL, TL, and SL.

**Formal versus informal use**. This distinction depends on whether or not formality is *functionally required*. Formal communication (if applied in favourable circumstances), is clear-cut, predictable, and its use can be automated, which is why it is ideal for system-supported, re-occurring forms of communication. Informal communication is preferred if considerable implicit background knowledge is expected to be needed for satisfactory sign interpretation (semantic argument, taking formality as optimal). Another reason for employing informal communication may be that it simply 'works better' because it 'comes natural' and

thus is 'cheaper' (human performance argument, taking formalisation to be a difficult process). The choice between formal and informal communication has a great impact on which form of conceptualisation is best applied.

**Level of isolation of concepts**. Isolation of a concept does not necessarily entail formalisation, but rather the pinpointing or constructing of a sign (representation plus shared meaning) which does (only) what it should do in its intended use. For example, a complicated diagram or scenario description may be very effective in its own right, but does not isolate a concept. In forms of active conceptual analysis, the most powerful conceptual descriptions are those that give all defining parties the 'exactly right' feeling in specific matters. In the case of informal use, this involves 'semantic reassurance': a symbol appears to evoke enough common associations to reduce the chance for interpretive mismatch to an acceptable level [Hoppenbrouwers and Weigand, 2000]. In formal use, this requires definition according to the rules of the formalism. Isolation of concepts usually requires some investment or effort, and in some cases non-isolated meanings do the job as well or even better; whether or not isolation is embarked on should be decided depending on the situation.

Some of the above parameters are reflected in figure 2 below, which represents a number of operational modes of conceptualisation. The matching of concrete conceptualisation techniques with the parameters renders a matrix which can be used as the basis for a typology of conceptualisation techniques. Figure 2 below includes some of the types reflecting parameter settings, but it is primarily intended to provide a practical division in 'modes of conceptualisation' inspired by analysis of a large number of methods and techniques involving conceptualisation. They are mostly related to the fields of Conceptual Modelling and NL-based Definition.

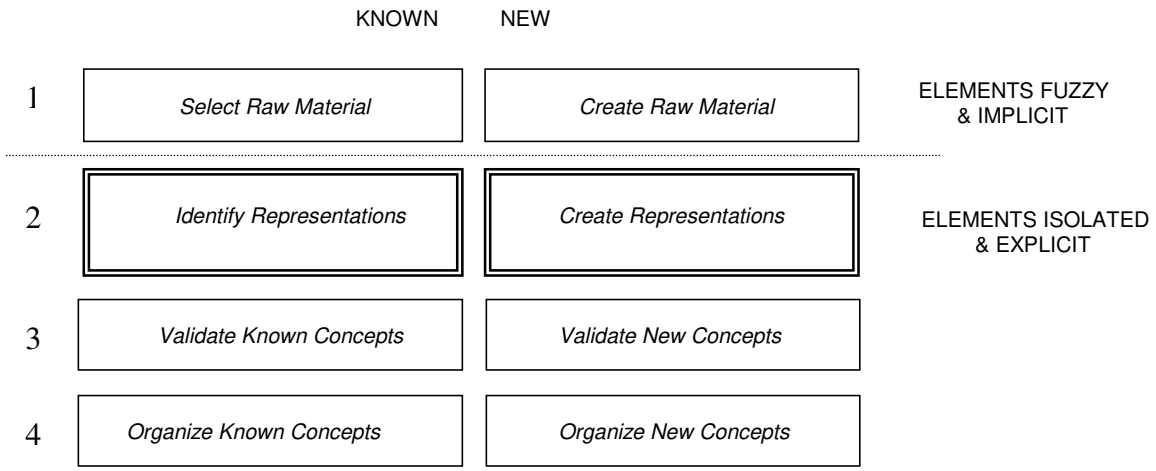



Figure 2: Modes of Conceptualisation

Note that some modes (notably modes 1 and 4) are perhaps not modes of conceptualisation in a very strict sense, but rather modes of analysis closely involved with conceptualisation. We consider these modes to be relevant enough to be included. We conclude our sketch of the preliminary framework with some typical examples of mapping of conceptualisation techniques (we have so far identified and described 34 of them) to figure 2.

| | *KNOWN* | *NEW* |
|---|---|---|
| *Mode 1*: | Selecting artefacts | Scenario writing |
| *Mode 2*: | Grammatical analysis of textual descriptions | Creating ER-like diagrams |
| *Mode 3*: | Corpus research (lexical) | NL paraphrasing |
| *Mode 4*: | Dictionary, Ontology, Object Repository | - |

We intend to elaborate on our typology of conceptualisation techniques in a future publication. We realize that the modes and parameters presented yet fail to give a complete and in-depth picture but hope that our preliminary framework will at least reflect some of the flavour of our approach and some of the practical goals we work towards.

## 4 Case Domain: Conceptualisation of 'Work' and CSCW

Because it is aiming for a concrete contribution to the improvement of IC systems specification and design, we will develop and test our framework in context of an elaborate and detailed study of a case domain. The LAP has always been closely related to the field of Computer Supported Cooperative Work (CSCW), and *communication about work* (e.g. about the planning, coordination, and flow of work) is a prominent, if not central conceptual domain in both LAP and CSCW research. In addition, the subject of conceptualisation with the goal of making possible communication about work, and the 'fixing' of those concepts in formal IC systems (for example, CSCW or workflow management systems), touches upon many important issues in information and computer science [ACM, 1995]. On the one hand, for example, there is a growing demand for more flexible IC support of group work processes; on the other, there is a need for stable, transparent, a˝d above all manageable IC systems. Bringing together the two needs is perhaps the greatest challenge currently facing computer science. The ever growing digitalisation of communication about work often results in increasing formality and the impossibility of immediate response to breakdown. Distribution of work processes results in the decrease of shared work contexts and background (language, knowledge) among workers. All this feeds the demand for better support of work-related communication and conceptualisation [Papazoglou and Schlageter 1998].

Discarding the vast technical challenge underlying the conceptual/functional one, we will evaluate and improve our framework by using it to analyse the conceptualisation of work in two cases taken from industry. Examples of conceptual elements of the domain are concepts related to workflow description and modelling (including roles, tasks, deadlines), planning, expressions of commitment to tasks, etc. Note again that to us, CSCW is a conceptual case domain rather than our primary field of research. On the basis of our framework and case analyses we will discuss how various types of conceptualisation can best be deployed in view of the process of IC system specification and design, and verify the validity of these guidelines by means of some experiments in relation to the case domains. It is not our aim to come up with a tight conceptual framework or specification language for some sub-domain of 'work', nor to put together a particular conceptual 'specification toolkit', but to gain better insight in the dynamics of conceptualisation in a cooperative work context. Along the way, however, we will come across and consider in detail a number of relevant domain specific concepts and conceptual representations of various kinds and at various levels of abstraction, as found in specific, 'real' contexts.

## 6 Research Set-up

In sum, the central research question in our work is the following: *How do people conceptualise work-related concepts in an operational, cooperative environment?* A second, more applied question directly follows from the main one: *How can we engage in system specification processes while respecting situation-specific communicational demands?*

The set-up of our project is as follows. First, we explored existing theory concerning conceptualisation. We then presented and discussed our functionalist framework of conceptualisation and how it relates to the process of system specification. The framework is the basis for identification of a number of parameters for conceptualisation, which are used to put together a functionalist typology of conceptualisation techniques (the typology and overview of conceptualisation techniques are almost finished, but were only shallowly discussed in this paper for reasons of space). A brief sketch of this first part of the thesis has been presented above.

Next we will turn to the conceptual domain of 'work'. Exploration of the problem domain will involve, besides thorough literature study, a survey of attitudes concerning conceptualisation of and communication about work. The survey will cover a number of stakeholder groups and will be carried out at a department of a large insurance company deploying advanced internal work support. Following the survey, the formal and informal conceptualisation occurring in the department will be described and analysed in view of our functionalist framework (in an approach also inspired by Schoop 1999). This will

include an analysis of a number of relevant concepts/representations used in communication about work. We will also include a corpus analysis of e-mail produced by a team of colleagues in context of a consultancy project, which will provide insight into informal communication about work.

We will then construct a generic account of application of conceptualisation methods and techniques to conceptualisation of work, paying attention to conceptualisation in support of all previously distinguished types of generic, domain-specific, and situation-specific communication. This will result in some applied principles and guidelines for operational conceptualisation support and concept management in CSCW-related contexts and domains. Next, these principles and guidelines will evaluated against the case study domain. Finally, we will discuss some consequences of our findings for the specification process of IC systems in general and CSCW systems in particular.

Our project was started in November 1998, and is carried out on a half-time basis, under supervision of Dr. Hans Weigand and Prof. Dr. Mike Papazoglou, at the Infolab of Tilburg University. The research is currently being sponsored by the Ordina Institute for Research and Innovation. As we speak, the phase of exploring literature and theory about conceptualisation and conceptualisation techniques is drawing to an end. We are now about to turn to detailed analysis of conceptualisation concerning work, involving both literature study (focusing on conceptual domains such as CSCW, Workflow, Articulation of Work, Business Process Modelling) and the case studies mentioned above. We hope to conclude this second phase at the end of 2001, which should leave us another year to empirically validate conclusions, produce a solid thesis and wrap up the project. We hope and intend to present results of our ongoing research at future LAP events.

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# Relating Semantics and Communication Acts

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## Abstract

This paper introduces an approach to communication acts that arises from a prior investigation of semantics based on a definition of 'meaning' as a relationship between signs and patterns of behaviour. It leads to the question: How do patterns of communicative behaviour depend on other patterns of behaviour? First, meaning depends on what we understand by reality – the ontological issue. We adopt the position that the only knowable reality has to be perceived by agents as *invariant repertoires of behaviour* that are valuable to them. This suggests the syntax for a semantic formalism:

Agent behaviour

representing a modified agent, so recursively:

(Agent behaviour) behaviour

The concatenation shows that some invariant repertoires of behaviour can exist only when others do. Behaviours realised at the same time may be the necessary antecedents of some others:

Agent (paper, pen) draw

so that if the paper or pen goes out of existence so does the drawing behaviour. Communication acts are not so simple, because of this rigid time constraint. However the discipline it imposes forces us towards some interesting insights into communication, the patterns of behaviour we perform using signs. They will be the main theme of the talk.

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# Capturing Temporality and Intentionality in Information Systems

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## Abstract

Information modelling is a topic that has been researched a great deal, but still many questions around it have not been solved. An information model is essential in the design of a database which is the core of an information system. Currently most of databases only deal with information that represents facts, or asserted information. The ability of capturing semantic aspect has to be improved, and yet other types, such as temporal and intentional information, should be considered.

Semantic Analysis, a method of information modelling, has offered a way to handle various aspects of information. It employs the domain knowledge and communication acts as sources of information modelling. It lends itself to a uniform structure whereby semantic, temporal and intentional information can be captured, which builds a sound foundation for building a semantic temporal database.

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## 1 Introduction

A key objective of a system analysis is to understand and capture the users' requirements. The requirements, represented in the information model, serve as a foundation for the design of a database. Traditionally, an information system comprises databases and application programs. With the object-oriented technology, data and functions (or methods) are still the key components in an information system, but they are organised in a different way from a traditional approach to information systems engineering.

This paper suggests that there are a few important aspects in information modelling, such as semantic, temporal and intentional aspects. Although they are difficult to capture, these aspects deserve proper attention. A modelling method for capturing information requirements has been proposed. Examples of using this method have been given for illustration purposes.

## 2 Information Modelling

Data and code in a database is meaningless until someone assigns a meaning to it and someone is able to interpreter it. The meaning of data is rooted in social and cultural conventions and norms. The assignment of meaning to the data and interpretation of the data have to follow the same social and cultural norms. By norms, we mean conventions, habits, regularities and patterns of behaviour, displayed by people in a social group (see [Wright, 1963] for a definition of norms).

The interpretation of data is a complex and creative act that relies on personal knowledge and understanding of the norms. A successful use of data and derivation of meaningful information to a user is a key issue in databases. This issue cannot be resolved only by a technical means but by social and organisational arrangements.

There can be two kinds of meanings distinguished: intension (sense) and extension (or reference). These two notions can be applied to predicates, proposition and sentences. The intension of a predicate, i.e. its sense, is identified with the property it expresses; its extension is the generalised class of referents in the world of affairs which possess the property. The intension of a proposition is determined by the meanings of the predicates used; the extension is its correspondence to the world of affairs. Then the meaning of a sentence is determined by the propositions it contains. People sometimes do not know the extension (reference, denotation) of the components of a sentence, but o˝ly their intension (sense, understanding). However, they are able to understand a sentence intensionally without knowing its correspondence to a world of affairs [Thayse, 1989]. What is critical in modelling is the intensional meaning.

The norm based method of modelling employs a modelling language NORMA [Stamper, 1992; Liu, 1993]. In this language, the notion of affordance is crucial, which is derived from the word "afford" and is first invented by Gibson [1979] to describe that a context is necessary to afford some phenomenon in ecology. In the context of information modelling, the abilities of humans in sense-making, understanding and recognising of the intensional meanings are seen as necessary affordances for a successful analysis. These abilities are generalised patterns of behaviour of the human agents that are governed by the social norms.

The norm based approach aims at developing a semantic database, which takes an ontology model as the conceptual schema. A conceptual schema contains affordances and their dependencies. The schema in principle describes the existence and dependencies of the existence of the affordances, which justifies why it is called an "ontology model" (as "ontology" is the philosophical study of the nature of existence and the relationship between things).

Affordances are roughly comparable with entities and relations, and determiners (a specific kind of affordance) with attributes in terms of relational databases. Affordances are defined and organised according to the ontology model. Instances (or particulars of affordances) are called realisations of the affordances and are managed

*(university#employer, person#employee)employment*, and
*(university, person#student)registration*
constitute a practical circumstance in which the boundaries and semantics of the concepts are settled by linking the dependants to the ontological antecedents. The antecedents (e.g. in this case, *university* and *person*), moreover, are ontologically dependent on some other antecedents. The graphic representation may explain better how a student and a teacher are defined (see figure 1). The 'student' and 'employee' are role names for a person who is registered at or employed by a university. A lecturer is a specific kind of employee. 'Registration' and 'employment' are affordances that are ontologically dependent on the antecedents, the university and the person.

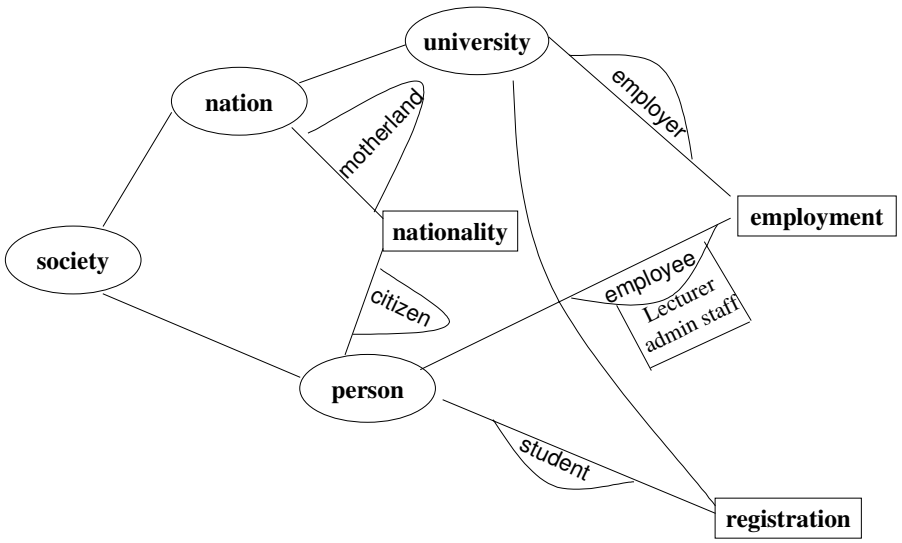


Figure 1: Ontological Structure and Semantics

An ontological dependency in NORMA is described as follows. Given two objects x and y, if y's existance depends on x's, and y only exists during or within the existence of x, then the dependency relationship between x and y is called an ontological dependency. Or it can be said that y ontologically depends on x. The object x is called the antecedent and y is the dependent. The structure constrained by the kind of ontological relationship determines exactly the boundaries of each object. In the example discussed above, the employment never exists beyond the existence of the person and the university.

## 2.2 The Temporal Aspect of Information

Winograd and Flores [1987] state that in communication, 'time is not an incidental condition, but a critical aspect of every speech act'. Therefore they build a mechanism for keeping temporal relations into the computer assisted communication system, The Coordinator. Many related works, e.g. [Auramäki *et al.,* 1988; Weigand, 1990] suggest that regarding the context of a communication act, time should be one of the elements for specifying the context. The temporal aspect is important in relation to the development and utilisation of information systems for at least three purposes: determination of boundaries of concep¸s that are expressed in language; description of dynamics of a social world or an organisation; coordination of human activities.

Time associated with the signs, first of all, can determine the boundary of concepts involved and clarify the actions and meanings. Any use of a sign, i.e. a speech or a physical act, brings about a meaning determined by examining the context of which time is one of the elements. This is also the case if one wants to be able to equate the `morning star' with the `evening star'. For example, someone says that it was bad weather the day before yesterday. To understand properly what is meant by `bad weather', someone else must be referred to the time mentioned in the utterance, only then can he understand that the `bad weather' just means it was a bit too cold, though some people may not think it was bad weather at all.

The use of language enables agents to talk about actions, states and events in the direct environment or at a distance. They may refer to something that happened in the past, or will happen in the future, or something they wish to avoid. Time plays a key role in such uses of language. For example, John informs his boss Mary that his colleague Henry is taking leave. In this case, it is important to know both when Henry left and when John told Mary. Things may get more complicated if John said to Mary that Henry told him to ask Mary for a permit for his leave. Then the time becomes essential, because appropriateness of Henry and John's behaviour is judged, to a large extent, on whether John's informing Mary took place well in advance to Henry's leave.

The temporal aspect of information has a great importance in coordinating actions in practical affairs. Perlocutionary effects will result in social consequences which have to be expressed in the time horizon. For example, an obligation is established for a certain period of time; a retraction of some speech act is to end the existence of an existing propositional attitude. An illocutionary act may take place at one time; the perlocutionary act may be at another time because of communication delay or time needed for the hearer to take a decision. Interpersonal relationships, e.g. commitment and responsibility, are set up at one time, altered or finished at another time. This kind of beginning and ending processes continues constantly. Every agent in a social and organisational context

is involved in a network of the constantly changing relationships. Commitments and responsibilities are only sensibly clear when time is taken into account. Time can be useful for checking the sincerity of a speaker and feasibility of actions - if the speaker promises or plans to do too many things at the same time, then either the speaker's sincerity or feasibility of performing the actions may be questionable. The commitments and responsibilities are normally placed into a temporal framework so that the actions (and the auditor's reactions) can be expected and coordinated.

There are other reasons for arguing that time is an important aspect of information. As a result, the semantic data structure for database design must contain time as an indispensable part. That means every data record in the database comprises times, e.g. the start-time and the finish-time of the realisation of an agent or an affordance.

## 3 Semantic Analysis for Information Modelling

Semantic Analysis is one of the methods from the MEASUR research [Stamper, 1993]. The primary purpose of Semantic Analysis is to assist an analyst and a problem-owner to articulate the requirements by focusing on clarifying the language used in expressing the problem. The ontology model, as the main outcome of a Semantic Analysis, is equivalent to an information model in other approaches, and serves as a database *conceptual schema* (a term defined in [Griethuysen, 1982]).

A Semantic Analysis is a process of conceptualisation of a business organisation through which the behaviour of the organisation is analysed and captured in the ontology model. The agents and the patterns of behaviour are the focus of representation in an ontology model. The semantic primitives appearing in the model represent possible patterns of actions of a complex agent, which are known as affordances in NORMA [Stamper, 1992; Liu, 1993, 2000]. The boundary or existence period of an affordance in NORMA is bound to the agent who possesses it, while in many other information analysis approaches, e.g. [Chen, 1976; Verheijen & Bekkum, 1982], *entities* are supposedly observable independently from the agents involved.

The affordances captured in an ontology model comprise a conceptual representation according to which the data can be organised in a database. The realisations of the affordances are the instances that are recorded in the database records. For example, an expression in NORMA:

*(university person) employs*

defines a part of the conceptual model, which can be represented as an o tology chart (as shown in figure 1). The affordances of *university* and *person* are two

antecedents that jointly afford a pattern of action *employs.* The particulars of universities, persons and employments will be instances to be stored in the database. Figure 2 shows the some instances of these three affordances in a database.

Each instance of the affordance employment has two antecedents, showing the ontological dependency. For example, the first instance of the employment involves Susan and Staffordshire University, reflecting the precise meaning of the employment whose existence depends on the existence of the two antecedents: Susan and Staffordshire University.

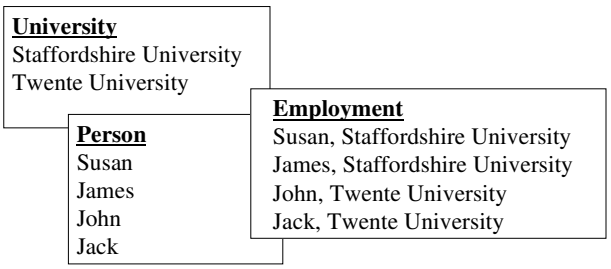


Figure 2: Instances of Three Affordances

### 3.1 Intentions, Propositional Attitudes and Consequent Operations

The semantics of language used in the problem domain is handled with NORMA in Semantic Analysis. Semiotic behaviour is expressed in the formula: *B"Ax"*.Using signs enables the agent to talk about actions, states and events in different time with intentions. A proposition can be uttered, for example, as an assertion, a prediction or a hypothesis, which are coined as intentions. An extension is made to the NORMA syntax for the association of the intention with the formula of semiotic behaviour as follows:

*B"Ax"* $\alpha$, where *B* is the agent performing the semiotic action with an illocution $\alpha$, between the quotes are signs employed by *B* in his behaviour. *Ax* is the meaning or referent of the semiotic action. E.g. *Mary"John happy" assert*.

The intention operator $\alpha$ can be assigned different illocutions for indicating the intentions of the agent in using the signs. The illocutions by the speaker are categorised under the eight headings. Following the illocutions, there will be consequent actions by the speaker and by the hearer. In case a database is involved as a medium of recording and assisting the communication, there will be corresponding operations on the database, as shown in figure 3.

The directives will bring the hearer into an action as normally the directives produce social consequences of deontic nature. The types of deontic consequences that are recognised in deontic logic are *obliged, permitted*, and *prohibited* which are typified by auxiliary verbs in speech acts such as 'should', 'should not', 'may', etc. Another type of deontic consequence that may be produced by the directives is a *liberty* (or *freedom*). This is comparable with the Hohfeld's legal concept of *privilege* (or *immunity*) (see [Allen and Saxon, 1993] for a further discussion), because having a privilege is legally weaker than having a right. The privilege enables an agent to preserve discretion in taking actions. Some of the directives and other illocutions by the speaker generate a liberty. The deontic attitudes of obligation, permission and prohibition can be created by the directives. Some of the illocutions do not involve deontic modalities at all. This can be seen from the fact that if the hearer does not follow the expected pattern of behaviour, there would not be a punishment enforced on the hearer. For example, if a speaker makes an illocutionary act of forecast by uttering 'Mr. X will arrive here tomorrow', it is at the hearer's discretion whether to believe or not, though normally the hearer will believe what the speaker uttered if the communication is honest and sincere. Therefore, this figure only represents some ideal patterns that are based on the supposition that the agents involved in communication 'behave normally' (i.e., obey social norms of sincere, honest communication).

| **illocutionary category by speaker (S)** | **propositional attitude of hearer (H)** (after speech acts performed) | **operation on database** to reflect S's acts) |
|---|---|---|
| proposal | obligation | record (or insertion) |
| inducement | expectation | record (or insertion) |
| forecast | expectation | record (or insertion) |
| wish | belief | record (or insertion) |
| palinode | retraction | update |
| contrition | retraction | update |
| assertion | belief | record (or insertion) |
| valuation | judgement | record (or insertion) |

Figure 3: Illocutions, Propositional Attitudes and Database Operations

Figure 3 depicts a part of a system of social norms of communication, especially focusing on the consequent actions by the both speech agents. Operations on the database, which is used to record and assist the communication, are derived as seen from the figure. In most of the cases, the operation on the database is to record the

speech act except for the illocution of retraction. The illocution of palinode or contrition is used by the speaker when an earlier speech act is to be withdrawn. In this case, an operation of correction is required on the database. Following the above mentioned, it can be seen that all operations on the database comprises three aspects: *semantics, intention* and *time*.

### 3.2 Information Captured in Database

Current databases store facts (or assertions); and often, no temporal qualification is associated with the facts that are recorded in a database. We argued here that beside the asserted facts, a database should be able to store and manipulate other types of information.

A database, at the syntactic level, can be viewed as a well organised, but variable set of data packages, which during a longer period is used in an organisational system as a means of communication. The language-action approaches regard a database as a model of some Universe of Discourse for communication [Weigand, 1990]; a database functions as a device for recording, processing, indexing, and transmitting communication acts. From this point of view, what is managed in a database is not the 'recording of facts', as suggested by Nijssen [1986], but subjective observations, opinions and beliefs. Based on the two radical subjective axioms adopted, knowledge is bound to the *knower*. To retain the subjectivity, both knowledge and the knower will have representations in a database. Personal value judgements, the speaker's intentions, and differences in perspectives and interests seem no less important than the propositional contents of the utterances, which should be accommodated in the database as well.

From another dimension of database studies, numerous researchers have noticed that with many databases, information in the system reflects only the current state of affairs (e.g. [Clifford and Tansel, 1985; Kim *et al*., 1990; Sadeghi *et al.,* 1988]). The databases of this kind only provide a snapshot of an organisation. However in business practice, historical information is important. Based on his historical studies and business experience, Achueler [1977] strongly appeals for a database technique that will be able to keep the historical records. He calls the common update technique in the database by erasing the records as 'Aton-Update', a 'mass update' of a large Egyptian Database pertaining to Aton that was undertaken with hammer and chisel throughout the country in 1347 BC. This kind of erasing update is also comparable to the 'update' of a most important database in the year 47 BC that the Library of Alexandria was completely 'updated' by a fire. Loss of the historical data through such actions on databases may sometimes cause irreversible, disastrous consequences. Meanwhile, the historical information can be useful for businesses. In banking, for example, information about the history of clients can help the banker assess the customer's credibility. Therefore it assists

them in making decisions about granting loans. When a company plans to introduce a new product into the market, historical information can help the company do a trend analysis and predict the market for the product. On the other hand, hypotheses and predictions of the organisation are relevant for studying organisational behaviour and performance, for coordinating future actions, and for planning and policy-making purposes.

## 4 Capturing Meaning, Intention and Time in Database

The semantic temporal database developed in the MEASUR project [Stamper, 1993] aims at accommodating data pertaining to business semantics and intentions. Each particular instance of actions and use of signs is associated with the intention that is expressed by the language user. Moreover, each instance has a pair of times, the start and the finish, to indicate the existence of an action or a state, from the speaker's point of view.

To show the distinctive components of semantic, intentional and temporal aspects that can be considered in the representation with the proposed data structure, the following sentences will be used in discussion (after [Searle, 1983] p30):

S1. *John wants Mary's house in the summer of 2001* (suppose 'now' = summer of 2000).
S2. *In 2001, John will want Mary's house.*
S3. *John now wants Mary's house in the summer of 2001 though by then he will not want it.*

A semantic analysis on the passage reveals there are a few universal affordances which should appear in the ontology chart: 'person' and 'house'. 'John' and 'Mary' are instances of the affordance 'person'. The word 'want' seems to be used with mixed meanings. To 'want' may mean to 'have'; to 'have' may be more specifically understood as to 'occupy' (or, to 'live in'), to 'rent', to 'buy' or to 'own'. In the same time, to 'want' may indicate an intentional modality. In order to represent the semantic and intentional aspects associated with the word 'want', several possible interpretations are captured in the analysis (e.g. 'occupy', 'rent' and 'own'). The temporal aspect of every affordance is treated as an intrinsic property, namely, every affordance is attached with a *start-time* and a *finish-time* to delineate its existence. The temporal aspect of every affordance is intrinsically handled by referring to the times defined in a standard time framework. Therefore the time 'now', '2001' and 'the summer of 2001' are not explicitly shown in the chart, but handled as hidden parts in all affordances in the ontology model. Figure 4 shows the ontology chart resulting from the semantic analysis of the three sentences.

Some other concepts, such as 'illocution' and 'attitude' are added to the chart in addition to the affordances identified in the early analysis for discussion of the

aspects of communication acts. With such an ontology chart, one can represent a fact such as 'John occupies/rents/owns Mary's house (in a certain period)', and all the three sentences S1, S2 and S3 (they are either predictions, assertions or

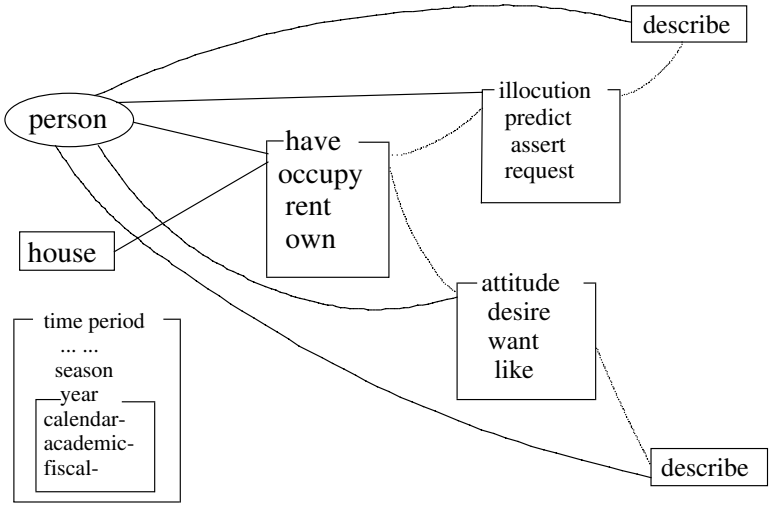


Figure 4: Semantic, Intentional and Temporal Aspects in an Ontology Chart

requests). The dotted lines linking the illocution and the attitude to the affordance 'have' (with three specific kinds of meanings listed under it) can indicate the illocution and the attitude attached to the utterance. As shown in the figure, time is defined in a standard temporal reference system that can be referred to by every affordance. There are some important issues in the chart worth discussing.

- To grasp the meanings of the word 'want', several possible interpretations are identified on the chart, which allows the language user to determine the meaning of 'want' between 'occupy', 'rent' and 'own' when the word 'want' is employed in the sentence.
- An illocutionary act can be made with or without an illocutionary verb explicitly in a sentence. In the latter case, however, it may require careful analysis to decide to which illocutionary category the sentence belongs. For example, the sentence S1 ('John wants Mary's house in the summer of 2001') may be regarded as a prediction, an assertion, or a request.
- Intentions may be different from propositional attitudes. For example, if one says 'I want your house' it may appear to be analogous to 'I like your house' [Searle, 1983]. In addition, one may very likely encounter a situation in which a speaker has an un-stated, different propositional attitude than the expressed intention. However, in most of the analysis in this thesis, an assumption is that communication normally takes place in a sincere and honest manner, which

means the consistency between the intentions expressed in illocutions and the propositional attitudes.

With the chart (figure 4), one can describe the present situation (the house is presently occupied by a person, which is just one of possible specific forms of 'have') and the different scenarios described by the three sentences. The situation at present can be described as in the following expression:

| | |
|---|---|
| (B, house)occupy | the house is now occupied by the person B (the person B may be John or Mary, for example). |

In steps, the following can be obtained in analysing the sentence S1:

| | | |
|---|---|---|
| R1.1 | *(A, house)occupy* | person A occupies a house; |
| R1.2 | *(A, house)occupy, summer of 2001* | in the summer of 2001, the person A will occupy the house; |
| R1.3 | *"(A, house)occupy, summer of 2001"* | a semiotic act (i.e. a speech act) with the contents between the quotation marks; |

therefore, as a whole, the following is obtained:

R1. *A "(A, house)occupy, summer of 2001" want.*

The expression R1 represents the sentence S1. The contents between the quotation marks are propositional contents which is seen as the semantic part of the whole expression: 'the person A wants to occupy the house summer of 2001'. Note that the time 'summer of 2001' is related to the action '(A, house)occupy' to express that occupation of the house will take place in the summer of 2001.

In steps, the following can be obtained in analysing sentence S2:

| | | |
|---|---|---|
| R2.1 | *(A, house)occupy* | person A occupies a house; |
| R2.2 | *"(A, house)occupy"* | a semiotic act (i.e. a speech act) with the contents between the quotation marks; |
| R2.3 | *A "(A, house)occupy" want* | a speech act performed by the person A with an illocution 'predict'; |
| R2.4 | *("(A, house)occupy" want), summer of 2001* | the act of wanting will take place in the summer of 2001; |
| R2.5 | *"("(A, house)occupy" want), summer of 2001"* | a semiotic act (i.e. speech act) with the contents between the quotation marks; |

therefore, as a whole, the following is obtained:

R2. *A "(A "(A, house)occupy" want), summer of 2001)" predict.*

The expression R2 is from a semantic analysis of the sentence S2. It is a prediction that in the summer of 2001 the person A will want to occupy the house.

The analysis of the sentence R3 in steps results in the following:

R3.1 *A "(A, house)occupy, summer of 2001" want*
same as in R1;

R3.2 *"(A, house)occupy" not want* 'not want' is an illocution to indicate a retraction of the speech act performed earlier which is the content between the quotation marks;

R3.3 *("(A, house)occupy" not want), summer of 2001*
the act of 'not want' will take place in the summer of 2001;

R3.4 *A " ( " (A, house)occupy" not want), summer of 2001" predict*
the person A has made a prediction that in the summer of 2001 A will not want the house (which is now occupied by B);

therefore, a complete expression by combining R3.1 and R3.3 is obtained as follows:

R3. *A "(A, house)occupy, summer of 2001" want ,*
*A " "(A, house)occupy" retract-want, summer of 2001" predict*.

The expression R3 results from the sentence S3 which says that the person A now wants to have the house in the summer of 2001 meanwhile he predicts that in the summer of 2001 he may not want the house. In the expression, the mood 'may not' is represented by the illocution of prediction.

## 5 Designing A Semantic Temporal Database

The three aspects of information can be seen from the above analysis of the three sentences. The core of the meaning is conveyed by the proposition which can be interpreted in a semantic sense without there being any intention associated with it. The meanings of the propositions are determined by putting the words in the semantic context in the ontology chart. The intentional aspect of the semiotic act is reflected by the associated illocutions. The time aspect is dealt with as a necessary component in every expression. All these three aspects will have to be accommodated in the semantic template, to be discussed in the next section. The semantic template will be defined as a uniform syntactic structure for databases that can handle the semantic, temporal and intentional information.

The three aspects of information have been identified to be represented and processed in the semantic temporal database: semantics, intentions and time. A standard record structure based on the elements of a speech act can be derived. Consider the following fragment of an ontology model,

*(person#absentee, course)absence*

which can be represented in a form of ontology chart (figure 5). With this ontology model, one can record in a database facts as to who is absent from which course at what time. In addition to that, it is also possible to record in the database the more sophisticated uses of signs, such as hypothetical or declarative uses. The two appearances of 'illocution' in the chart show the possible recursive uses of signs, namely, an illocutionary act can be contained in another, and so on.

Suppose the following speech comprising a piece of knowledge: 'Susan yesterday observed that John had been absent from 1-6-90 till 30-6-90'. This piece of

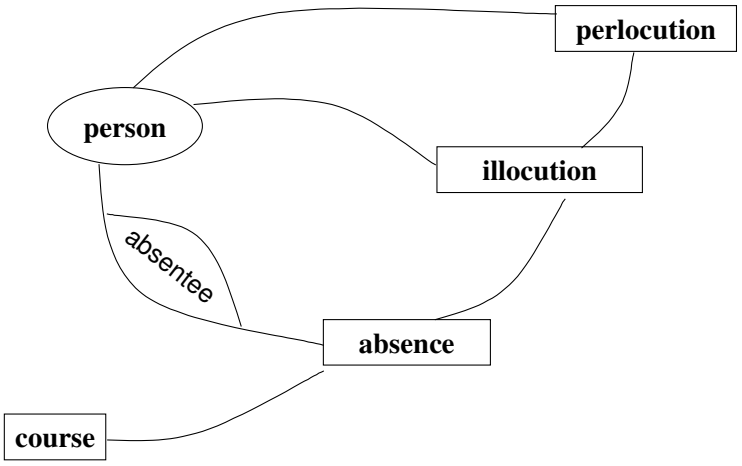


Figure 5: A Chart of Person-Course-Absence

knowledge can be captured in a record as follows:

<Susan, <John, absence, course 123, 1-6-90, 30-6-90>, assert, assert, yesterday, ->.

The explanations below will assist reading of this record and also present considerations of some issues, such as agent, intention and time, in knowledge representation in the database record form:

1) Susan is the agent who uttered the speech act, the user of sign.
2) The semantic part of Susan's action resides in the proposition which is abbreviated as '<John, absence, course 123, 1-6-90, 30-6-90>'. The meaning of 'John', 'absence' and 'course 123' is determined by referring to the corresponding part of the ontology chart.
3) '1-6-90, 30-6-90' refers to the period during which an instance of John's absence is realised.
4) Both the start mood (i.e. *mood*+) and finish mood (i.e. *mood*-) of the proposition, found in Susan's action, are assertive. This is because what is represented is an observation, which can be seen from the original sentence (if

it is not directly seen from the speech, it is up to the analyst to decide what mood Susan had).

5) 'Yesterday' indicates the start of Susan's observation. The blank finish-time means the assertion is valid till now (a filled finish-time would suggest a retraction of the assertion, which would mean Susan had withdrawn the assertion).

## 6 Summary

In this paper, current approaches to database design have been critically referred to as the base line in the discussion of a semiotic approach to information modelling. It has been argued that a database, as the core of an information system, should not only store and process factual information, but also be able to deal with other aspects, including temporal and intentional information. Alongside the knowledge about the problem domain, speech acts involved are one of the sources for information requirements.

Semantic Analysis, a method for information modelling, has been introduced to demonstrate how an ontology model can capture semantic, temporal and intentional information. Semantic Analysis is powerful in capturing semantic, temporal and intentional information. A uniform structure for a semantic temporal database, resulting from an ontology model, is capable of handling information expressed in a speech act with other additional information such as temporality. This can be significant useful for further development of modern databases that are capable of coping with more than just factual information.

*The paper is partly based on chapter 9 of Liu (2000). Permission is being sought from Cambridge University Press.*

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# Searching for Meaning – Performatives and Obligations in Public Key Infrastructures

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## Abstract

This paper begins by giving examples of the confusion between technical and legal terminology in public key infrastructures (PKIs). It argues that the conduct of business needs to happen within a technically and commercially secure environment where the business risks can be addressed by examining the conditions in which performatives are effective, and the infelicities which herald their failure. Semantic analysis of the permitted, the obligatory, and the forbidden acts described within certification practice statements reveal the deontic structure of performatives in PKI relationships. It proposes a semantic schema that distinguished between semantic elements, substantve rules, and procedural rules that embodies obligations imposed on various parties. It is a first attempt at investigating methods of modelling communication acts between parties using PKI in open electronic commerce settings.

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## 1. Performatives and Public Key Infrastructures

Recent advances in public key cryptography provide an enabling platform for the secure exchange of electronic business documents. While much has been written about the potential for Public Key Infrastructures (PKIs) in securing electronic commerce, little consideration has been given to how business performatives might use PKIs. The presentation of digital certificates is said to 'authenticate' trading parties. Digitally signed messages are said to ensure message integrity and thus provide 'non-repudiable' evidence. Certificate-based applications are said to reduce 'risk' in transacting, providing the much-needed 'security' for electronic commerce. At the low technical level these 'secure' electronic commerce applications, based on PKI, offer various technical protocols which at the higher social level can signal intentions, create obligations and perform business acts. Viewing PKIs from this angle suggests the primary role for PKI applications might be to 'do things' rather than merely to exchange information.

However, words such as 'trust', 'authentication', 'non-repudiation' and 'ıisk' have been overloaded with meaning in the general hyping of security and electronic commerce. This tendency is especially disturbing when legislative efforts seek to extend the cryptographic context of use of terms directly into legal terminology. Ellison and Schneier illustrate this danger when they claim the term 'non-repudiation' in academic cryptography refers to unlikelihood of a forged digital signature because of the strength of the digital-signature algorithm [Ellison and Schneier, 2000]. The technical use of the term 'non-repudiation' however has been extended to the legal domain, assigning legal responsibility for digitally signed signatures to legal entities who are not allowed to repudiate. This apparently logical extension of meaning is dangerous because it assumes the social world operates in circumstances similar to the idealised world of the mathematical algorithm. A digital signature can be created by anyone with access to the signing key. The signing key could have been compromised by anything from computer viruses, Trojan horse programs, insecure computing environments, to unauthorised, and unintended signing of the signature. Such legislative efforts therefore pre-empt perfectly valid reasons for disputing a digital signature rather than provide the certainty needed for secure electronic commerce.

It has been rather difficult to disentangle the various meanings of terms adopted in PKI, especially when there are no simple analogies for performatives traditional in the paper-based world. Fortunately there are easier ways of analysing communication acts between parties using PKI. In publicly available Certification Practice Statements (CPSs) Certification Authorities (CAs) declare their contractual relationship with certificate holders and relying parties. These CPSs form the contractual framework in which the CAs obligations are advertised and discharged. The study of business performatives and deontic structures in PKI could be facilitated by examining the obligations and liabilities documented in CPSs. This paper describes our approach towards modelling business

performatives and deontic structures in open PKIs. The approach is firmly based in the economic [Williamson, 1979], legal and socio-linguistic disciplines [Stamper, 1987]. Instead of focusing on the technology *per se* to resolve the issues of trust and risk, we focus on the patterns of commercial and organisational behaviour. Semantic and legal analyses specify the social and organisational affordances and ontology in this domain, and the norms that the various agents must share in order to interact with confidence.

This analysis of performatives in trust services utilising PKI is distinct from analyses of business transactions in electronic commerce [Bons, 1997][Wiegand, 1998]. PKI provides the platform for authenticating the origin of data, securing message confidentiality and integrity for electronic commerce. PKI infrastructure by itself does not engage in transacting, even though it does go some way towards enabling the clarification of communication acts and business performatives. The widespread availability of large-scale PKI infrastructure could allow truly open electronic commerce if it enabled parties without pre-arranged relationships to interact and transact with confidence [Lee, 1999][Tan, 1999]. In section 2, we illustrate deontic structures in PKI. We describe in section 3 our research framework for semantic analysis of CPS. We conclude in section 4 with the discussion of the potential for this type of research. As the research described here is still in the early stages of development, our purpose is to illustrate the value of such an approach and to solicit comment from the academic community.

## 2. Deontic Structures in Public Key Infrastructures

As described in the technical standards [X.509, 1997][PKIX, 1999][RFC 2459, 1999], certificate users (denoted as RP for relying parties) using the PKI rely on certification authorities (CA) for the accurate binding between natural persons (EE for end entities) and the public keys certified in digital certificates ("certificate"). The contractual framework for using the trust services of a CA is shown in figure 1. The obligations and liabilities of a CA to all parties are described in the CA's CPS. Some CAs explicitly declare their obligations and liabilities to an EE in a separate subscriber agreement, and to an RP in a separate relying party agreement (RPA). We use the term CPS to encompass all the CA's contractual obligations and liabilities. Most PKIs in deployment today assume that EEs and RPs operate within the contractual framework of one root CA with certification depth of one (rather than one root CA with subsidiary CAs[1], or two distinct root CAs shown in Figure 1). Certificate users reverse roles from RP to EE as security protocols and the transaction processes require. For the sake of simplicity, we will illustrate the issues from the perspective of the merchant as an RP.

[1] The distinction between certification authorities (CAs), issuing authorities (IAs), and registration authorities (RAs) will not be considered in this paper owing to space limitations.

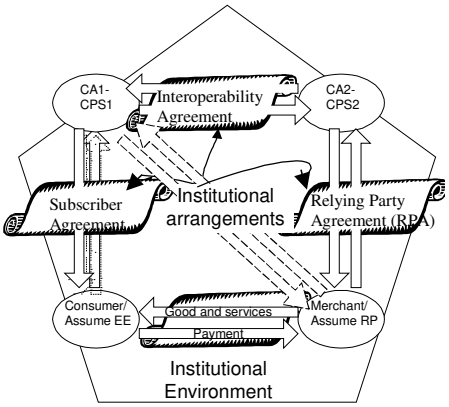


Figure 1: PKI Relationships- the Four-Cornered Model

A merchant in open electronic commerce needs to decide which CAs to 'trust' in order to authenticate EEs and their digital signatures. Evaluating which CAs to 'trust' entails studying individual CPSs to determine the appropriateness of the certification policy for particular business processes and applications. Failing that, 'trust' in a particular CA is based merely on the reputation of that CA. Note the word 'trust' here conveys reliance rather than confidence. The legal relationship between the CA and the RP is also problematic because of the lack of an explicit contractual relationship. Unlike the CA's relationship with the EE, where a service is provided in exchange for a consideration (the issuance fee), RPs that rely on the CA to authenticate an EE's certificate only enter into a contractual relationship (the service warranty) with the CA once the RP decides to accept a certificate issued by that CA. A CA provides warranties to the RP only when a series of checks and conditions specified in the CPS and RPA is fulfilled. Current storage and processing constraints limit the amount of information that can be included in the certificate. An RP only sees a highly condensed digital certificate in an abstract syntax notation [X.509, 1997] where the terms and conditions are incorporated by reference. Since CPS and RPAs are carefully crafted to limit CA liability, unsuspecting RPs would be naïve to place their confidence in the CA solely based on such premises. As PKI services are just emerging, whether such practices are enforceable in a court of law will need to be tested. Here there is the usual trade-off of risk and reward. Merchants will be prudent to rely only on CAs with whom they stand a reasonable chance of engaging in disputes and claiming compensation. However they will also be limiting themselves in terms of EEs with whom they interact and transact business. While the business risk needs to be balanced with the potential for business gain, this example shows the how the word 'trust' has been overloaded with meaning. 'Trust' was originally used in academic cryptography to assert that a certification 'authority' could be relied on to provide a secure mechanism of exchange of public keys. It has somehow been

taken for granted that the assertion itself is sufficient for confidence. Similar analyses can be given for the terms 'authentication', 'non-repudiation', and 'ıisk'.

Many information security experts, legal experts, and civil liberty advocates recognise the problems of the multiple meanings and interpretations of PKI terms and conditions. However, most assume that such ambiguities can be resolved through legislation and policy or through clarifying the allocation of liabilities. We believe it is too early to recommend or design solutions without a clear understanding of the full extent of business and technical risks in PKI. The business risks can be addressed by examining the conditions in which performatives are effective, and the 'infelicities', which herald their failure. The profile of business risks can be thus examined by analysing the deontic logic in PKI relationships. Deontic obligations entered into by PKI parties specify the permitted, the obligatory, and the forbidden acts and state of affairs.

| Semiotic framework | In the analysis of Contracts | In the analysis of PKI Risks and Inter-domain Trust |
|---|---|---|
| Business world | Business environment in which commercial arrangements are enforced, informally through sanctions and formally through dispute resolution | Business and legal interpretation of contractual arrangements for certificate-based applications, e.g. business models based on Signed XML documents, OCSP Responder extensions |
| Pragmatics – intentions | Context, commercial norms and culture, and common practices which affect the expectations, assumptions, and intentions of the contracting parties | Certificate usage, e.g. interpreting CPSs, CPs, policy extensions, policy mapping, cross-certification, trust transfer dynamics Defining roles and obligations, determining liability, and dispute resolution process |
| Semantics – meanings | Understandings, agreements and obligations derived from the utterances, gestures, etc. in a given context | Certificate and signature semantics, e.g. signature verification and certificate-based authorisation |
| Syntactics – formalisms | Contracting procedures such as offer and acceptance, or formal requirements such as writing and signatures | Certificate and signature syntactics, e.g. certificate processing and validation, authentication and signature protocols |
| Empirics – signals/codes | The physical signs used in the contracting process: verbal utterances, gestures, written letters, actions performed on web sites, etc. | Certificate profiles and digital signatures, cryptographic algorithms and standards |
| Physical world | Markets for products and services | Information systems security and compatibility |

Table 1: Semiotic framework for analyses of roles, obligations, and risks in PKI

The analysis of deontic structures can be approached further using the following semiotic framework (see Table 1). This approach to information systems and their specification was first developed under the LEGOL project (Legally Oriented Language) [Stamper, 1979] which later led to the NORMA language (Norms and Affordances) [Stamper, 1986]. Unlike other specification formalisms, NORMA has an explicit semantic theory and places the responsible agent at the centre of the determination of meaning. It was developed by reiterations of testing semantic models against legal norms. It has been adopted for the study of information systems security [Backhouse, 1996], electronic contracting [Backhouse and Cheng, 2000] and now PKI.

## 3. Framework for Semantic Analysis of Certification Practice Statements

An overview of how we intend to study deontic structures in PKI is shown in figure 2.

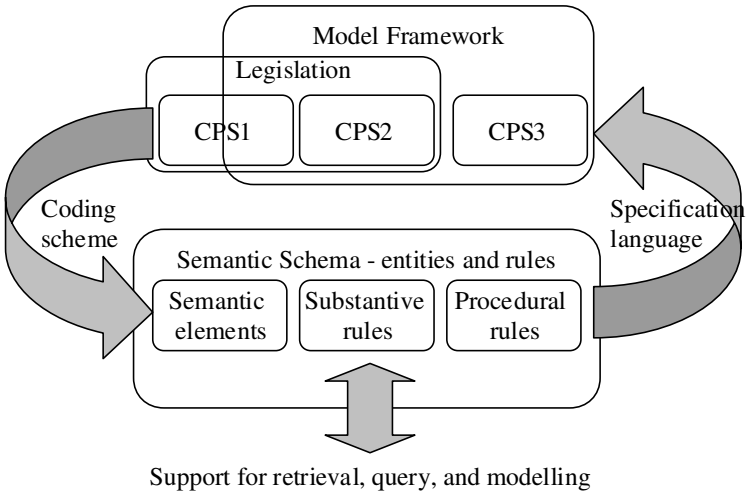


Figure 2: Framework for semantic analysis

Input for the identification of deontic structures in PKI comes from various sources. Model CPS frameworks and CA guidelines [RFC 2527, 1999][NACHA, 1999][ECOM, 1998] describe generic rules. National and state digital signature legislation describes norms or rules for enforcement by these particular courts of law. Individual CPSs describe rules that CAs, EEs, and RPs are obliged to follow. Input from these sources including the full text of twenty-eight CPS are collected and stored in a text database, and coded based on a coding scheme. A sample of the coding scheme is shown in table 2 below.

A qualitative analysis tool is used to facilitate retrieval, query, and further modelling. The conceptual schema and coding scheme are revised through iterative processes of coding, mapping relationships, and analysing for semantic rigour. Codes are categorised into entities and rules to facilitate semantic analysis. Three categorises of codes are identified borrowing from work done on systems specification languages for legal and social affairs, namely LEGOL and NORMA [Stamper, 1980][Stamper, 1986]

| **Search Expression** | **Code segment by string, word, line, paragraph, sentence** |
|---|---|
| **Keywords** | |
| $CERT:= Certificat[e\|ion] | Word |
| $CRL:=[Certificate Revocation List\|CRL] | String |
| $CPS:=[$CERT Practice Statement\|CPS] | String |
| **Legal Entities** | |
| $CA:=[$CERT authority\|CA\|RA\|IA] | String |
| $RP:=Relying part[y\|ies] | String |
| $EE:=[end entity\|subscriber\|certificate holder\|applicant] | String |
| **RFC 2527 Model CPS** | **March 1999** |
| 1. Introduction | Paragraph |
| Contact [details\|person] | Paragraph |
| 2. General Provisions | Paragraph |
| 2.4 Interpretation and Enforcement | Paragraph |
| Governing law | Paragraph |
| Dispute resolution | Paragraph |
| 2.5 Fees | Paragraph |
| [Issuance\|renewal] fees | Sentence |
| 2.6 Publication and Repositories | Paragraph |
| 3. Identification and authentication | Paragraph |
| 4. Operational Requirements | Paragraph |
| 5. Physical, Procedural, and Personnel Security Controls | Paragraph |
| 6. Technical Security Controls | Paragraph |
| 7. Specification Administration | Paragraph |
| 7.1 Certificate profile | Paragraph |
| 7.2 Certificate extension[s] | Paragraph |
| Certificate polic[y\|ies] | Sentence |
| Certificate Us[e\|age] | Sentence |
| Key Usage | Line |
| Incorporation by reference | String, also Incorp. By Ref. LIAB.LTD |

Table 2: Selected section of thesaurus used to automate coding of CPS text database

- Semantic elements - Fundamental elements are mapped explicitly to codes. These elements include entities (entity definitions are recorded in dictionary and thesaurus, e.g. legal person, CA), substantive acts (e.g. issuing, revoking, verifying) and affordances (e.g. roles played by RP, EE, registration authority and issuing authority).
- Substantive rules - substantive rules operate on semantic elements to create institutional facts (e.g. rules for signing, authorisation, and validation).
- Procedural rules - procedural rules control operation of substantive rules, these rules describe the constitutive rules for creation of performatives.

Semantic analyses based on the semantic elements, substantive and procedural rules will result in the articulation of the underlying patterns of behaviour/affordances in the PKI domain. This leads to a semantic schema, or ontology chart [Backhouse, 1990]. With the schema in place, attention will move to the elaboration of the various commercial and legal norms that apply to all relevant parts of the schema [Backhouse, 2000]. The semantic and norm analyses provide the backdrop for a deontic system that embodies obligations imposed on the various parties.

Applying the semantic theory in the NORMA language to the text in the database reveals the interplay of signs and their referents. Certificates are sign-types that point to the existence of a state of certification but ontologically certificates and certification are distinct affordances - hence the need to check continually the validity of the certificate. The existence of the certificate should testify to the state of certification but only by reference to the pattern of norms that support this ideal. Seeking certification means requesting the certificate and here a discrete "conversation" between subscriber and CA is engaged. This conversation resembles most others that lead to contracts, formal or informal. Request is followed by evaluation or validation (i.e, identification and authentication), leading to acceptance and fulfilment in this case the issuance of the certificate, which is the formal sign that conveys to the world the fact of certification. Each act is supported by procedural rules about what steps the various agents must follow if they are to obtain their goal.

There exist procedural rules, for example, about who in the CA may issue the certificate, about the need for the applicant to agree to terms and conditions before being issued with the certificate i.e. press the *I Agree* button, about the need for class 3 certificates to include the validation of Notaries or Issuing Authorities. But the underlying substantive logic of request, validation, acceptance and issuance remains unchanged. For different legal jurisdictions there will be different rulings about what precisely constitutes a Request, an Acceptance and so on, but the notion of a request and its place in the logic of the "conversation" will never be challenged. On the basis of an ontology elucidated through the application of a

penetrating semantic theory, the researchers are constructing a platform from which the various local norms and interpretations may be mapped and compared.

The advantage of such an approach is in its ability to distinguish between signs, referents and their meanings. It maps business and legal terminology to cryptographic terminology such as identity, authentication, confidentiality, integrity, and non-repudiation. It permits analysis of the communication acts and performatives that create institutional facts governed by constitutive rules. By comparing intention, contractual realities, and the actual text of the various agreements, we can identify in the deontic logic of the various agreements potential risks stemming from ambiguity or competing interpretation, and suggest possible remedies. The resulting analysis of the deontic system is used to derive a risk model and a specification language that can support PKI interoperation in different legal and organisational regimes. The specification language can be used to help understand the nature of business risks and to draft better CPSs and legislation.

## 4. Discussion

Our search for canonical intepretation of PKI terminology in the business world has brought us to the investigation of communication acts and business performatives in PKI. As explained in section 2, the elaboration of contractual relationship between various PKI parties is documented in CPSs. We feel the ready availability of these contractual obligations made it conducive to our use of a semiotic approach and analysis. We illustrate in section 3 a framework for analysing the CPSs. This will be an opportunity to test semiotic techniques in an area where great technical strides have already been made, but where progress is blocked for lack of proper understanding and consensus around the legal, commercial and organisational issues. We hope the analysis of norms and affordances can specify the deontic structures in PKI, and be used to create a specification language to support the drafting of CPSs. The research described here is a first draft of how we intend to approach the problem. We welcome comments from and collaboration with the academic community.

The potential applications of such a research can be extended to other domains. In particular, we hope to address the question of PKI interoperation across PKI domains. The core issue in PKI interoperation is the nature of incompatible CPSs across PKI domains. Interoperable PKIs require common standards and protocols for both technical interoperation - between both hardware and software products, and for inter-domain operation - between the certification polices and practices adopted by the various CAs. However, because certification policies (CPs) and CPSs are implemented for specific communities of users and applications, defining and harmonising CPs and legal principles is fraught with difficulty. Moreover, CAs operate from within different jurisdictions rendering uncertain the

enforceability of agreements. The results of our research could be applied to the problem of inter-domain interoperation by identifying the business risks when accepting certificates from different domains. Rather than attempting to harmonise overarching practice statements and legal rules in a top-down approach to regulating certification services, our project aims to provide a basis on which differing degrees of risk may be directly ascertained and accepted.

In summary, this paper introduces a piece of research homing in on the confusion between technical and legal terminology in public key infrastructures (PKI). It argues that PKIs will be unable to extend beyond their "home" territories and become truly interoperable unless a canonical and common representation of the various commercial and legal realities is constructed. The researchers contend that successful electronic commerce needs a technically and commercially secure environment, where the business risks can be addressed by examining both the conditions in which performatives are effective and the infelicities which herald their failure. Semantic and norm analysis of the permitted, the obligatory, and the forbidden acts described within certification practice statements will reveal the deontic structure of performatives in public key infrastructure relationships. The paper reports on preparations under way to specify the ontology, substantive and procedural rules within PKI under which are created the obligations imposed on the various parties. The research constitutes a first attempt at investigating methods of analysing and modelling the communication acts between the parties using PKI and it aims support the transacting of business with confidence in open electronic commerce settings.

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# Towards a formal model for contract execution

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## Abstract

In this paper, we propose a formal model of the execution of a trade procedure that is subject to a predefined agreement (contract). We will examine how the clauses of a contract influence the communicative steps during contract execution.

## 1. Introduction

Over the past few years, much effort has been invested in constructing formal models of the way organizations interact with each other. Examples of these formalisms are DEMO (Dietz, 1995a, 1995b, 1996), illocutionary logic (Dignum and Weigand 1994, 1995, Weigand, Verharen and Dignum, 1995), and documentary Petri-nets (Bons, 1997, Lee, 1999). Although each of these approaches provides useful insights for formalizing the way organizations do business with each other, it seems that some aspects, especially those related to contractual agreements are still missing. In our current work we will point out some of these aspects and make a proposal about how they should be integrated

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into a comprehensive framework for contract execution.

This paper is structured as follows. In section 2, we will discuss Weigand and van den Heuvel's framework describing the levels that can be distinguished in business communication and transactions. Using this framework, we will classify our current research goal. In section 3, we will briefly discuss a number of relevant existing modeling approaches and point out which aspects are still missing for our purpose. In section 4, we will provide an overview of Dialaw, and point out why the idea underlying it is relevant for modeling contract execution. In section 5, we will, based on the previous discussion, present our own proposal for modeling contract execution. Section 6 contains the conclusions, as well as some issues for future research.

## 2. Meta patterns for business communication

Weigand and van den Heuvel (1998) distinguish 5 levels – they also refer to them as meta patterns – on which the communication during inter-organizational trade can be perceived. An overview is shown in figure 1.

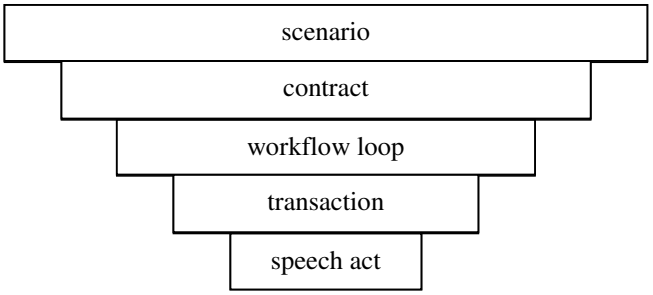


Figure 1 – 5 levels of business communication

At the lowest level, one finds *speech acts*, which can be defined as an utterance that constitutes a performative act. A well known classification of speech acts is given by Searle (1969) and includes assertives, directives, commissives, expressives and declaratives.

The second level concerns *transactions*. Weigand and van den Heuvel define these as the smallest possible sequence of actions that has an effect (such as the creation of an obligation, authorization or accomplishment) in the social world of the participants. Transactions often come in the form of message pairs. An example of this is the request/promise sequence, in which actor A requests actor B to execute action $\alpha$, after which actor B responds by promising actor A to perform action $\alpha$. In the social world, this creates an obligation of actor B to perform action $\alpha$.

The third level consists of what is called the *workflow loop*. A workflow loop, or action workflow as Medina-Mora et.al (1992) call it, consists of four communicative steps. The first step is the proposal, that is, a request from the customer (the initiator) or an offer by the performer (the executor). During the second step, the customer and performer come to an agreement. After performing the agreed action, the executor declares that he has performed the promised action. During the last step, the initiator declares that he agrees with the result. A new fact in the social world is created only if all four communicative steps are executed successfully.

A workflow loop only concerns the performance of one of the two (or more) parties involved in a trade procedure. In order to provide a more symmetrical view, the *contract* level is defined. A contract typically consists of two workflow loops, both for customer (who requests product delivery) and supplier (who requests payment). Weigand and van den Heuvel regard the contract level not only to contain the fulfillment stage (consisting of the earlier mentioned two workflow loops), but also to include for instance the previous stage in which parties are seeking business partners. In our current work, however, we will restrict ourselves to the fullfillment stage. Notice that although Weigand and van den Heuvel also define a fifth level (the scenario), we will not go into it, as it falls outside the scope of this research.

Our current research goal can be described as finding a suitable formalism for the contract level. What we want is to define a modeling approach that provides a clear view on the structure of a contract. During the execution of a contract, the model should give an overview of the current state of affairs and the actions to be performed by both parties. At the same time, the formalism should not be too rigid, as written contracts often leave a lot of details unclear, for instance about what exactly constitutes a contract-conform delivery.

## 3. Three existing formalisms

In this section , we will provide a brief overview of three modeling approaches that contain aspects we feel are relevant for defining a proper formalism for the contract level. These are the Transaction Process Model, illocutionary logic and documentary Petri-nets.

### 3.1 The Transaction Process Model

The Transaction Process Model (TPM) (van Reijswoud, 1996), now part of the DEMO modeling approach, aims to provide an exact specification of the communicative actions that take place during the execution of a business workflow

loop) of the Meta-patterns framework. Figure 2 shows the TPM in its most basic form.

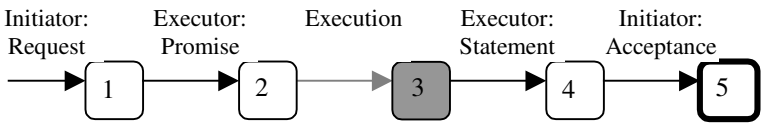


Figure 2 – the successlayer of the TPM

According to the Transaction Process Model, a transaction begins with the first actor (the initiator) issuing a request (e.g. for the delivery of goods). This request can be responded by the second actor (the executor) by issuing a promise. The third step is the actual performance of the agreed action, after which the executor states that it has performed as was agreed upon. When the initiator is satisfied with the result, he issues an acceptance, and the transaction is terminated successfully. The first two steps (request and promise) are part of the actagene conversation, in which the participants try to agree about the action(s) to be performed. The last two steps (statement and accept) are part of the factagene conversation, in which the participants try to agree whether performance has been acceptable.

In figure 2, only the TPM's success layer has been depicted. A more elaborate picture of the TPM is shown in figure 3.

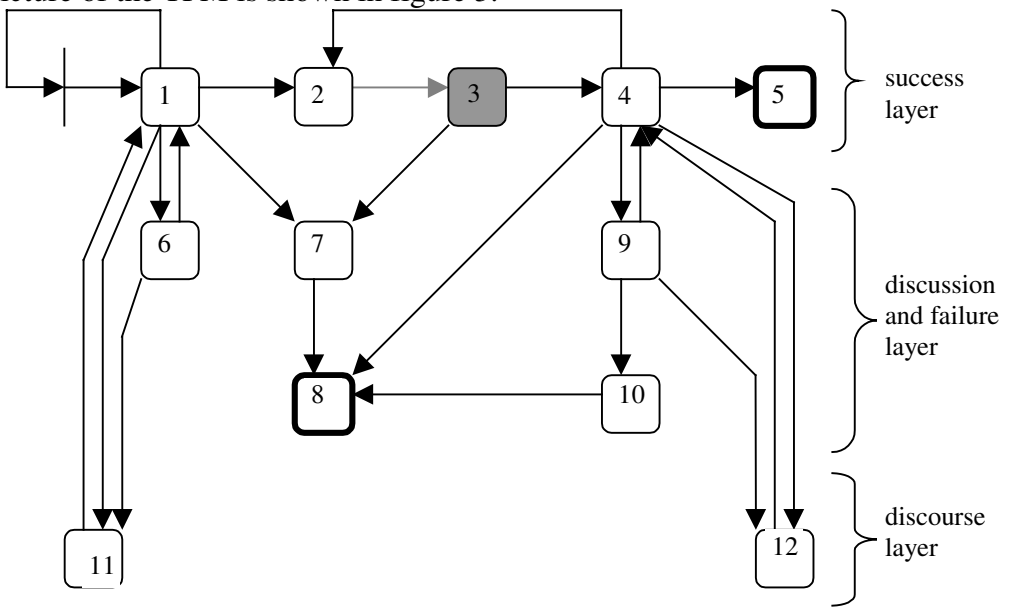


Figure 3 – the three layers of the TPM

Figure 3 shows two additional layers: the discussion/failure layer, and the discourse layer. The discussion/failure layer is concerned with the possibility of the

other actor not agreeing with a validity claim. For instance, a buyer may object that a delivery does not satisfy the pre-agreed quality requirements and therefore dispute the seller's statement that it made a correct delivery. In the discourse layer, the actual norms and rules that govern the transaction can be discussed. The main difference between the discussion/failure layer one hand and the discourse layer at the other hand is that the former is exclusively related to the current transaction, whereas the latter concerns the transaction type, and thus also influences future transactions.

An important property of the TPM is that it aims to be generic. It is claimed that every instance of a communicative oriented transaction process can be described by the Transaction Process Model of figure 3. This, however, also brings with it the disadvantage that it is not clear how the TPM should be customized to a particular context, such as the specific terms and conditions that the business partners have stated in their (written) agreement.

Another issue is that the TPM is at level 3 (the workflow loop) of the Meta-patterns framework, whereas our research interest goes to level 4 (the contract). It is therefore necessary to specify how transactions can interact. In DEMO, which builds upon the Transaction Process Model, this is covered by the Process Model. The Process Model, however, is very much focussed on the success layer and this makes it hard to express what happens in case of failures. For instance, after a late delivery the buyer may want to initiate a transaction for damage compensation. In our view, these aspects of what happens when an obligation is violated play an important role in business contracts.

### 3.2 Illocutionary logic

Illocutionary logic is a logical formalization of the theory of speech acts. In this section we will focus on the illocutionary logic of Dignum and Weigand (Dignum and Weigand, 1994, 1995, Weigand *et al.* 1995), which is an extension of dynamic deontic logic. Dynamic deontic logic (Meyer, 1988, Dignum *et al.* 1994) is a formalism for specifying actions and their effects, in particular, the effect of creating an obligation. Dignum and Weigand defined an extension of dynamic deontic logic, focussing on the effects of illocutionary acts. The effect of, say, an agent uttering a promise, can be the creation of an obligation. An earlier overview of Dignum and Weigand's illocutionary logic can be found in (Caminada et al, 1999), so we will keep our current discussion brief. Dignum and Weigand include the following kinds of illocutionary acts:

- DIR(i, j, $\alpha$) i requests j to do $\alpha$
- COM(i, j, $\alpha$) i commits himself (promises) to j to do $\alpha$
- ASS(i, j, $\phi$) i asserts to j proposition $\phi$
- DECL(i, j, $\phi$) i declares and informs j that $\phi$ holds from now on

Illocutionary acts like DIR can be grounded in three different ways: charity, power and authorization, indicated with the subscripts *c*, *p*, and *a*. $DIR_c$ means a request is made without the receiver being obliged to comply. $DIR_p$ stands for a request based on power; if i has power over j with respect to action $\alpha$ (notation: $j <_\alpha i$) then i can give j an order ($DIR_p$) which j is obliged to carry out. $DIR_a$ is similar to $DIR_p$ in that it concerns a request that must be complied with. The difference is that $DIR_a$ is based on an authorization relation (notation: *auth*(i, $\alpha$)) that is more flexible then the power relation; authorizations can be created or deleted during the course of a transaction, whereas the power relation remains fixed.

The most important axioms of illocutionary logic are the following:

1. $j <_\alpha i \rightarrow [DIR_p(i, j, \alpha)] O_{j,i}(\alpha)$
2. *auth*(i, $DIR_a$(i, j, $\alpha$)) $\rightarrow$ $[DIR_a(i, j, \alpha)] O_{j,i}(\alpha)$
3. $[COM(i, j, \alpha)] O_{i,j}(\alpha)$
4. $j <_\phi i \rightarrow [DECL_p(i, j, \phi)] \phi$
5. *auth*(i, DECL(i, j, $\phi$)) $\rightarrow$ $[DECL_a(i, j, \phi)] \phi$
6. $j <_\phi i \rightarrow [ASS_p(i,j,\phi)] B(j,\phi)$
7. *auth*(i, ASS(i, j, $\phi$)) $\rightarrow$ $[ASS_a(i, j, \phi)] B(j, \phi)$

Statements between square brackets represent actions. Obligations are specified by the capital letter "O", indexed by the carrier of the obligation (i) as well as the counter party (j) towards which i should fulfil his obligation. The B-predicate stands for the belief operator, stating that an agent beliefs a certain proposition. As an example, the first axiom should be read as: "if i has power over j with respect to action $\alpha$, then i ordering j to perform $\alpha$ results in j having an obligation to i to do $\alpha$".

The axioms specify the general consequences of illocutionary acts, valid in every situation. Each trade procedure, however, has its own additional rules. These are specified in what is called a *contract.* An example of how a contract between buyer and seller can be specified in illocutionary logic, taken from (Dignum and Weigand 1995) is given below.

1. $[DIR_c(b, s, give\text{-}quotation(s,b,g,p,))] O_{s,b}(give\text{-}quotation(s,b,g,p) \cup refuse(s))$
   After the buyer (b) a requests a quotation (a request based on charity) the seller (s) is obliged to give a quotation or send a refusal.
2. $[give\text{-}quotation(s,b,g,p)]$ auth(b, $DIR_a$(b,s,deliver(s,b,g,p)))
   After the seller gives a quotation for the goods (g) at a certain price (p), the

obliged to deliver; and after delivery the seller is authorized to request payment.

4. $O_{s,b}(\text{deliver}(s,b,g,p)) \rightarrow [\text{deliver}(s,b,g,p)] \neg\text{auth}(b, \text{DIR}_a(b,s,\text{deliver}(s,b,g,p)))$
   If the seller is obliged to deliver, then after doing so, the buyer is no longer authorized to request delivery (it has to get a new quotation).

5. $\text{auth}(s, \text{DIR}_a(s,b,\text{pay}(b,s,p))) \rightarrow [\text{DIR}_a(s,b,\text{pay}(b,s,p))] O_{bs}(\text{pay}(b,s,p))$
   Follows from the axioms.

6. $O_{b,s}(\text{pay}(b,s,p) \rightarrow [\text{pay}(b,s,p)] \neg\text{auth}(s, \text{DIR}_a(s,b,\text{pay}(b,s,p)))$
   After paying, the seller cannot demand another payment.

Illocutionary logic would best be classified at level 4 (contract level) of the meta-patterns framework. However, not all steps of the underlying two workflow loops are supported. As for the actagene conversation, only requests that are based on charity require a promise to create an obligation. Requests based on authorization create an obligation right away, thus stepping away form the idea of communication as a cyclic process. As for the factagene conversation, it is interesting to see that this concept is not explicitly represented in illocutionary logic. When there is an obligation to perform $\alpha$, then after doing $\alpha$ the obligation is immediately fulfilled. No conversation is needed to determine whether or not $\alpha$ actually took place because this issue is assumed to be immediately clear to both parties. The question whether or not $\alpha$ holds simply falls outside of the scope of the logic as given.

### 3.3 Documentary Petri-nets

Documentary Petri-nets (Lee, 1999) provide a formalism for the specification of trade procedures. Although the Documentary Petri-net approach does not follow the LAP paradigm, we will nevertheless discuss it as an example of a specification formalism at the contract level.

A DPN can be seen as an extended version of the Petri-net formalism. An example DPN, taken from Bons (1997) is given in figure 4.

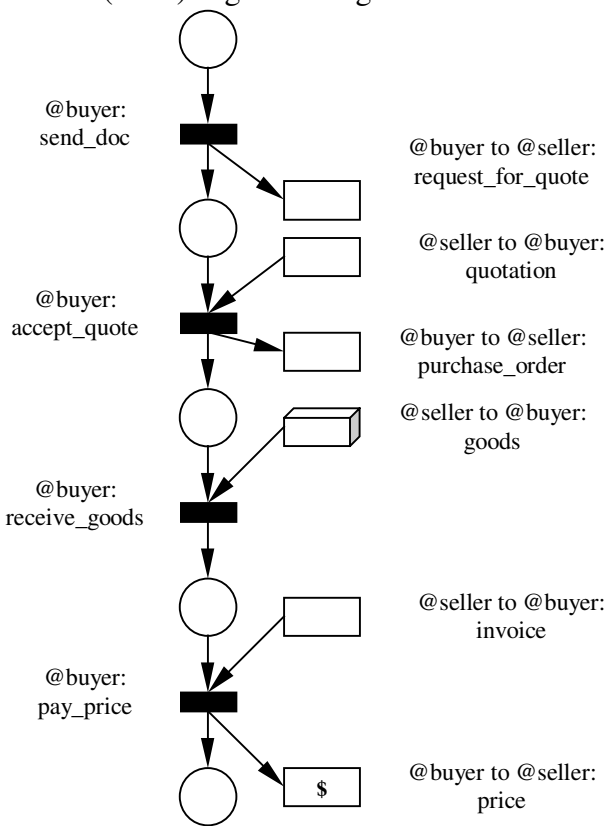


Figure 4 – a DPN for the role of buyer in a post-payment scenario

In figure 4, internal states are represented as circles, transitions as bars. For items that are exchanged during the course of the trade procedure, three different symbols (denoting Petri-net places) are defined. An empty rectangle denotes the exchange of a document, rectangle containing a dollar '$' symbol represents the exchange of funds and a cube represents the exchange of goods. Each role that participates in the trade procedure has its own DPN, and all of these DPNs can be linked together. As DPNs are specialized forms of Petri-nets, one can use tokens to denote the current state of affairs.

One of the applications of DPNs, as described by Lee (1999), is that it enables trade scenarios to be stored in a publicly accessible electronic library, and downloaded by trading partners as needed. The DPN formalism also makes it possible to apply certain safety checks on a trade procedure to ensure that sufficient controls are available to prevent parties from cheating each other. This is the subject of the work of Bons (1997). A tool that can perform automatic safety

checks and supports the construction and simulation of the DPNs is also available (Lee, 1999).

## 4. Dialogue systems

Contracts regulating trade procedures are essentially legal texts. In this section, we will discuss one of the approaches in the field of AI and Law that deals with legal reasoning. First, however, we would like to provide an example of the legal clauses that regulate a trade procedure. In order to maintain a certain level of generality, we have chosen an example of the UN Convention on Contracts for the International Sale of Goods (CISG). Figure 5 contains article 33 of the CISG, which aims to regulate issues of the conformity of goods.

```
(1) The seller must deliver the goods which are of the
    quantity, quality and description required by the
    contract and which are contained or packaged in the
    manner required by the contract.
(2) Except where the parties have agreed otherwise, the
    goods do not conform with the contract unless they:
      (a) are fit for the purposes for which the goods of the
          same description would ordinarily be used
      (b) are fit for any particular purpose expressly or
          impliedly made known to the seller at the time of
          the conclusion of the contract, except where the
          circumstances show that the buyer did not rely, or
          that it was unreasonable for him to rely, on the
          seller's skill and judgement;
      (c) possess the qualities of the goods which the seller
          has held out to the buyer as a sample or as a
          model;
      (d) are contained or packaged in the manner usual for
          such goods or, where there is no such manner, in a
          manner adequate to preserve and protect the goods.
(1) The seller is not liable under sub-paragraph (a) to (d)
    of the preceding paragraph for any lack of conformity of
    the goods if at the time of the conclusion of the
    contract the buyer knew or could not have been unaware
    of such lack of conformity.
```

Figure 5 – article 33 of the CISG

It should be noticed that the above article contains various terms like "ordinarily", "unreasonable", "usual" and "adequate".This make it hard to automatically deduct when a certain shipment contains goods that are conform in the sense of the CISG. There is a lot of space still open to discuss issues like the exact purpose for which

the goods would ordinarily be used, or in which situations it is unreasonable to rely on the seller's skill and judgement. This vagueness is a very common property of legal texts, including contracts. It is exactly this problem of not being able to objectively determine when a certain event (say, the delivery of contract-conform goods) has taken place, that illustrates the need of a factagene conversation. This factagene conversation, however, is missing from both illocutionary logic and Documentary Petri-nets. In both approaches, events are seen as simply having taken place or not.

The problem of how to deal with vague and ambiguous terms has been studied in the field of AI and Law. One of the approaches has been found in *dialogue systems.* An example of a dialogue system, one that is especially aimed for legal purposes, is Dialaw (Lodder, 1998) The approach of DiaLaw is based on the idea that the justification (or truth) of a statement can solely be based on agreement between parties. In order to achieve this agreement, the parties hold a *dialogue*, a structured discussion in which parties try to convince each other of their respective standpoints. An important aspect of this approach is that parties enjoy a large amount of freedom in deciding which statements are justified or not. Dogmas are absent; each statement can be questioned, meaning that termination is not guaranteed.

Dialaw is centered around four illocutionary points: claim, question, accept and withdraw. A move is a tuple (P, A, S, L, B) where P is the name of the party, A is the illocutionary point, S the propositional content of the illocutionary act, L the level at which the move takes place, and B is the proposition the move is a response to. The first move is always a claim and has the form: (P, claim, S, 0, dialaw). An example of an (unfinished) dialogue, slightly modified from (Lodder, 1998) is given in figure 6.

```
(Bert,  claim,     murderer_OJ,     0,    dialaw)
(Ernie, question,  murderer_OJ,     0,    murderer_OJ)
(Bert,  claim,     shot_her,        1,    murderer_OJ)
(Ernie, question,  shot_her,        1,    shot_her)
(Bert,  claim,     smoking_gun,     2,    shot_her)
(Ernie, accept,    shot_her,        2,    smoking_gun)
(Bert,  claim,     on_purpose_so_murderer, 1,
murderer_OJ)
```

Figure 6 – Example dialogue

It can be seen from figure 6 that in a dialogue, players usually take turns (although there are exceptions). Furthermore, each time after a question is raised, the level is increased by 1, to indicate that a subdiscussion is taking place. At each step it is registered which statements each of the individual players is committed to. A claim creates a new commitment for the party issuing it; the same holds for an accept.

Commitment is lost after issuing a withdrawal. The dialogue is ended when both players have the same commitments.

DiaLaw contains various rules that specify when it is allowed to make a certain move. It is, for instance, not allowed for a party to contradict himself, that is, to issue a claim that is inconsistent with his commitments. Another example is that if a party P1 is committed to statement S, while party P2 is committed to statement ~S (not S) and P2 withdraws ~S, then in the next step P1 is obliged either to concede S or to question S. The exact rules that govern the dialogue are given in (Lodder 1998) and will not be repeated here.

Statements, according to the Dialaw approach, "are justified if they are defended successfully in a dialogue". This, however, implies that the truth of the agreed statements is restricted to the participants of the dialogue and the time and place the dialogue took place. That is, outcome is inherently subjective, as it is based on agreement between the participants. This is a great contrast with approaches like formal logic, which aim just to calculate the truth from a certain given set of premises. However, contracts, as well as other legal texts, do not seem to allow such a derivation of statements that are "objectively" true. Or, as Lodder (1998) states it: "Whether statements that have been justified are really just (fair, legitimate) is a question that cannot be answered."

## 5. Towards a formal model for contract execution

In this section, we will propose a formal model for the execution of a contract. Our aim is to provide a model that is clear, graphical and formal, while at the same time flexible enough to support the kind of ambiguous and vague clauses that are common to legal texts. In particular, the formalism should support *contract monitoring* (Gisler et al, 1999), that is, it should provide insight into the current state of affairs during contract execution. We have chosen Petri-nets as an underlying formalism because of its graphical representation and its ability to deal with both sequential and parallel actions.

### 5.1 The workflow loop

An important building block of our formalism – which we will refer to as a *contracting Petri-net* – is the workflow loop. Figure 8 shows its representation.

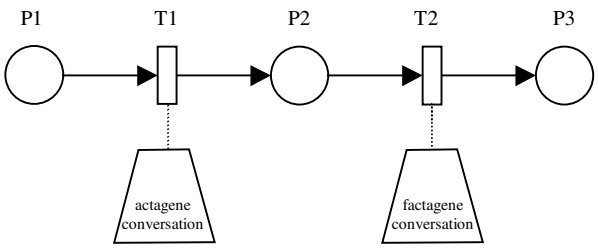


Figure 8 – representation of workflow loop

A workflow loop is represented as a Petri-net consisting of three places and two transactions, each of which is accompanied by a dialogue. The actagene conversation takes place in the form of a dialogue related to T1; the factagene conversation takes place in the form of a dialogue related to transaction T2. These dialogues determine whether or not a Petri-net transaction has taken place. To simplify the picture, they do not have to be represented explicitly.

We will now give an example of a workflow loop of a customer ordering goods at a seller. We assume the order is a call-off order subject to a predefined contract. Furthermore, to keep things simple we assume that at this moment, no disputes concerning validity claims are taking place.

Initially, the token is located at place P1. At a certain moment, the buyer places a call-off order, which can be seen as a directive. This directive is issued under the authority of the framework contract. It is assumed that the contract provides a certain *authorization* for the buyer to send this directive. Thus, according to the classification of illocutionary logic, this order can be seen as a directive grounded in authorization. By sending the directive, the buyer also implicitly states that he is authorized to do so, as this is the validity claim of the directive. This claim is the starting point of the actagene dialogue. After the seller receives the order, he verifies whether to his opinion the order falls under the pre-agreed contract (and thus constitues an authorized directive). If so, he accepts that the buyer has sent a valid directive, and that therefore, the seller has an obligation to perform. This means that the shortest possible dialogue for T1 consists of two moves. First, there is the call-off order of the buyer, which contains a *claim* that this order is authorized. In the dialogue second step, the seller *accepts* this claim, and therefore agrees that an authorized order has taken place. The dialogue of T1 is now ended, and the token is moved to place P2, in which the seller has the obligation to deliver.

After delivery (which is not explicitly modeled) a factagene conversation takes place, in the form of a dialogue under T2. The first step is the seller claiming it has performed. The second step is the buyer accepting this claim. This ends the dialogue, and the token is moved to P3.

When one compares the procedure described above with van Reijswoud's Transaction Process Model, it can be seen that – at least as far as the success layer is concerned – the factagene conversation is quite similar in both approaches. The actagene conversation, however, is handled differently. To discuss the differences it is useful to recall the distinction, as made by illocutionary logic, between directives based on charity and directives based on authority. Directives based on charity require an explicit promise for an obligation to come into existence, whereas directives based on authority create an obligation right away (provided that the proper authorization relation is in place). Directives based on charity, in our view, mainly take place during contract negotiation, where none of the parties can force the counterparty to accept a proposal. After the contract has been signed, however, guidelines are assumed to exist that regulate call-off orders, as well as the payment procedure. Therefore, in the post-contract phase the emphasis will lie on authorized directives. As our focus is on the post-contract phase, we have taken the directive based on authorization as the starting point for actagene conversations.

One of the design principles of our approach is that a Petri-net transaction should indicate a change of deontic status. For instance, in place P1, there is no obligation whatsoever. In place P2, the seller has an obligation towards the buyer to deliver and in P3 this obligation has been fulfilled. The focus on deontic is the reason why we have chosen only three places in a workflow loop, which is less than the success-layer of van Reijswoud's TPM, which depicts every communicative act during the process.

Both actagene and factagene conversation are subject to the clauses as defined in the contract. As an example, recall article 33 of the CISG, depicted in figure 5. In Dialaw, it can lead to the following dialogue.

```
(seller, claim, proper_delivery, 0, dialaw)
     "I have delivered according to the contract"
(buyer, claim, ~proper_delivery, 0, proper_delivery)
     "No you haven't"
(seller, question, ~proper_delivery, 0, ~proper_delivery)
     "Why not?"
(buyer, claim, goods_not_conform(CISG 33.2), 1,
     ~proper_delivery)
     "Because the goods are not conform in the sense of article
     33.2 CISG"
(seller, question, goods_not_conform, 1, goods_not_conform)
     "Why not?"
(buyer, claim, not_fit_for_purpose(CISG 33.2.b), 2,
     goods_not_conform)
     "they are not suited for the production process in my
     industry and you know this"
(seller, claim, unreasonable_to_rely_on_seller, 2,
     not_fit_for_purpose)
     "I am really not familiar with your industry and you could
```

```
     not have expected me to know the requirements of your
     production process"
(buyer, withdraw, ~proper_delivery, 0,
     unreasonable_to_rely_on_seller)
     "OK, you have got a point. I can no longer maintain that
     you have made a non-conforming delivery..."
(buyer, accept, proper_delivery, 0,
     unreasonable_to_rely_on_seller)
     "...and therefore accept that a contract-conform delivery
     has taken place."
```

One can see that the arguments in a dialogue can be derived from the clauses of a contract (or, in this case, meta-contract).

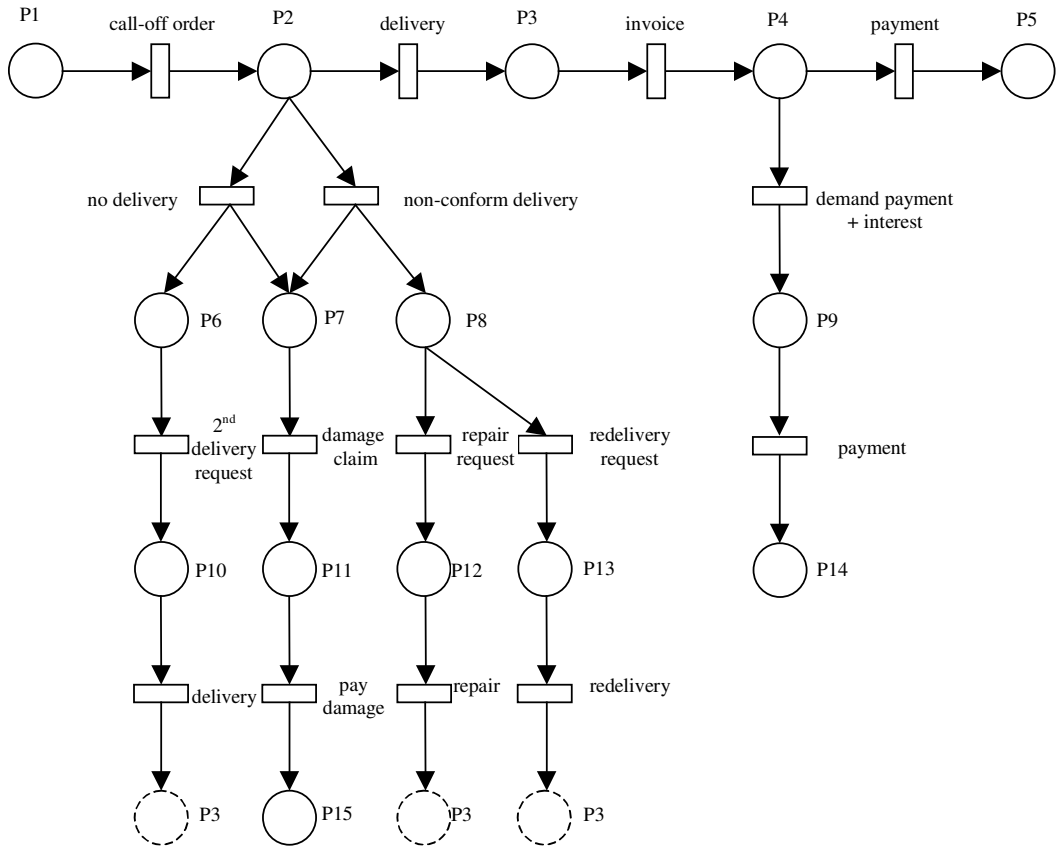


Figure 9 – example contract layer

Figure 9 shows an example of the contract layer according our formalism. Seven workflow loops (all but one derived from the CISG) can be distinguished:

1. delivery (P1, P2, P3)
2. payment (P3, P4, P5)
3. late delivery (P6, P10, P3)
4. damage compensation (P7, P11, P15)

5. repairment (P8, P12, P3)
6. redelivery (P8, P13, P3)
7. late payment (P4, P9, P14)

All of these workflow loops are connected through common places or through a Petri-net transaction between places of different workflow-loops. It should also be mentioned that a Contracting Petri-net such as figure 9 is aimed to depict the obligations that parties have towards eachother, and therefore does not show any actions that are purely internal.

Not every Petri-net is a valid contracting Petri-net. Apart from the restrictions on the structure of each individual workflow loop – which is required to consist of three places and 2 transitions – there are also restrictions that specify how workflow loops can be composed together. The first restriction concerns when different transactions can share places. Based on two workflow loops (WF1 and WF2), each with three places (P1, P2 and P3), this results in the following (theoretical) combinations:

1. WF1 place P1 is identical to WF2 place P1. An example is the place shared between repair and redelivery. This situation occurs when two workflow loops cannot be executed together.
2. WF1 place P1 is identical to WF2 place P2. An example is the place shared between the payment and late payment. This situation occurs when one workflow loop is executed if an obligation in the other workflow loop is violated.
3. WF1 place P1 is identical to WF2 place P3. An example is the place shared between the order and payment workflow loops. This situation occurs when workflow loops are sequentially linked to each other.
4. WF1 place P2 is identical to WF2 place P2. This would mean that, for instance, an actagene conversation in WF1 could be followed by a factagene conversation in WF2. We therefore explicitly disallow this combination.
5. WF1 place P2 is identical to WF2 place P3. This would mean that in WF1, a factagene conversation could take place without the actagene conversation ever having taken place. For this reason, we also disallow this combination.
6. WF1 place P3 is identical to WF2 place P3. An example is the place shared between the delivery and repair workflow loops. This can occur when a repair-workflow loop (one directly or indirectly originated from place P2 of another workflow loop) is terminated and execution resumes as if the previous workflow loop has been terminated successfully.

Workflow loops can also be connected by a transition between a place of WF1 and a place of WF2. Connections through transitions are also useful to implement AND splits. We distinguish three different kinds of situations:

1. Connections from a certain place of WF1 to place P1 of WF2. This can be subdivided into three situations:

a) A transition from WF1 place P1 to WF2 place P1. An example would be a special offer (WF1), only valid for limited time. When the time has expired (that is, the linking transaction takes place), one can only order through the normal conditions (WF2).
b) A transition from WF1 place P2 to WF2 place P1. Examples are the "no delivery" and "non-conform delivery" transactions in figure 9.
c) A transaction from WF1 place P3 to WF2 place P1. An example would be an AND-split, where the counterparty can be asked to perform multiple actions in parallel (for instance, both to deliver the goods, and to send the correct documents)

2. Connections from a place of WF1 to place P2 of WF2. These are not allowed because they would create an obligation without any actagene conversation taking place.
3. Connections from a place of WF1 to place P3 of WF2. Because these kinds of links would not make sense – the transition is going to a terminated workflow loop – we only allow this situation to occur if place P3 of WF2 also serves as place P1 of some other WF-loop (say, WF3).

Using the above constraints, we can now formally describe the structure of a contracting Petri-net. A contracting Petri-net consists of a tuple (N, W, R) where N is a (connected) Petri-net (P, T, F, B), W a set of workflow loops in N, and R a set of rules (the contractual clauses). P is the set of Petri-net places, T the set of (labeled) transactions such that $P \cap T = \emptyset$, F a relation in $P \times T$ which specifies the forward flow (from places into transactions), and B a relation in $T \times P$ which specifies the backward flow (from transactions into places). W is a set of tuples (workflow loops) of the form (P1, T1, P2, T2, P3) with $(P1, T1) \in F$, $(T1, P2) \in B$, $(P2, T2) \in F$, $(T2, P3) \in B$, $P1 \neq P2$, $P2 \neq P3$ and $T1 \neq T2$. For each place P in the Petri-net, it is required that there exists a tuple $w = (P1, T1, P2, T2, P3) \in W$ such that w.P1 = P, w.P2 = P, or w.P3 = P, that is, every place should be contained in at least one workflow loop. The fact that we do not allow obligations to be created without an actagene conversation means that P2 can have exactly one inflow, that is, for each tuple w = (P1, T1, P2, T2, P3), if $(T, P2) \in B$ then T=T1.

## 5.2 The dialogue system

As was said earlier, the firing of each Petri-net transaction depends on an underlying dialogue where the two parties try to agree whether the transaction took place or not. For the specification of the structure of a dialogue, many formalisms have been defined. Examples include MacKenzie's DC (MacKenzie, 1979, 1990), Rescher's Dialectics (Rescher, 1977) and the earlier mentioned Dialaw (Lodder, 1998). None of these, however, seems to be especially well suited for the specification of dialogues that are based upon a predefined rule base. An exception

is Gordon's Pleading Game (Gordon, 1995). Here, legal rules are translated into defeasible logic. The great complexity of Gordon's system, however, forms a serious barrier for any practical use.

In our opinion, a dialog system that is suitable for use within the contracting Petri-nets as described above, would have to satisfy the following properties. First, it should support *structural* as well as *procedural* arguments, as Lodder (1999) calls them. Structural arguments are arguments based on rules and logic. An example would be an argument of $p$ and $p \rightarrow q$; if a party commits himself to $p$ and $p \rightarrow q$ then he also has to commit himself to $q$. A procedural argument is an argument that may not be valid in logical sense, but is still strong enough for a party to be convinced. For instance, *university_professor* can be an argument for *smart_person*, even if no explicit rule *university_professor* $\rightarrow$ *smart_person* is present. Procedural arguments are only as strong as parties find them convincing, thus allowing a subjective element to enter the dialog. Structural arguments are needed to deal with the rules as laid down in the contract. Procedural arguments are needed to settle the issues the contract has no explicit clauses for, that is, issues that are open to interpretation. Procedural arguments provide added value for using a dialog system; if only procedural arguments would be allowed than the functionality would be equal of that of a system of formal logic.

A second issue is how defeasibility should be handled. Contractual rules can have exceptions to their applicability. Furthermore, they can be conflicting, and these conflicts should not lead to inconsistency.

A third issue is burden of proof, where we will follow the approach of Prakken (1999) of incorporating burden of proof in the rule base.

The fourth and last issue is that the contractual rules should not force parties into conclusions that neither of them wants to draw. If in a certain situation both parties prefer to work out a solution of their own, rather than strictly following the contractual clauses, than they should be allowed to do so.

Based on the above issues, we can present the following dialog system. Notice that our specification is sometimes done in a semi-formal way, in order to focus on the main line and not on any technical details.

**Definition 1. Terms.**

An *entity* is either a constant, a variable or a function $f(e_1, e_2, \ldots, e_n)$ *where* $e_1, e_2, \ldots, e_n$ are entities. An *atomic term* consists of a relation $R(e_1, e_2, \ldots, e_n)$ where $e_1, e_2, \ldots, e_n$ are entities. If $\alpha$ is an atomic term, then $\alpha$ and $\neg\alpha$ are *terms*. Although strictly not a term, we identify $\neg\neg\alpha$ with $\alpha$. A term is *closed* when it does not contain any variables. Each of the two parties has a set (commitment store) $O$, which contains the terms the party is committed to (that is, the terms the party holds for valid)

**Definition 2. Rules.**

A *rule* is an expression of the form $\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\gamma} \beta$, where $\alpha_1, \alpha_2, \ldots, \alpha_n$ (the antecedent), $\gamma$ (the exception), and $\beta$ (the consequent) are terms.

**Definition 3. Moves.**
A move consists of a non-empty set of statements, where each statement is of one of the following forms:

1. *claim(*$\alpha$) where $\alpha$ is a closed term that does not contain *applies*.
2. *applies*($\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\gamma} \beta$) where $\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\gamma} \beta$ is an instantiated rule (that is, a rule in which all variables are replaced by closed terms) from the contractual rule base, thus forming a structural argument.
3. *supports(*$\alpha$, $\beta$*)* where $\alpha$ and $\beta$ are closed terms. This is how procedural arguments are supported.
4. *question(*$\alpha$*)* where $\alpha$ is a closed term. With this statement a party asks the counterparty for arguments for the term $\alpha$ the counterparty is committed to.
5. *concede(*$\alpha$*)* where $\alpha$ is a closed term. With this statement a party indicates that the counterparty has convinced him of the truth of term $\alpha$.
6. *retract(*$\alpha$*)* where $\alpha$ is a closed term. With this statement a party indicates that he is no longer convinced of the truth of term $\alpha$.

**Definition 4. Pre- and postconditions.**
In this definition we assume that the two parties are called P1 and P2 and that the current move is being done by party P1.

1. *claim(*$\alpha$*),* where $\alpha$ does not contain *applies*
   a) preconditions:
      i) it is either the case that:
         a) *claim(*$\alpha$) is the first statement of the dialogue (and thus the main claim, that is directly related to the Petri-net transition); or
         b) $\alpha$ is equal to an exception of an earlier claimed rule application by the counterparty: *applies*($\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\alpha} \beta$)
         c) *claim(*$\alpha$) is a reaction to a previous move of the counterparty that made him committed to term $\neg\alpha$.
      ii) $\alpha$ is not in the commitment store of P1 or P2.
      iii) $\neg\alpha$ is not in the commitment store P1.
      iv) it is the first time during the conversation the statement *claim(*$\alpha$) is made.
   b) postconditions:
      i) $\alpha$ is being added to the commitment store of P1
2. *applies*($\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\gamma} \beta$)
   a) preconditions:

i) there is a rule in the rule base of which $\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\gamma} \beta$ is an instantiation.
ii) $\alpha_1, \alpha_2, \ldots, \alpha_n$ is not inconsistent with the commitment store of P1.
iii) the exception $\gamma$ is not part of the commitment store of P1.
iv) $\beta$ is already part of the commitment store of P1
v) it is the first time during the conversation the statement *applies*($\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\gamma} \beta$) is made.

b) postconditions:
i) $\alpha_1, \alpha_2, \ldots, \alpha_n$ is being added to the commitment store of P1

3. *supports*($\alpha, \beta$)
a) preconditions:
i) $\beta$ is part of the commitment store of P1
ii) $\alpha$ is not inconsistent with the commitment store of P1
iii) it is the first time during the conversation the statement *supports*($\alpha, \beta$) is made.
b) postconditions:
i) $\alpha$ is added to the commitment store of P1

4. *question*($\alpha$)
a) preconditions:
i) $\alpha$ is part of the commitment store of P2
ii) $\alpha$ is not part of the commitment store of P1
iii) it is the first time during the conversation the statement *question*($\alpha$) is made.

5. *concede*($\alpha$)
a) preconditions:
i) $\alpha$ is part of the commitment store of P2
ii) $\alpha$ is not part of the commitment store of P1
iii) $\alpha$ is not inconsistent with the commitment store of P1
b) postconditions:
i) $\alpha$ is added to the commitment store of P1

6. *retract*($\alpha$)
a) preconditions:
i) $\alpha$ is part of the commitment store of P1
ii) $\alpha$ is not part of the commitment store of P2
b) postconditions:
i) $\alpha$ is removed from the commitment store of P1

**Definition 5. Forced commitment.**

If P2 has done a move containing *applies*($\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\gamma} \beta$) in the past, than it is not allowed for P1 to do a move after which:

1. P1 is committed to $\alpha_1, \alpha_2, \ldots, \alpha_n$
2. P1 is not committed to $\gamma$
3. P1 is not committed to $\neg\beta$ (that is, P1 is not defending any counter argument)
4. P1 is not committed to $\beta$.

**Definition 6. Forced retraction.**
If before the current move P1 is committed to term $\beta$ while P2 is not committed to $\beta$., then it is not allowed for P1 to do a move after which:

1. there is no *applies*($\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\gamma} \beta$), done by P1 either in the current move or in the past where $\alpha_1, \alpha_2, \ldots, \alpha_n$ are still part of the commitment store of P1 and $\gamma$ is not part of the commitment store of P1.
2. there is no *supports*($\alpha, \beta$), done by P1 either in the current move or in the past where either:
   a) P1 is no longer committed to $\beta$ or
   b) P2 is committed to $\beta$.
3. P1 is still committed to $\beta$ .

**Definition 7. Moves after claim.**
If in the previous move of P2, P2 became committed to $\alpha$ while P1 is not yet committed to $\alpha$, then in the current move, P1 is obliged to do a move containing either *question*($\alpha$), *claim*($\neg\alpha$) or *concede*($\alpha$).

We shall now examine how the earlier mentioned desired properties are implemented in the proposed system. First, there is the issue of structural and procedural arguments. Forced commitment can only be based on structural arguments. For procedural arguments, say *supports*($\alpha, \beta$), the counterparty is not obliged to concede $\beta$, even if he conceded $\alpha$. The *supports* relation should be seen as providing circumstantial evidence. The fact that the streets are wet may support the conclusion that it has rained, but this alone need not to convince the counterparty to draw this conclusion and more evidence may be required. Definition 6.2.b basically specifies that once party P2 has accepted the validity of $\alpha$ while not yet having accepted the validity of $\beta$, then party P1 is obliged either to provide more arguments for $\beta$, or to retract it.

Regarding defeasiblilty, it can easily be seen that using definition 1 to 7, it is not possible to get an inconsistent commitment store. This also means that any conflicts related to rules with conflicting outcomes remain unresolved, until one of the parties retracts his standpoint (possibly after a discussion with procedural arguments).

As for the burden of proof, the general principle is that whenever a statement is claimed, the party who claims it has to present a convincing argument for it. When making use of a structural argument, the antecedent should be justified as well. The absence of an exception, however, does not have to be proved by the proponent of the consequent. When the opponent of the consequent wants to deny the application of the rule, *he* bears the obligation of finding proper justification for the exception. For instance, if the rule is *call_off_order* $\rightarrow^{\neg force_majeure}$ *obliged_to_deliver* then it is the seller's task to find justification of any case of *force_majeure* and not the buyer's task to justify its absence.

Another property is that the contractual clauses do not force parties into a conclusion that neither party wants to draw. If party P1 has made statement *applies*($\alpha_1, \alpha_2, \ldots, \alpha_n \rightarrow^{\neg\gamma} \beta$) to convince party P2 of $\beta$, then P2 can still make a procedural counterargument *supports*($\alpha, \neg\beta$). P1 can then voluntarily chose to accept this counterargument (and thus retract $\beta$ and accept $\neg\beta$) or he can chose to refuse so and request more argumentation until P2 runs out of arguments and is forced to retract $\neg\beta$.

## 6. Summery and future research

In the current paper, we have outlined a formalism for the contract level of Weigand and van den Heuvel's meta-patterns framework. In this formalism, the influence of texts (Weigand et al., 1999) upon conversations is modeled by using structural arguments. Our approach combines the Petri-net formalism with the notion of dialogues. By using dialogues that are based upon a predefined rule-base (the contract) parties can choose which terms they want to define by means of the contractual clauses and which terms they want to keep open for interpretation (by means of procedural arguments). The greatest advantage of using a dialog system instead of any purely deductive system (like formal logic), is in our view that it enables partners to define their own subjective version of the truth, where rules play a guiding , but not an overly forcing role.

When we compare our formalism with the earlier mentioned approaches then the following can be said. Regarding the Transaction Process Model, it can be seen that although our workflow loop is largely based on the TPM, the dialogs underneath each Petri-net transaction allow us to see exactly which arguments are put forward, something that is left implicit in the extended version of the TPM in figure 3. Regarding illocutionary logic, it can be said that our formalism leaves some space open for parties to make their own settlements, whereas in illocutionary logic the validity of statements is something that can simply be deducted, needing no discussion or agreement. Regarding Documentary Petri-nets, it can be seen that DPNs do not pay explicit attention to for example all ins and outs of what exactly constitutes a correct delivery. It should be noticed, however,

that DPNs are largely developed to model the domain of international trade, where parties reside in different countries. If the quality of the goods is an issue at stake, then an often followed approach is to involve a third party who inspects the goods and issues a certificate of quality. A proper delivery then consists of both the goods and the certificate of quality, both of which are objective facts that need no interpretation of discussion. The approach of involving a third party, however, only makes sense if the costs of doing so is relatively low compared to the value of the transaction. In situations where this is not the case, parties may want to settle disputes among themselves.

Many issues have been left open. For instance, nothing has been specified about what happens if the contract is at a certain moment declared avoided (like after a fundamental breach of contractual obligations). In this situation, the primary contractual obligations (delivery and payment) should be cancelled, any fulfilled primary obligations should be turned back, while any workflow loops related to damage compensation should continue to be executed. It is not yet clear how the situation of contract avoidance should be incorporated into the contracting Petri-net.

Furthermore, certain properties about the proposed dialogue system are still to be proved. For instance, it would be desirable to have a proof that at every step, a party can make at least one statement. It should however be noticed that also existing dialogue systems like that of Lodder (1998) and of Gordon (1995) do not provide this kind of verification.

The greatest challenge, however, is to submit the formalism to a few real world cases and to show how existing trade contracts can be modeled with the above described framework. We hope to provide more information on this in the near future.

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# Meta-communication in the Language Action Perspective

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## Abstract

Meta-communication has not received much explicit attention in LAP literature, but in view of application of the LAP to system specification and IC system design, meta-communication needs to be taken seriously: all discussion about communication tools (such as languages, but also systems dedicated to specific contexts and tasks) involves meta-communication. In this article, we discuss the place of meta-communication in the LAP, linking it to such subjects as the discussion and discourse layers, the claim to comprehensibility and other validity claims, context, and definition theory. We also discuss Polanyi's framework of tacit knowledge and introduce the notion of 'semantic reassurance'. We conclude with a discussion of some implications for IC system specification and argue in favour of the support of controlled discussion-level meta-communication in future IC systems.

## 1. Introduction

"Meta-communication" is the general term for communication *about* communication that in everyday life is often part and parcel of any conversation. A simple request "can you repeat that?" is already a kind of meta-communication, and so are requests for clarification and dialogue management functions such as "let us come to a conclusion". In this article, we focus on meta-communication,

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placing it in context of a small set of communication-oriented theoretical frameworks (most but not all of which have been previously introduced in the LAP literature). We will work towards a discussion of some implications for the field of information and communication system specification.

The driving idea behind this article is that specification processes[1] are executed by means of a range of language-related techniques and "tools" which enable people (and potentially also automated intelligent agents) to communicate about means for communication and, along the same lines, about communication systems [Hoppenbrouwers 2000]. Such tools include conceptual devices like lexicons, ontologies, syntactic conventions, and conversational conventions. Tool selection and design is vital to any engineering effort, and if this holds for functional IC system specification as well, communication tools and *modes of conversation about them* deserve to be taken seriously as such, systematically studied, and improved.

The paper is organized as follows. First we will present an overview of the discussion concerning meta-communication in LAP literature so far. Central to the discussion will be such topics as Van Reijswoud's model of the *Discussion Layer*, *Conversation for Clarification*, and the place of *Definition* in Speech Act Theory (section 2). Next, we will further explore some fundamental aspects of conversation for clarification, relating it to Polanyi's ideas on tacit knowledge and to the introduction of the notion of *semantic reassurance* (section 3). We conclude by discussing some implications of the matters presented for IC systems specification (section 4).

This article is for a large part related to ongoing PhD research [Hoppenbrouwers, in progress; Hoppenbrouwers 2000], and has an explorative character. We are aware that consolidation of our ideas through confrontation with the practice of IC system design/use is called for, and plan to include an empirical component into our continuing research, to back up our theoretical ideas.

## 2. Meta-communication in the Language-Action Perspective

"Meta-communication" is the general term for communication *about* communication. It is most typically viewed as taking place at breakdown (ex post meta-communication), but any toolkit or system designed to support communication implies anticipation of breakdown, and pro-active discussion about communication (ex ante meta communication). As an explicit topic, meta-communication has so far received little attention in generally available LAP literature, though 'between the lines' reference to meta-communication can be found in abundance. The one notable exception is the work of [Schoop 1998;

[1] We are concerned only with those involving functionality specification and user-oriented requirements engineering, and therefore not with matters of implementation.

1999], who explicitly mentions "the metalinguistic level" [1999:65] but does not address the matter from a broad perspective, focusing mostly on the need for clarification of terminology and 'translation' between professional groups. While similar fundamental matters underlie Schoop's discussion as well as ours, we hope to present a somewhat wider view on meta-communication, linking explicit conversation about language and definition to various modes of specification. Central to our discussion will be the *discussion layer* and *discourse layer* described by [van Reijswoud 1996] as part of his Transaction Process Model (TPM), and their relation to *conversation for clarification* which concerns the *claim to comprehensibility* [Habermas 1981; Schoop 1998, 1999].

First a classic quotation [Winograd and Flores 1986:66]: "Conditions of satisfaction are not objective realities, free of interpretations of speaker and hearer. They exist in the listening, and there is always the potential for a difference among the parties. This can lead to breakdown […] and to a subsequent conversation about the understanding of the conditions."

Most typically, if communicative transactions fail this is because there is disagreement about some aspect of the propositional content, which is at least successfully communicated. However, the propositional content may not come across successfully in the first place. In such a case, there are three main possibilities:

- Immediate breakdown occurs on account of clearly perceived incomprehensibility of some utterance;
- The listening/reading party suspects incorrect interpretation on her behalf, because of a perceived mismatch between what is said and what is to be expected in the wider context of the conversation. She may or may not start a conversation for clarification;
- No misunderstanding is perceived and problems may arise only later, if at all.

We will focus on those cases in which the listener expresses the suspected occurrence of comprehensibility failure and thus enters into a *conversation for clarification* [cf. Winograd 1988]. We are concerned here not only with clarification based on incomprehensibility of the propositional content, but also of expressions of illocutionary force [Schoop 1999:65]. We thus include all cases in which the language/utterance used notably fails to do its intended communicative job. In sections 2 and 3, we mostly (but not exclusively) take as central breakdown as it occurs in actual language use; we put anticipation of breakdown central in section 4.

### 2.1 Discussion, Discourse, and Text about Communication

In Van Reijswoud's Transaction Process Model [1996:95], three layers of conversation are distinguished: the Success Layer, the Discussion-and-Failure Layer (further called "Discussion Layer" in this paper), and the Discourse Layer. The Success Layer is where transactions take place that do not suffer breakdown. If, however, breakdown occurs (or threatens), the Discussion Layer is entered. At this level, "the participants in a communicatively oriented transaction process discuss whether the claims incorporated in a communication act and laid down in a transaction state are *true*, *justifiable* [elsewhere called *appropriate*], and *truthful*" [italics added] [1996:97]. "However, in some situations a discussion relates to the background conditions of a group of related transaction processes. These discussions, called *discourses* [italics added], are dealt with in the discourse-layer […]." [1996:100]. "Discussions about validity claims, on the one hand, relate to a particular instance of a transaction type, e.g. the order with the order #93154. Discourses, on the other hand, abstract from particular instances of a transaction type, and focus on the underlying rules of a particular transaction type." [1996:165].

Meta-communication can be placed in this model without much trouble. Conversation about the meaning of a term, for example, can occur for clarification of communication taking place in the success-layer. Important is that at discussion level, statements are made concerning the meaning of X *in context*. There is an enormous difference in interpretive depth between an isolated linguistic expression (for example, a sentence) and a fully contextualised utterance *including* that sentence, and evoking an *interpretation* [cf. Dik, 1989]. Discussion for clarification concerns a particular utterance in some context, which is complex and may be for a large part implicit. Because it is contextualised, it is difficult to anticipate and is a hard subject for ex ante (anticipatory) meta communication. There is a correspondence between instantiated (contextualised) linguistic utterances and conversation at Discussion level.

Discourse for clarification, on the other hand, typically involves more fundamental and persistent, 'decontextualised' issues, grounded in communal rules and norms, which are more general since they cover a type of situation rather than one particular, instantiated situation. In this sense, there is a parallel between generic elements of language (general word level, syntax) and the Discourse level in that they both involve community-based rules and norms [Weigand and Hoppenbrouwers 1998]. Discourse level is therefore also likely to be the primary arena for ex ante meta communication.

If semantically rich, contextualised meanings are evoked by linguistic utterances using more generic elements, then it can be argued that such generic elements are *communally grounded tools used to evoke contextualised meanings in individuals*. Such a functionalist perspective on language [Dik 1989, Harder 1994,

Weigand and Hoppenbrouwers 1998, Hoppenbrouwers 2000] implies not only that linguistic form is seen as 'being used to evoke meaning', but also that this involves social construction of signs (combinations of form and meaning). This is in line with the semiotic and language-action perspectives. As [van Reijswoud 1996:45] explains: "a constructivist principle assumes that meanings are constructed, and continuously tested and repaired, through people using syntactic structures to organize their coordinated action. The repair is taking place when they judge that the language action relationships have failed." We agree on this, and consider meta-communication to concern such 'repair', or else construction in anticipation of breakdown.

As said, we follow Van Reijswoud (and ultimately [Stamper 1993]) in embracing a semiotic point of view, and the distinction between a number of semiotic domains (the 'Semiological Ladder', cf. figure 1).

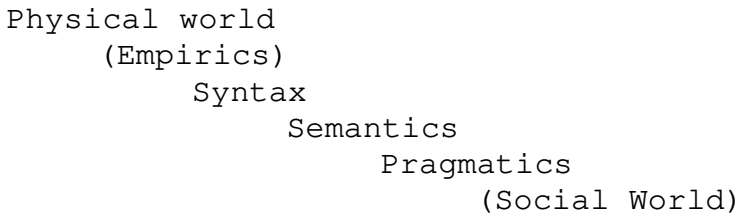


Figure 1: the Semiological Ladder (Stamper 1993)

In the *physical world*, signs are examined as phenomena: physical properties of signals and marks are studied. At the *empirics* level, statistical properties of signs are studied. *Syntax* is concerned with rules composing complex signs from simple ones, focusing on form. The *semantic* domain is concerned with the meaning of signs. The *pragmatic* domain is concerned with the relationships between used signs and the resulting behaviour of responsible agents in a social context. In the *social world*, the focus lies on actual, or perlocutionary effects [Van Reijswoud 1996:45].

Let us return to the discussion and discourse layers in van Reijswoud's TPM. Various kinds of breakdown may send a conversation into the discussion layer. The type we are concerned with concerns a failure (or suspected failure) in one of the domains of the semiological ladder. In this paper, as we have nothing in particular to say about the Social World and the Empirics layer, we will further discard these levels, and for now assume a four level semiotic model. Breakdown (or anticipated breakdown) in either of the levels may trigger meta-communication. In other words, once breakdown in any of these layers occurs, discussion follows:

**Physical**: discussion about the material markers/signals used: "Why don't you use email instead of a fax?" "Speak up, please, I cannot hear you". The physical level is strongly related to the notion 'media'.
**Syntactic**: discussion about correct *formulation* whereby syntactic rules are the cause of confusion, as in the following example: "Two cars were reported stolen by the Aachen police yesterday".
**Semantic**: any discussion about the meaning of some sign (word, or even sentence –a complex sign): "What do you mean here by …" (contextual); "What does … mean? (general)".
**Pragmatic**: meta-linguistic discussion about pragmatic concerns questions like "Do you really mean you want me to …" about some pragmatic interpretation. Note that meta-communication about pragmatics should not be confused with discussion about e.g. a claim to appropriateness concerning some linguistic act. It purely concerns *correct interpretation*.

If the validity claims challenged and discussed in the Discussion Layer are not agreed upon, in most cases the transaction will simply fail and be broken off. However, it is also possible that as a result of the discussion of a specific utterance in context, more general questions are raised, and the communal norms and rules underlying the discussion are subject of conversation in the Discourse Layer. Examples of questions raised in such discourse might be:

**Physical**: can you use email for confidential information?
**Syntactic**: should the *-sign have priority over "/"? (example from arithmetic)
**Semantic**: does term X really mean Y in the common vocabulary of language L?
**Pragmatic**: is illocutionary marker M really commonly understood as giving
illocutionary force I to utterance U in language L?

Because the discourse layer concerns communal norms and rules, it may involve any text known to the community in which such norms and rules are described [cf. Weigand et al., 1999]. Dictionaries are the most straightforward example, but similar texts are also imaginable at other semiotic levels (grammar books, interaction protocols, guidelines for the use of materials and communication equipment). Note that in cases where a set of norms and rules used is mostly based on NL, those norms and rules are mostly left implicit, but that in more restricted, artificial communicational set-ups, norms, rules, standards, and explicit descriptions or definitions thereof are imaginable and indeed occur across all semiotic layers. This is especially and increasingly the case in environments in which information and communication technology is deployed. Note that such

texts often play a role in active construction of language rather than just making implicit rules and norms explicit.

## 2.2 Validity Claims and Comprehensibility

Consider the following illustrative dialogue from Lewis Carroll's *Through the Looking Glass*:

HD: 'there's glory for you!' *(assertion, still in the success layer)*
A: 'I don't know what you mean by "glory,"' *(objection; conversation is taken into the discussion layer)*
HD: 'Of course you don't -- till *I* tell you.' *(indicates individual (stipulative) perspective on meaning)*
'I meant "there's a nice knock-down argument for you!"' *(explicit clarification)*
A: 'But "glory" doesn't mean "a nice knock-down argument,"' *(objection. Claim to truth? Appropriateness?)*
HD: 'When I use a word, it means just what I choose it to mean – neither more nor less.' *(meta-meta claim, discourse level)*
A: 'The question is whether you *can* make words mean so many different things.' *(challenge of meta-meta claim)*
HD: 'The question is which is to be master -- that's all.' *(claim to power)*

Comprehensibility of utterances expressing the semantics which in turn 'serve to carry out some goal' (pragmatics), is crucial to the communicative effort as a whole. Nevertheless, the status of comprehensibility in speech act theory varies. For example, in some discussions of validity claims underlying transactions [e.g. Van Reijswoud 1996], the *claim to comprehensibility* as introduced by [Habermas 1981] is not adopted. [Schoop 1998; 1999:65-6], however, does adopt it, and argues it is relevant to all five types of speech act (Assertive, Commissive, Directive, Expressive, Declarative) and both related to Propositional Content and Illocutionary Force. We side with Schoop in adopting the claim to comprehensibility, but discuss it in relation to other validity claims, and to the semiotic levels.

As for the relation between the Comprehensibility claim on the one hand, and the claims to Power, Truth, Truthfulness, and Appropriateness on the other, we believe there is more to it than a division in five types if meta-communication is concerned. Once the claim to comprehensibility is challenged and a conversation for clarification is entered ('I don't know what you mean by "glory,"'), we enter into a new linguistic domain in which terminology but possibly also all other aspects of language are tuned to meta-communication. Such a conversation has its own dynamics and properties, which may be quite different from those active at the level of the 'success layer', including all four validity claims and authority structures. It is therefore not enough to associate meta-communication with the claim to comprehensibility alone. Let us illustrate this by considering examples of

claims concerning all five validity claims. For sake of the argument, we will discuss them in a somewhat unusual order, Comprehensibility last.

*Power* in meta-communication may seem a difficult claim to substantiate, because thought control is not something that can be easily exerted, and meaning is a hard thing to 'control' in the best of circumstances. However, the claim to power can certainly be made, realistically or not, and up to a certain point successfully. Texts can play a role here, but as we have seen they can only enforce a skeletal, decontextualised form of communicational norms and rules. At the *Discussion* level, power is most easily exerted. If one of the communicating parties, for example, makes the claim to power (Humpty Dumpty: 'The question is which is to be master - - that's all.'), and the other party (Alice, who is a polite English girl), does not want to break off the conversation, then the latter is forced to adopt the meaning of a word at least for the duration of the conversation; yet she can 'drop' that meaning the moment it ends. Note that a situation is possible in which power is exerted at the meta-communicational level, while at the same time no such power can be exerted in other respects.

Whether in meta-communication *truth* of some element of language (for example, the meaning of a word) can be questioned at all is already matter of debate. Can some word meaning be fundamentally 'true' or not? Is it possible to identify a 'false illocutionary act'? One of the oldest questions in philosophy is on the debate between nominalism and realism. Where realism asserts that concepts exist somehow in reality, nominalism accepts the existence of individual objects only; in this perspective, words are arbitrary signs denoting some set of objects. Another question is whether reality has to be reduced to the objective-scientific abstraction of it. A complete overview of these questions is beyond the scope of this paper, but in section 3 we will consider some answers provided by Polanyi.

In explicit meta-communication about meaning, claims are perhaps most typically based on its social use. Language is (at least from one point of view) an inherently social phenomenon ([Habermas 1981], among many others), and it is therefore reasonable to base claims concerning word meaning or use of grammar on *appropriateness*. General usage dictionaries are based on this principle, and if sufficient authority is attributed to such an explicit *text* describing word meaning, a certain meaning of a word may even become mandatory. But even if linguistic conventions are left implicit (as is usually the case), they are crucial in communication because language is based on *common ground* between language users [Weigand and Hoppenbrouwers, 1998].

Linguistic conventions may play a crucial role in language, but the interpretation aspect of communication, which in our view goes in fact far beyond language as such [Winograd and Flores 1986, Harder 1996, Weigand et al. 1999], has also a very individual, subjective component in it. Apart for a claim to appropriateness, therefore, discussing meaning often involves a subjective opinion, and meta-communication an attempt to get across such an opinion. In these cases,

the central claim is *truthfulness*: whether or not someone is sincere about what she 'feels' a word to mean. Note that though such a claim can in principle concern general usage of a word, it will most likely be made *in context*.

So what about *comprehensibility*? It is violation of the claim to comprehensibility which may trigger discussion about communication, i.e. meta-communication. However, also at the level of meta-communication, the claim to comprehensibility holds. Since meta-communication needs a language of its own, it is not impossible that this language, and utterances composed using it, include elements not shared by all parties involved, which may lead to breakdown, (meta-) meta-discussion, etc.

Summarizing the validity claims as applied to meta-communication:

| | |
|---|---|
| *power:* | *X means Y because I say so* |
| *truth:* | *X means Y because that's the way it is* |
| *truthfulness:* | *X means Y because I can't imagine anything else (so that's the way it is)* |
| *appropriateness:* | *X means Y because everyone uses X that way (so that's the way it is)* |
| *comprehensibility:* | *You know what 'mean' means* |

But what about the meta level in meta-communication? Should communicational rules and norms be community based or may they be enforced by a power-exerting party? "*Can* we make words mean so many different things?" Discussion of such norms and rules applying to meta-communication, whether they exist in a particular context or in general use, is *meta-meta-communication*.

Whereas various claims are made in meta-communication, we do not know yet whether there is one claim that prevails. To answer this question, we will proceed by first discussing some types of word definition.

## 2.3 Definition as a Speech Act

One of the central activities in meta-language discussion is *definition*, most typically definition of word meaning. Quite appropriately, this immediately calls for a definition of 'definition'. Here is a nice one taken from (Vanderveken 1990; also mentioned in Viskil 1994:134) (although we will see shortly that it lumps various different kinds of definition together in one):

> "*To define is to declare, by way of stipulating, the meaning of a word in a certain linguistic context (e.g. a text or a conversation). From the moment of utterance, the word or phrase defined is taken to have the meaning*

> *thereby given (propositional content condition).* […] *A definition can fix the sense as well as the denotation of a linguistic expression.*"

Below we present a speech-act related, functionalist view on definition as put forward by Viskil (1994), as a concluding part of his elaborate and in-depth discussion of definition. Some of the findings mentioned by Viskil (most relevant to this paper) are:

> "Precision of definition is always connected to a certain goal or a certain context. No statement can be expected to hold absolutely or universally; only that it is precise enough for the goal and context for which it was brought forward" (1994:3) [translated from Dutch].
> "The break-off point of definition is determined intersubjectively: language users participating in communication together decide whether enough clarity has been achieved –for what they want to achieve" (1994:3).

Viskil, after a thorough comparison of many accounts of definition, distinguishes four main types of definition:

**Stipulative definition**: speech-act type = *language use clarification*; records word meaning with the purpose of clarifying (statement). For example, "With X, I mean Y"; the definition concerns a particular instance of use of a word; the person defining describes subjectively what the word means to her.

**Lexical definition**: speech-act type = *language use assertion*; describes word meaning as attached to a word in usage by language users (observation). For example, "In Dutch, X means Y"; the definition concerns the meaning of a word as it is perceived by 'people in general'; de person defining takes an objective attitude.

**Stipulative-lexical definition**: speech-act type = language use *clarification through language use assertion*: combines stipulative and lexical definition in that it is an assertion (statement) about word meaning explicitly grounded in observed usage. For example: "X means Y in Dutch, and therefore it also means Y in this particular case"; the definition concerns a particular instance of use of a word, but the person defining chooses to stick to the 'common' meaning; the subjective agent conforms to previous objective observation defined meaning, usually as expressed in some authoritative dictionary.

**Factual definition**: speech-act type = *assertion*; empirical description of a fact; not meta-language. A definition-like description is used to explain some object, situation, state, process, etc.; however, such a definition has no meta-communicational function.

Further discarding factual definition (which does not concern meta-communication), there are some interesting relations between various aspects of meta-language as previously discussed and Viskil's definition types:

| ***definition*** | ***scope*** | ***prevailing claim*** | ***TPM layer*** |
|---|---|---|---|
| **lexical** | general | Truth | discourse |
| **stipulative** | in context | Truthfulness | discussion |
| **stip-lex** | in context | Appropriateness | discussion |

Figure 2: Relations between definition types and some meta-communication properties

We distinguish discussions on the meaning of a concept from discussions on the reference of a term. In [Weigand and Hoppenbrouwers, 1998], it is argued, in line with Functional Grammar, that a speaker uttering a term performs many linguistic acts: he not only utters words, but also (by uttering a word or idiom) *evokes* a concept and (by expressing a term, consisting of a category and restrictors) *refers* to some entity (that satisfies the conditions that the speaker puts into the term). A question about concept evocation is a question about meaning (definition). A question about the reference of a term is a question about denotation (interpretation).

According to Vanderveken (see above), the illocutionary force of a definition is declarative. This would imply that a definition does not make a truth claim. In the next section, we will go into the nature of a definition, which is closely intertwined with our view on knowledge and concepts.

Without going into the detail here, we must remark that in organizational contexts, definitions are often heavily loaded with normative statements. Think about the definition of an employee, or of a staff member. If a definition influences the obligations and authorizations of the members of the organization, then the definition makes a claim about the appropriateness or rightness of these obligations. A discussion about such a claim has to be distinguished from a conversation for clarification proper.

## 3. Conversation for Clarification

We will now elaborate on some mechanisms fundamental to conversation for clarification. As mentioned, interpretation in context involves *implicit* information concerning that context, which is not carried by language as such. To clarify the link between implicit (tacit) and explicit interpretation, we will present helpful

ideas put forward by [Polanyi 1958, 1969] concerning tacit and explicit knowledge. We take Polanyi's view on knowledge and its tacit component as a starting point.

### 3.1 The tacit dimension

When developing their hypotheses regarding knowledge creation, [Nonaka and Takeuchi 1995] draw heavily on the distinctions between explicit and tacit knowledge made by Polanyi. It should be recognized, however, that Polanyi assumes knowledge to exist on a spectrum where *all* knowledge has a tacit dimension. 'Tacit' is opposed to 'explicit' or 'conscious'. "We can know more than we can tell" [Polanyi 1958:95]. The reason for this is that knowledge, according to Polanyi, is first of all acquired by our body and the daily activities we are engaged in. Therefore, it is not only often impossible to externalise this knowledge – think of an attempt to explain someone how to ride a bike – but also not desirable. Knowledge is something that resides within us, and manifests itself through our actions, and we therefore do not *need* to document it for our own sake. We just use it. Should we have to express our tacit knowledge in words, it would not be for our own sake but for the benefits of someone else in our organization or community. Again, according to Polanyi, all knowledge has a tacit dimension. For riding a bike, this dimension prevails. But in many organizational tasks, there is both a tacit and an explicit dimension; the explicit dimension (e.g. business rules) lends itself to inclusion in an automated system.

According to Polanyi, tacit knowledge has two distinct properties: *distal* and *proximal* (also see [Stenmark, 2000]). The proximal term is the part that is 'closer' to us, while the distal part is 'further away'. He exemplifies this by describing how the police helps a witness who is unable to describe a perpetrator to create a phantom picture by selecting pictures from a large selection of human features such as eyes, noses and hair. By attending *from* the first, closer image that resides within (tacit), *to* the second, more distant picture collection, the witness is able to communicate her awareness of the face.

What does this mean for language? Polanyi views language as just another bodily action [Polanyi 1969:193]. It also involves relying on our subsidiary awareness of some things (for example, the syllables) for the purpose of attending focally to a matter on which they bear (the sentence meaning). Only in the case of a breakdown, the speaker can focus his attention on certain parts, but then he cannot focus anymore on the whole. However, Polanyi also accepts at least a weak form of the Whorfian view that our thinking is heavily dependent on language:

> "*In learning a language, every child accepts a culture constructed on the premises of the traditional interpretation of the universe, rooted in the idiom of the group to which it was born, and every intellectual effort of the*

> *educated mind will be made within this frame of reference. Man's whole intellectual life would be thrown away should this interpretative framework be false*" [Polanyi 1958:112].

Yet this commitment to the centrality of language in our thought does not make him a logicist. In relationship to our tacit knowledge of concepts as proximal term, language is the distal term. It provides clues for the communicating subjects, but does not describe the meaning exhaustively. This holds both for normal sentence meanings and for lexical definitions. In our view, Polanyi in this respect comes very close to the functionalist perspective on language [also see Hoppenbrouwers 2000].

According to Dik's Functional Grammar [Dik 1989:81-], meaning definitions are to be given in natural language and he discards any logical description of conceptual meaning in some formal meta-language. The problem with these meta-languages is not only that they need to be grounded again, since it cannot be maintained that they are self-evident, but also that they ignore the tacit dimension and *assume* from the outset that a set of necessary and sufficient meaning conditions can be found. Dik supports the use of meaning definitions in natural language but emphasizes that these definitions will not provide an exhaustive definition. We could say that the criterion is not whether the concept is described completely, but whether it is *described sufficiently for linguistic purposes*. We call this the functionality principle. For a structuralist this would mean: in order to be able to distinguish the term from sister terms. For example, in the definition of "lending" as opposed to giving or selling, the features "for money" and "temporarily" are significant. In the spirit of Polanyi the functionality principle would mean: in order to be able to communicate and evoke the right tacit knowledge: "*is it a useful clue?*" As far as lexical definitions are concerned, Polanyi can afford to be quite liberal. A metaphor or story can be as revealing as a list of properties. He can be that liberal because the definition is jus¸ a vehicle for communication and thinking, not a complete articulation.

Finally, it must be remarked that Polanyi is still a realist. Not in the Platonic sense, believing that concepts exist somewhere outside as ideal entities, but in the sense that the structure and order of (tacit) knowledge reflect structures and orderings in reality. *In that sense, definitions make a claim to truth*. An example [Polanyi 1958:111] is the scientific discussion in the 1930s on the definition of isotopes after the discovery of heavy hydrogen. Heavy hydrogen did not obey the meaning conditions of isotopes as elements chemically inseparable from each other. But the result of the discussion was that it was generally felt that hence the definition should be modified or, one could say, sharpened. "This demonstrates the principle which must guide us when adapting the meaning of words, so that what we say shall be true: the corresponding conceptual decisions must be right- their implied allegations true". In the course of time, meanings are adapted when we

learn more. “Languages are the product of man’s groping for words in the process of making new conceptual decisions, to be conveyed by words”.

### 3.2 Semantic Reassurance

Depending on the argumentative framework that is used, different foundations of discussions about meaning will be deemed necessary or satisfactory. Very often, just exchanging statements (‘X means Y’) is enough to reach consensus (often it is really just clarification: one party asking for more information). In this case, the argumentation form (using Toulmin’s theory of argumentation) is as follows:

```
Claim
      ->  X means Y
Data (on wich the claim is founded)
      -> X evokes Y with me
Warrant (fundamental, non-inferential justification)
      -> Paraphrasing (Xp) shows recurrent evocation of Y by Xp.
```

‘Proof by paraphrasing’ is subjective, but a sincere person will be honest in answering the question ‘do X and Xp both mean Y for me’. Semantic claims on an individual level are never decisive. Semantic claims on a social level may be, but authority is then derived by quantitative means (enough people agree).

Individual meaning is very much association-based. A certain sign evokes a certain association (the proximal term). Also, this is a matter of *explicitness*: a concept can only be ‘seen’ once it is made explicit through some sort of language, where we hope that this representation evokes the same interpretation as intended. Note that some degree of dissatisfaction in explicitly expressing some concept is commonplace.

A primary way of making ‘sure’ that X means Y for an individual, or rather means Y for *various* individuals (the communicating parties), is to express the particular bit of meaning in various ways, not only directly but by various means of expression that all trigger a certain, important aspect of that concept. This includes semantic relations such as PART-OF, ISA, antonyms, etc. It is important to see that such exemplary conceptualizations are presented in the context (with the goal) of finding one isolated bit of meaning. Once enough examples intended to evoke a particular bit of meaning seem to indeed invoke a certain bit, the individuals will become more and more *reassured* that that particular meaning is meant. This all hinges around a question we assume every individual has, so to speak, in the back of her/his mind: how likely is it that all these different ways of evoking one specific association indeed render an identical association while it is still a ‘wrong’ association (i.e. differing crucially from that of the other party)?

If the conceptual meaning cannot be fixed in one step, a process of stepwise lexical decomposition [Dik, 1989] can be followed. This implies that some simpler underlying concepts are defined first. Once these are assured, they can be used to assure the meaning of the focal concept. Note that "simpler" does not mean "more abstract" (higher in a generalization hierarchy) but closer to the basic level of everyday knowledge.

Procedures to establish semantic reassurance presuppose that the person in question already knows the concept (or underlying concepts) tacitly. If this is not the case, the procedure will fail. The partners have to decide whether the issue is essential or can be ignored. If it is essential, some form of learning procedure must start, for example, by giving the person in question hands-on experience (real-life, by means of video, or a story). A good reason to ignore the issue could be reliance on the *division of linguistic labour*, as [Putnam 1975] called it. According to Putnam, ordinary people do not know the exact procedure to determine the true extension of concepts such as "gold", or "uranium", but they still distinguish these concepts because they rely on the fact that experts, such as chemists, have a means to keep them apart.

## 4. Meta-communication and ICT Systems Specification

As we have seen, meta-communication very directly concerns communication about 'communication tools'. Considering communication tools at large (including the whole range from NL to specialised ICT applications), there is a gliding scale from quite generally applicable tools (e.g. the basics of NL) to highly specialised tools (like a database or a workflow engine) which support a very particular kind of situationally adjusted communication. In principle, every IC system can be seen as a complex communication tool dedicated to specific purposes [cf. Winograd and Flores 1986:155]; a purpose-specific language. Therefore, talking *about* communication systems functionality falls under our definition of meta-communication, more specifically ex ante meta-communication. Though it is has not been so explicitly stated in the LAP literature, this idea has always been an implicit part of the LAP enterprise. However, making it explicit, and looking at it more closely, some questions come to mind as to how meta-communication relates to system specification and design.

Winograd and Flores make it clear that anticipation and prevention of communication breakdown should be at the core of IC system design. Meta communication is an inherent part of the design process of any information and communication system. A system, being fixed (a text), dictates the language that system users have to work with; design of such a system involves ex ante discourse about and construction of that language.

[Winograd and Flores 1986:156]: "In a computer-mediated system (as opposed to direct communicational action), it is difficult to maintain […] the potential for a

dialog in the face of breakdown". [1986:158]: "New computer-based communication technology can help anticipate and avoid breakdowns. It is impossible to completely avoid breakdowns by design […]. But we can partially anticipate situations where breakdowns are likely to occur […] and we can provide people with the tools and the procedures they need to cope with them."

However, practical consequences for IC system specification and design derived from this perspective only include anticipation of breakdown (ex ante meta-communication). Yet in any situation where background information and interpretation play a role, breakdown threatens [also see Hoppenbrouwers 2000]. Given that in such situations, breakdown can not always be accurately predicted, ex post meta communication should be considered as a potential solution to the problem.

In view of a growing demand for more flexible IC systems, it becomes more and more interesting to provide means for the user to specify (where necessary and if possible) certain properties of the system she works with. For example, specification of ad hoc workflow [cf. Hoppenbrouwers, in progress] and other ad hoc activities cannot be expected to be a part of the design phase.

It is neither possible nor desirable to explicitly conceptualise and communicate at every level of abstraction. For example, for a piano player to make explicit and talk about all her intricate finger movements is not only of little use, but it also interferes with her capacity to play fluently. Explicit conceptualisation may raise barriers for some types of action, for example those involving our muscular and nervous systems at a very low, 'physical' level. Care should be taken that such a level is not touched upon in conceptual system specification, but that only higher levels of abstraction are entered which lend themselves to constructive linguistic expression.

If specification of IC systems is considered in view of specification techniques that are currently common practice (e.g. formal conceptual modelling, scenario-based requirements engineering), it may well seem a rather naive idea to introduce 'run-time specification' by users rather than pre-use design and iterated upgrades. However, there are opportunities for the development of techniques for the support of more informal meta-communication. Such techniques might aim for semantic reassurance in a controlled and goal-oriented, systematic way, building on previously determined concepts engrained in the system. Feedback of such discussion level meta-communication may eventually be carried on at discourse level (involving system managers) and so influence the more fundamental system specifications *inspired by actual use of concepts*, but it may also simply play a role in the solution of 'local' breakdown due to violation of comprehensibility.

In [Schoop 1998:129] it is claimed that "In routine interaction, comprehensibility problems are usually solved by rephrasing and translating. These problems can be easily overcome in face-to-face communication. However, if communication takes place via a written document, there is no simple solution

for comprehensibility problems. There must be some kind of rephrasing according to the different requirements in order to avoid a breakdown due to non-comprehensibility." As a solution of observed problems of this kind in a case involving digital communication between two professional groups (doctors and nurses), [Schoop 1999:65] proposes a 'translation system' taking care of terminological differences between the groups. Such a translation system is an excellent example of an application that both takes the communally determined language apparatus seriously, and will involve a great deal of (ex ante) meta-communication to develop. As argued, however, a translation system will still fail in some circumstances requiring immediate response to breakdown. In such cases, a dedicated system helping agents involved in reaching quick semantic reassurance or possibly a working definition may be very valuable indeed.

Run-time specification of meaningful structures used in communication can be expected to become an increasingly desirable capacity of IC systems as inter-organisational and distributed digital communication increases (e-business, inter-organisational workflow, etc.). While run-time specification cannot be expected to work miracles (given the limited capacity, motivation and resources of most users as well as implementation problems), it may push systems into a level of flexibility and semantic accuracy not achievable through traditional 'pre-specification' in the design phase. Once we understand the basic problems facing run-time specification in an IC systems context, which concern (at least in part) meta-communication, we may be able to develop dedicated support mechanisms for it. Some of our future research will develop along these lines. Note, however, that we consider it absolutely vital for such a discussion-level mechanism to be closely linked to discourse level and pre-specification, both procedurally (in terms of system modelling and maintenance) and conceptually (conforming to and complementing the more rigid, formalised conceptual structures of the system).

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# Reassessment of the Action Workflow Approach: Empirical Results

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## Abstract

The goal of this paper is a reassessment of the Action Workflow approach, a well-known application of the Language Action Perspective (LAP). Based on empirical work, we will assess the Action Workflow approach with reference to its suitability for the modeling of business processes. Three case studies are presented, and the *Guidelines of Modeling* developed by Becker et al. [Becker et al., 1999] are applied to the Action Workflow approach. We discuss advantages as well as shortcomings of the Action Workflow.

## 1 Introduction

The Language-Action Perspective (LAP) has received much interest in the field of information systems. The first computer-based application of LAP is the Coordinator [Flores et al., 1988, Winograd, 1988, Winograd and Flores, 1986]. It aims at supporting communication in an office setting. In the early 90s, when business process modelling and redesign became an important research topic, the Action Workflow methodology [Medina-Mora et al., 1992, Schäl, 1996, Schäl, 1998] which is based on many characteristics of the Coordinator was developed. The goal of this paper is a reassessment of the Action Workflow approach. We will discuss its suitability

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as a method for the modeling of (cooperative) business processes. The evaluation is based on empirical work that was performed during the research project *AdCo*. In this paper, we will present some results of the application of the Action Workflow approach to some case studies, as well as an assessment of the approach based on the *Guidelines of Modeling* (*GoM*) [Becker et al., 1999].

It will be shown that the Action Workflow approach has been useful for the modeling and analysis of business processes, but has several drawbacks. For example, it is not intuitive to understand but rather rather difficult to explain to process stakeholders. Due to the lack of an exact (formal) semantics, modeling is difficult. Several characteristics of existing business processes such as temporal aspects, multilateral workflows, missing workflows, etc., cannot be represented.

The structure of the paper is as follows: Section 2 gives a brief overview of the Action Workflow approach and its relationship to the Language Action Perspective (LAP). Section 3 describes the application context in which we employed the Action Workflow approach. In section 4, we present our case studies and their results, as well as the results from the application of the *Guidelines of Modeling* to the Action Workflow approach. Section 5 contains the lessons learned from these case studies, and section 6 concludes the paper.

## 2 The Action Workflow Approach

The broader context of the present work lies in the so-called Language-Action Perspective (LAP). LAP is based on theories of communication and focuses on communication aspects in information systems. In LAP it is argued that language is used to coordinate actions, an experience that was made during the case studies that will be described in the following sections. This section introduces the Language-Action paradigm and one application that forms the basis for the present work.

### 2.1 The Language-Action Perspective

The Language-Action Perspective was first introduced in the field of information systems in 1980 by Flores and Ludlow [Flores and Ludlow, 1980] who stated that human beings are fundamentally linguistic beings and act through language. It was argued that language is not only used for exchanging information as in reports, statements etc. but also to perform actions, e.g. promises, orders etc.

The conventional perspective on information systems stresses the contents of messages rather than the way they are exchanged [Lyytinen and Lehtinen, 1984]. For example, data flow diagrams are used as primary design tools. Thus, the focus is on the form and structure of messages. In contrast, the Language-Action Perspective emphasises what people *do* while communicating, how language is used to create a common reality for all communication partners, and how their activities

are coordinated through language. Here, the focus is on the pragmatic aspect of language, i.e. how language is used in particular contexts to achieve practical goals such as agreements or mutual understandings. This new approach argues that as social action is mediated through communication, the main role of an information system should be to support organisational communication. LAP has since developed into a new paradigm for the design of computer systems.

The early work on LAP is based on Searle's Theory of Speech Acts [Searle, 1969]. As a result of criticism of the shortcomings of Searle's theory (e.g. [Dietz and Widdershoven, 1991, Suchman, 1994]), Habermas' Theory of Communicative Action [Habermas, 1981] is nowadays combined with Searle's theory as the philosophical foundation of LAP.

There are a number of basic assumptions underlying LAP [Lyytinen, 1985, Verharen, 1997], e.g.:

- The basic unit of communication is a speech act.
- Natural language sentences correspond to the performance of speech acts.
- The meaning of sentences can be revealed by specifying the speech acts that have been performed.
- Speech acts obey socially determined rules.
- Cooperative work is coordinated by the performance of language actions which are speech acts.

The Language-Action Perspective is not merely a philosophical framework but has stimulated the development of a number of methodologies and computer-based tools. Some of these applications deal with communication support (e.g. [Schoop, 1998, Schoop, 1999, Schoop and Wastell, 1999, Verharen et al., 1996, Verharen, 1997, Winograd, 1988]) while others are concerned with business process modelling and business process redesign (e.g. [Dietz, 1994, Lind and Goldkuhl, 1997]). Next the Action Workflow approach will be introduced as one application of LAP that is relevant for the present work.

### 2.2 Action Workflow

In the present section, we will concentrate on the service-oriented business process modeling approach described by Schäl [Schäl, 1998], which is based on the Action Workflow approach. Action Workflow [Medina-Mora et al., 1992] is a generic methodology for the design of workflow management systems and also the name for a supporting software tool. It can be seen as an expansion for the area of business process redesign of the first computer-based application of the Language-Action

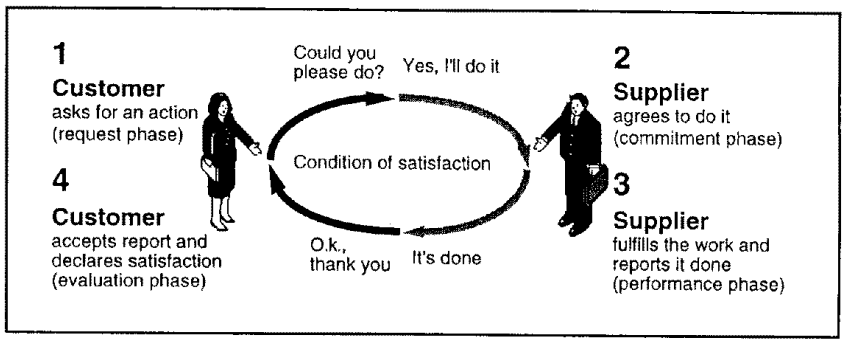


Figure 1: Action Workflow Loop [Schäl, 1998]

Perspective, i.e. the Coordinator [Flores et al., 1988, Winograd, 1988, Winograd and Flores, 1986]. Like the Coordinator, the Action Workflow methodology uses speech acts classified according to Searle, conversations as sequences of such acts, and an explicit representation of these elements [Medina-Mora et al., 1992]. Following the general philosophy of the Language-Action Perspective, the focus in Action Workflow is not on tasks but on the speech acts that constitute these tasks.

The main element of the methodology is the *Action Workflow* loop as shown in figure 1. The loop represents the so-called conversation for action as described by Winograd and Flores [Winograd and Flores, 1986, Winograd, 1988]. An interaction begins with the *request phase* where the customer requests an action to be performed by the supplier (or the supplier offers to perform a certain action). This is followed by the *commitment phase* where the two parties agree on the conditions of satisfaction that will guide the interaction including a time for completion. In the *performance phase* the supplier reports the performance of the action to the customer who then declares satisfaction in the last phase of the interaction which is the *evaluation phase*. The action itself is not modelled. The first two phases aim to establish a commitment for the supplier whereas the last two phases aim to establish satisfaction of the customer with the action performed by the supplier. In speech act terms, the customer's request is a *directive*, the supplier's commitment is a *commissive*, the supplier's report is an *assertive*, and the customer's evaluation is a *declarative* speech act.

At all stages there can be discussions, clarifications, further actions etc. Different loops can be related to each other, as shown in figure 2. The request phase can initiate interactions aiming at *clarifying* certain aspects of the customer's request, i.e. solving comprehensibility problems. Before a supplier commits himself or herself to an action requested by a customer, negotiation usually takes place, e.g. by means of counteroffers. This is represented by the separate *negotiation workflow* in figure 2. During the performance phase, the supplier can decide not to perform the action himself or herself but to delegate it to another supplier. In this case, the

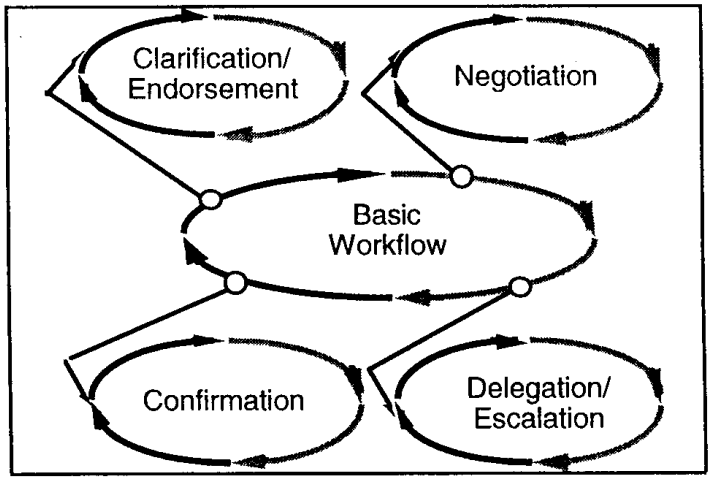


Figure 2: Complex Action Workflow [Schäl, 1998]

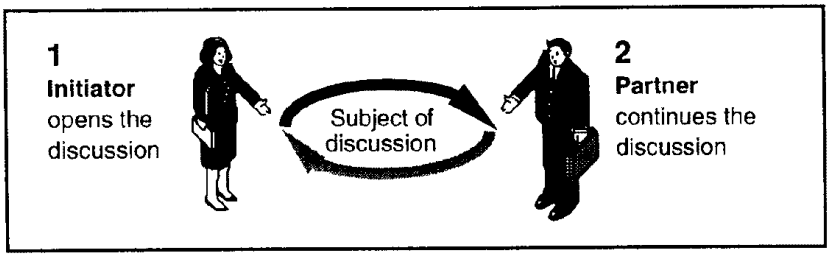


Figure 3: Declaration Workflow Loop [Schäl, 1998]

supplier now becomes the customer in the *delegation/escalation workflow*. Finally, the evaluation phase can initiate a *confirmation workflow*.

Apart from the conversation for action, there are other types of interactions. The so-called conversation for possibilities which speculates about future conversations for actions and might initiate them is represented in the Action Workflow methodology by the *Declaration Workflow*, see figure 3. It consists of two phases, i.e. the *initiation* of the discussion by the initiator and a *continuation* of the discussion by the other discussion partner.

In the following sections, we will present results of empirical studies using the Action Workflow approach. Based on the empirical findings, and a framework for assessing the quality of a modeling process, the advantages and shortcoming of this approach will then be discussed.

## 3 Application Context

We have evaluated the Action Workflow approach by applying it to case studies from the BMFT project *Regionale Kooperationskompetenz* (*AdCo*).

The project *Regionale Kooperationskompetenz*, or Advanced Cooperation, *AdCo*, was funded from October 1996 until June 1999 by a BMBF grant in the *Produktion 2000* framework. The main objective of the project was the introduction of interorganizational cooperation as one strategy to small and medium-sized enterprises (SMEs). SMEs characteristically have few resources for mid- to long-term strategies such as cooperation [Jarke and Kethers, 1999]. Consequently, SMEs often have little or no experience with cooperation, although they can benefit significantly from cooperating.

The project participants were eight companies that can be classified according to the taxonomy in [Pfohl, 1997, Kayser and Ibielski, 1986] as one small company, one large company, and six medium-sized companies. None of the companies had cooperated with any of the others before, and in general, the companies had not had much contact with the others.

In addition to the companies, several researchers and companies aiming at supporting the companies' cooperation efforts were involved in the project, including the Information Systems Group, RWTH Aachen.

Over the course of the project, several of the companies found that they did not know enough about their own processes to be able to cooperate efficiently with other companies. Therefore, four of the companies wanted to have one of their key business processes (either product development or complaints handling) evaluated by us.

As most companies had documented their processes in an activity-oriented fashion only, we decided to consider the processes from different angles so that problems and bottlenecks would become more visible. One of the process modeling methods which we applied to the process in order to develop a service-oriented model, is the Action Workflow approach as described in section 2.

We performed four case studies, one dealing with complaints handling, and the other three focusing on the product development process. The first one is described in more detail in the following section.

## 4 Case Studies

### 4.1 Research Design

This section describes the research design employed in the case studies reported below. The case studies consisted of a group session, which was performed at the respective company, and the preliminary examination of documents related to the companies and their business processes. Before these group sessions, we collected

some information on the respective companies, e.g. organizational charts, and process flowcharts. We also discussed the list of participants with the person who had contacted us about the analysis.

Each group session had about nine to eleven participants, viz. six to eight employees of the company, as well as three researchers from the Information Systems Group, who acted as observer-as-participants. One of the researchers facilitated the session, while the other two recorded the minutes of the session and any ensuing discussions.

This type of group session was not part of the employees' normal work, although in the case of company 1, the case study participants were members of a working group aiming at improving the complaint management process, and had been holding regular meetings discussing the process for some months.

The case studies and their locations are described in more detail in the next section.

### 4.2 Case Study 1: Complaint Management

Company 1, a medium-sized medical engineering company, approached us to have their complaint management process reassessed. The company had previously realized that the process was far from perfect, and had established a working group for the reengineering of the complaint management process. Members of this team came from most departments involved in the process. In the course of this case study, a first analysis of the complaint management process was performed (cf. [Kethers, 2000]), which motivated the group to redesign the process. The redesigned process was documented in a flowchart, and reviewed by us. For the purposes of the review, we decided to apply Schäl's service-oriented modeling approach (as described in section 2) to the process. We derived the service-oriented model from the process flowchart and discussed it with the members of the working group in a facilitated group session, as described above.

An excerpt of the process flowchart, depicting the start of the process, before the actual service, repair, or complaints handling process is initiated, is shown in figure 4. A corresponding excerpt of the service-oriented model is shown in figure 5. As indicated in figure 5 (but not easily seen in figure 4), the process steps shown belong to the *request* phase of the main process workflow, `deal with defect product`.

Both figures show only the first few steps in the process; after the product has been identified, classified, and registered by the `CH` department, either a service, a repair, or a complaints handling process is triggered. This and the following process steps then form the *commitment*, *performance*, and *evaluation* phases of the main workflow.

As can be seen from the two figures, even this small excerpt from the flowchart

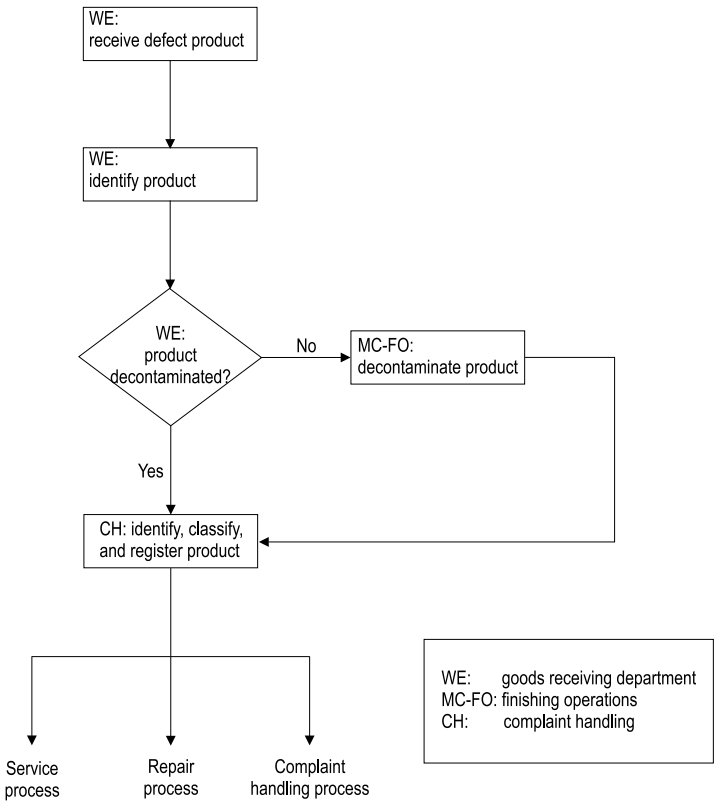


Figure 4: Flowchart of the redesigned process (excerpt)

results in several questions that need to be resolved before a full service-oriented model can be developed:

- Who are the actual customer and supplier of the main workflow, `deal with defect product`? The flowchart suggests that the `WE` department is the main customer contact; however, the actual main customer contact is the sales department that does not enter the process until after the product has been identified, classified, and registered.
- Does the `WE` department get to know whether the product has been successfully decontaminated and forwarded to the `CH` department? Does `WE` need to keep track of this?
- Obviously, `WE` forwards the product to `CH`, but who makes the `CH` department identify, classify, and register the product? Who is informed of the result?
- There is hardly any exception handling. Consider e.g. the case that the product cannot be identified. Does the `CH` department contact the customer? There is

no information about this in the flowchart.

- Who decides on which process needs to be initiated after the registration of the product? What happens if this decision is later revoked?

The service-oriented model [Schäl, 1998] helped us to detect these open issues. In addition, the model showed us several other potential problems with the process.

For example, a characteristic of the process is that there is a large amount of workflow loops, which means that the process is potentially very slow. This cannot easily be seen on the flowchart. In addition, hardly any of the workflows contain an evaluation phase, i.e. feedback is missing from nearly all subprocesses.

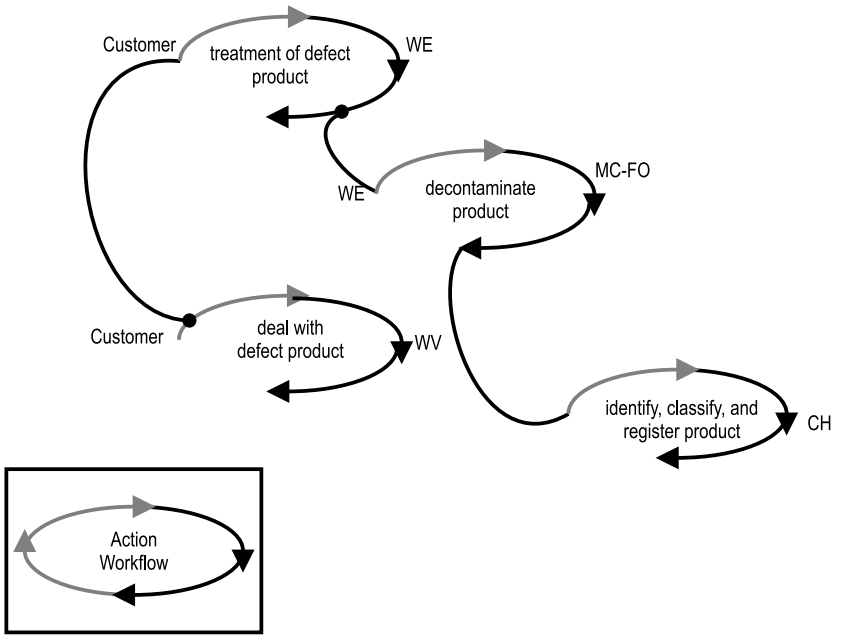


Figure 5: Service-oriented model of the redesigned process

Based on the service-oriented model of the process, we developed the following recommendations that were then discussed with the working group members. On a general level, we recommended that all workflow loops should be complete. In particular, all action workflows should have feedback loops so that the supplier gets to know about the customer's satisfaction or dissatisfaction with the supplier's performance. Furthermore, the customer should only have to deal with one person at the company ("one face to the customer") as recommended by e.g. [Schäl, 1998]. This person, representing the main workflow's supplier from the main workflow customer's point of view, should be trained to deal with complaints, and should be responsible for completing the processing of the complaint. For this, she needs to be kept informed about the state of the process.

During the group session, two alternatives were proposed for the new process. Figure 6 shows the process after its redesign which has been focusing on operational aspects. This process focuses on operational aspects, and is suitable for repair processes in particular. The customer deals with the custom service technician, who is responsible for delivering the defect product to the goods receiving department, and acts as the internal customer for the secondary workflows, with the exception of the `deliver product and bill` workflow, which is initiated by the RS department..

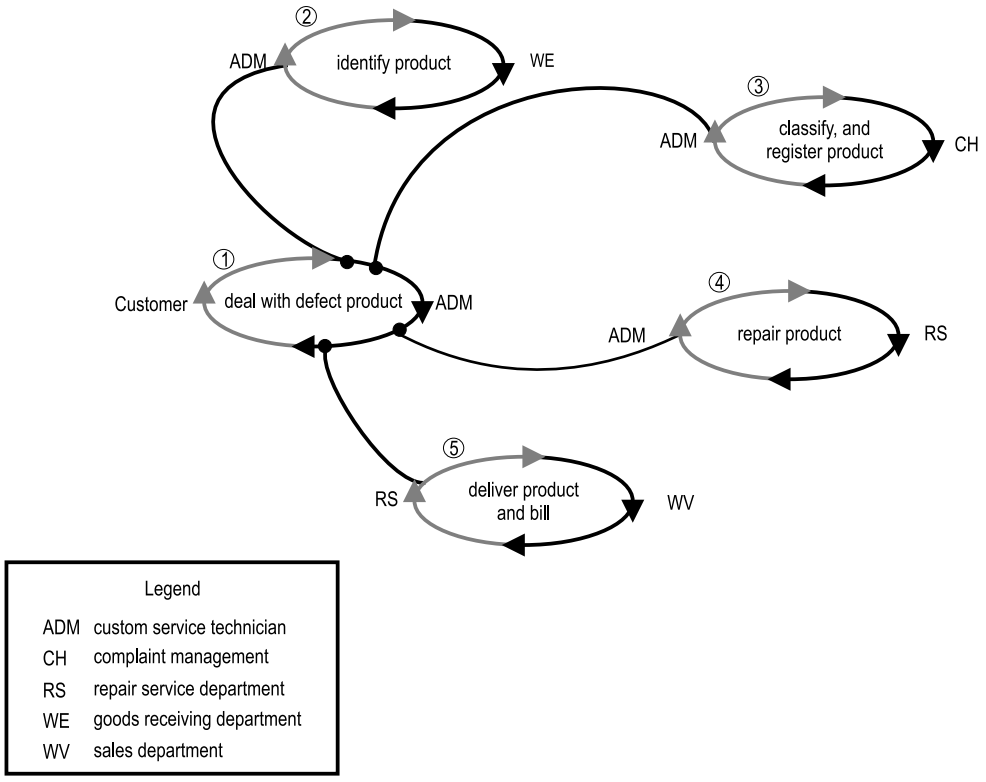


Figure 6: New service-oriented model of the redesigned process (operational)

Figure 7 shows the process after its redesign which has been focusing on knowledge management aspects. In this case, the customer deals with the quality assurance department, QAR, which is primarily responsible for managing complaints. The sales department initiates the actual repair process, but the quality assurance department is always being informed about the state of the process, and collects all information on the actual problems with the product, which are then used for administrative and legal (e.g. notifying the appropriate legal bodies) as well as technical (e.g. notifying the development department, and discussing potential improvements to the product) purposes.

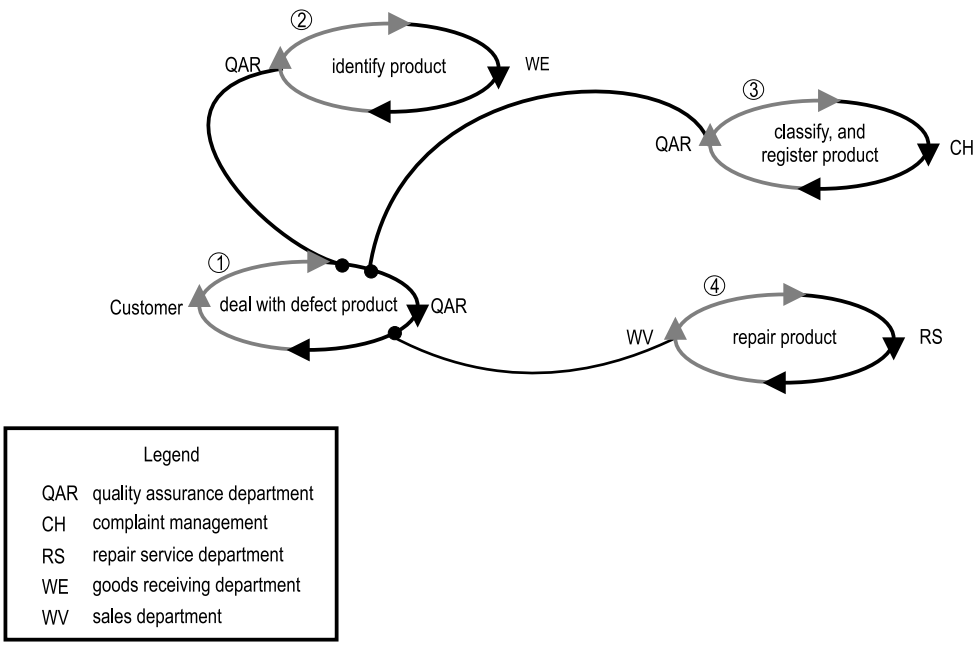


Figure 7: New service-oriented model of the redesigned process (knowledge management-oriented)

Both process models contain only closed loops, and the roles of the individual process stakeholders have been defined more clearly. The working group found the models enlightening, and revised their flowchart accordingly.

The following section briefly describes two further case studies that were performed in the context of the *AdCo* project.

### 4.3 Case Studies 2 and 3: New Product Development

Two more case studies, dealing with the product development process, were performed at other companies. Case study 2 was performed at company 2, a relatively young company, both in terms of company age, and of average employee age. The company was founded as an engineering office in 1988, now has offices in the USA, Singapore and Taiwan, and has experienced an explosive growth during the last 3 years. The number of employees more than doubled, and many changes were necessary so that this rapid growth could be dealt with. The company had been extremely successful so far, but now thought that they needed to reconsider their business processes which were less well-defined and formalized than was now felt necessary.

Company 3 is also a relatively young company that was founded as joint venture of two well-established companies. The company has a relatively stable size, and its processes are well-defined and well-established. The product development process,

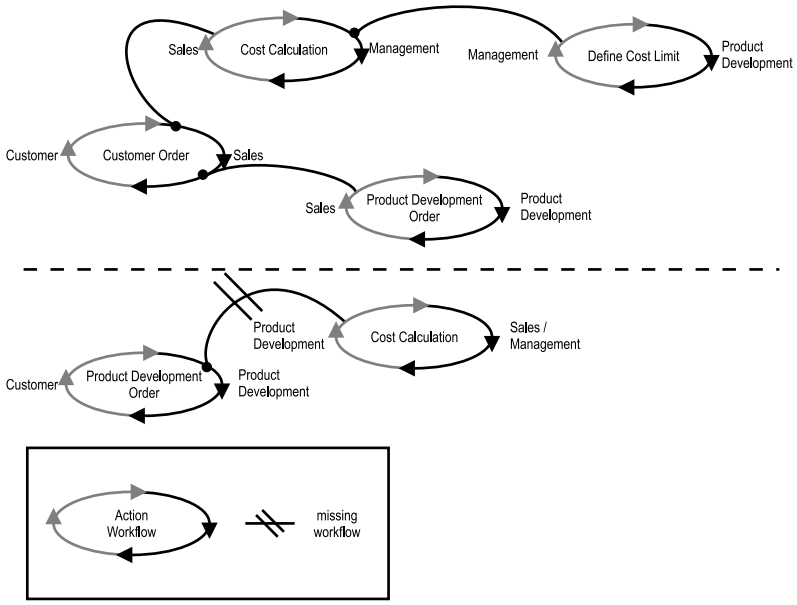


Figure 8: Service-oriented model of the Product Development Process [Jarke and Kethers, 1999]

however, is rather complex due to the fact that the company produces a large amount of product variants.

In the course of the case studies, both companies found that there were problems with reference to the fulfilment of the customer's wishes. Figure 8 contrasts excerpts from the service-oriented models of Company 2's and Company 3's product development process, respectively. The upper part of the figure shows Company 3's way of dealing with customer requirements. As the sales department deals with the customer exclusively, any changes that the customer wishes for are first transmitted to the sales department. The sales department then calculates the costs of the change request. The company management determines the budget limitations for the request, and informs the product development department. Meanwhile, the sales department gives the corresponding order to the development department. This procedure is neither very flexible, nor quick, so that the customer is not always happy with this. In addition, the sales department does not always understand the exact technical implications of the customer's change request; thus, additional discussions with the customer and / or the development department can become necessary. Note that the fact that the calculation workflow might be quite slow cannot be deduced from the Action Workflow process model.

In contrast, Company 2 has a very flexible and fast way of dealing with customer change requests (cf. the lower part of figure 8): The customer directly contacts the product development department, and discusses her wishes with the design

engineers. The drawback of this, however, is that the sales department does not necessarily know about the changes, so that they cannot be included in the cost calculation, which means that the company possibly loses money. Thus, the cost calculation workflow with the product development department as customer, and sales and management as suppliers, is missing from the process. In figure 8, this is marked as "missing workflow"; as the Action Workflow is aimed at representing as-is processes, there is usually no way of representing such missing workflows, which are part of an intended process, but are not actually performed.

## 5 Critical Evaluation of the Action Workflow Approach

As we have seen, the Action Workflow aproach helped us to detect several shortcomings of Company 1's redesigned process, and has also been useful for capturing and representing company 2's and Company 3's respective interactions between customer, sales, and the development department. In spite of the usefulness of the Action Workflow approach, however, we encountered several problems when developing and presenting the service-oriented models.

To assess the Action Workflow approach, we have applied the *Guidelines of Modeling* (*GoM*) developed by Becker et al. [Becker et al., 1999] to the approach. These guidelines decribe a set of both general and user-specific recommendations aiming at increasing the quality of models by providing criteria that are beyond mere syntactic issues, as well as increasing the quality of the modeling process. The GoM consist of the following three mandatory and three optional principles:

- **guideline of correctness**. Correctness has a syntactical and a semantic aspect. A model is syntactically correct if it is both complete and consistent with reference to its corresponding meta model. Semantical correctness means that the model retains the structure and behaviour of the underlying real-life object system, hence has been correctly derived from reality. The consistency of different models is also important to the correctness of a model.

- **guideline of relevance**. A model follows the guideline of relevance if the model is less useful once information is removed. The usefulness of a model depends on the goals of the modeller and of the person(s) for whom the model has been developed, and is thus subjective. It also depends on the degree of abstraction that the model contains, and on the relevance (to the modeling goals) of the underlying university of discourse.

- **guideline of economic efficiency**. The guideline of efficiency refers to the economical aspects of the modeling method, and thus restricts the amount of time (and other resources) that can be spent on developing models. Due to the

lack of a cost-benefit analysis of modeling, there are hardly any methods for assessing the economic efficiency, however.

- **guideline of clarity**. Clarity refers to representational issues such as the structure, graphical representation, and general readability of a model. Terminological aspects (e.g. consistent naming), the quality of the description of the modeling method's elements and constructs, and model understandability (which may be in conflict with the model's syntactical correctness) are also important. The question of how well a model complies with the guideline of clarity can only be decided on by its respective users, hence is subjective.

- **guideline of comparability**. As correctness, comparability has a syntactic and a semantic aspect. Syntactic comparability postulates the compatibility of models that have been developed by means of different modeling methods. The principle of syntactical comparability implies that the meta models underlying the different modeling methods need to be integrated and harmonized. Semantic comparability aims at the comparison of models with reference to their semantic contents, e.g. "as-is models and to-be models or enterprise-specific and reference models" [Becker et al., 1999].

- **guideline of systematic design**. The guideline of systematic design requires well-defined, consistent relationships between models depicting a real-life object from different perspectives. Systematic design is achieved by means of a shared, cross-perspective meta model, and by enforcing the consistency of shared objects across perspectives

Models that have been developed by means of the Action Workflow approach fulfil several, but not all, of these guidelines. The syntactical correctness of a model can rather easily be determined. The semantical correctness is much harder to determine: first, the Action Workflow approach lacks an exact semantics - modeling is sometimes difficult in that it is not always clear what exactly a link to a secondary workflow, or a workflow phase, signify. Besides this lack of formal semantics, there is no exact definition of the *object* of the workflow. Therefore, the question of whether the condition of satisfaction for a workflow has been fulfilled cannot be easily answered. The fulfilment of the condition of satisfaction is decided on by the customer, during her evaluation phase, and will often depend on "soft" criteria, such as timeliness, or friendliness of service, which cannot be expressed by means of the Action Workflow approach. Thus, it is not easy to determine whether the model is semantically correct. Second, workflows always involve exactly two process stakeholders, viz. customer and supplier (in the case of an Action Workflow), or initiator and partner (in the case of a Declaration Workflow), respectively. In addition, the action workflow approach strongly focuses on the customer of the process [Goldkuhl,

1996], and only represents communication actions, not material actions [Verharen et al., 1996]. Thus, in case studies 2 and 3, the actual new product development activities (e.g. prototype testing, or production) cannot be represented. Another, potentially more serious problem is that the four phases of an Action Workflow are strictly sequential; hence, once e.g. the *performance phase* has been entered, there is no way of backtracking to the *committment phase*. We feel this to be a strong, and undesirable restriction. Consider e.g. the upper part of figure 8. In case product development finds that the customer request is more difficult (and hence more expensive) than expected during the actual *performance* of the product development order, or that a necessary component has increased in price, or is unavailable, how can negotiations with the customer be re-opened? In addition, there is no way of expressing alternatives. In figure 4, the process continues with either the Service, Repair, or Complaints subprocess. In the Action Workflow approach, the fact that there is a choice can only be expressed by means of separate workflow diagrams, each depicting one possible subprocess. Another drawback is that there is no way of expressing the timeliness of a workflow, as we have seen in figure 8.

The fulfilment of the guideline of relevance is supported by the Action Workflow approach; the Action Workflow's modeling elements represent relevant aspects of the process, and the resulting process models have proven useful to our goals of evaluating the respective business processes.

Fulfilment of the guideline of ecomomic efficiency is rather hard to determine, as there are hardly any criteria for its evaluation. In the context of our case studies, however, we found that the development of the actual model was often beyond the capabilities and interests of the process stakeholders, although they found the analysis of an existing service-oriented model that uses the Action Workflow approach rather intuitive. This is probably due to the fact that most process stakeholders in our case studies were either sales persons, or engineers, and both seemed to lean towards activity-oriented thinking. In any case, the process stakeholders needed external support when applying the Action Workflow approach.

Concerning the guideline of clarity, the Action Workflow models are well-structured, can easily be "read", and are less unwieldy than e.g. flowcharts. Although a tool for drawing the model would be useful, the process models can also be drawn by hand. The guideline of comparability is a bit more problematic, however: due to the lack of semantics (see above), comparison between models developed by means of the Action Workflow approach and other modeling methods is difficult. For the same reasons, the guideline of systematic design poses problems: As there is no exact definition of how a model is to be developed, there is no unique model for a given process. Hence, modeling is rather subjective, and strongly depends on the modeler's personal understanding of the process, point of view, and modeling goals. This subjectiveness can be counteracted by jointly developing and discussing

the model with the process stakeholders.

## 6 Conclusion

The Action Workflow approach has already proven suitable for business process modeling [Schäl, 1996]. We have employed the Action Workflow method for the development of service-oriented process in the context of several case studies, and have also evaluated the approach by means of the *Guidelines of Modeling* developed by Becker et al. [Becker et al., 1999]. We have found several strengths and weaknesses of the approach, most notably the lack of a formal semantics, and the non-intuitiveness of the approach's theoretical aspects, and have suggest several improvements of the method.

A more formal semantics definition should be developed that clarifies the interplay between the different phases and secondary workflows. A first such attempt has been made in [Kethers, 2000], where a Telos [Mylopoulos et al., 1990] formalization of the Action Workflow approach has been described. This formalization allows for the analysis of inconsistencies and weaknesses of a service-oriented model (and hence of the underlying process) by means of Telos query classes. In addition, the Action Workflow approach is integrated with three other process modeling methods, so that the guideline of comparability is better fulfilled. Furthermore, the object of the workflow needs to be represented in a more explicit and formal way so that the state of the workflow can also be analysed with respect to the condition of fulfilment of the workflow's condition of satisfaction.

In addition, we suggest a slightly extended syntax of the Action Workflow approach so that alternatives, the difference between intended and as-is processes, and temporal aspects of workflows can be expressed.

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# The Validity of Validity Claims: An Inquiry into Communication Rationality

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## Abstract

The communicative action theory of Habermas has been discussed and used within the research community of Language Action Perspective. The concept of validity claim is considered to be an important contribution. In his theory, Habermas has formulated three validity claims to be universal in communication: The claims for truth, rightness and truthfulness. A theoretical inquiry into the validity claim concept and the three validity claims is performed in the paper. A critical analysis is pursued based on communication examples from Habermas. The concept of universal validity claims is transformed to general communication claims. The truth claim is rejected as universal. Besides the claims emanating from Habermas several other general communication claims are formulated: Descriptive correctness, addressee relevance, respectfulness, deliberation, dialogical adequacy and argumentativeness.

## 1 Introduction

Information and communication can be studied from many perspectives. In the disciplines of organisational communication and information systems (IS) there is a growing interest for an action view on information and communication, e.g. [Dietz, 1994; Goldkuhl & Lyytinen, 1982; Ljungberg & Holm, 1996; Winograd &

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Flores, 1986]. Much of this interest emerges from speech act theory, which was originally formulated by [Austin, 1962] and later refined by several scholars. Among later contributions the best known seem to made by [Searle, 1969] and [Habermas, 1984]. The fundamental speech act thesis is that speech should be seen as a special kind of action. Speaking (and writing) is not just describing the world. There are many kinds of communication - e.g. promising, commanding, issuing, thanking - which can not be reduced to just describing. To promise is to *perform an act* of promise directed towards other people. According to this theory, all speech acts can be said to consist of two parts; one descriptive part (called locutionary or propositional aspect) and one part expressing the action character of the speech (often called illocutionary aspect). The interest from organisational communication and information systems in speech act theory rests on this fundamental thesis but is also oriented towards other aspects of the theory.

Many scholars foster an interest in the communicative action theory of [Habermas, 1984]. One important contribution made by Habermas [ibid] is the concept of validity claim. He states that the communication between a speaker and a listener is constituted by the existence of three universal validity claims: The claims for truth, rightness and truthfulness. These validity claims play a fundamental role in communication according to Habermas: ”The concept of communicative action presupposes langauge as the medium for a kind of reaching understanding, in the course of which the participants, through relating to a world, reciprocally raise validity claims that can be accepted or contested” [ibid p 99].

There are several IS researchers who have shown an interest in Habermas´ communicative action theory and his validity claim concept; e.g. [Dietz & Widdershoven, 1992; Reijswoud, 1996; Auramäki & Lyytinen, 1996; Schoop, 1999 and Eriksson, 1999]. These authors, however, seem to take the validity claim concept for granted. They all acknowledge the importance of it and they do not question it. They discuss but do not really question the different validity claims described by Habermas. If we should use the validity claim concept in theorizing around information systems and communication in organisational settings, then it is necessary to pursue a critical discussion concerning the validity claim concept. This is the *main purpose* of this paper; to critically examine the validity claim concept and the different universal validity claims put forth by Habermas. It is of great importance to critically investigate one of the key concepts within the theoretical underpinnings of the Language Action Perspective (LAP). This critical analysis will be done in the critical spirit of Habermas. It is outside the scope of the paper to discuss other theories in the field of communication pragmatics. The focus will be on the validity claim concept of Habermas.

# 2 The Concept of Validity Claim

## 2.1 Validity Claims in Habermas´ Communicative Action Theory

Validity claim is an important concept in Habermas´ theory of communicative action. [Habermas, 1984] is critical towards Searle´s ”speaker-oriented” theory. Instead of this one-sided view Habermas wants to establish a theory concerning communication as a way to reach a shared understanding. In order to arrive at such a shared understanding the speaker and listener must agree on universal validity claims raised in communication. ”A *validity claim* is equivalent to the assertion that the *conditions* for the *validity* of an utterance are fulfilled” [ibid p 38]. This view of Habermas is rooted in his view of communication as a rational enterprise. To be rational is to be able to present good reasons (grounds) for one´s action. ”Rationality is understood to be a disposition of speaking and acting subjects that is expressed in modes of behavior for which there are good reasons or grounds” [ibid p 22].

When a speaker is performing a speech act he is (often only implicitly) raising a number of validity claims. These validity claims can potentially be challenged by the listener. To accept a speech act the listener accepts the validity claims raised. Habermas presents three kinds of validity claims which he asserts to be universal: Claims to truth, normative rightness and sincerity. He also talks about comprehensibility as a validity claim. But this a more fundamental claim directly related to the use of language as a medium for communuication. Comprehensibility can be seen as a basis for the three other claims. If the speaker can not present a linguistically understandable utterance, then there is, by definition, nothing to understand and assess. The three universal claims are associated with the three functions of language which Habermas presupposes. He distinguishes three fundamental uses of language: The cognitive use, the interactive use and the expressive use [ibid and Habermas, 1979]. These three modes are rooted in Habermas ontology. He divides reality into three worlds: The objective world, the social world and the subjective world.

Each of the three claims is related to one basic function of language and also to one ”world” (table 1). Although there is this primary relationship Habermas asserts that all three claims are inherent in all speech acts. We relate to all these worlds at the same time when speaking or as [Habermas, 1979 p 68] puts it the different worlds ”come to appearance together”. In his analysis of validity claims, Habermas also reformulates the speech act classes of [Searle, 1979]. Habermas reduces these to three classes: Constatives, regulatives and expressives. A fourth class, imperatives, is related to strategic action where there are no validity claims, only claims to power according to Habermas.

The different validity claims raised in a speech act are assessed by the listener and he can accept or contest them. [Habermas, 1984] differentiates three levels of reactions in relation to a percived speech act: 1) ”The listener understands the utterance, that is, he grasps the meaning of what is said” [ibid p 297], 2) ”with his ‘yes’ or ‘no’ the hearer takes a position on the claim raised with the speech act, that is, he accepts the speech act offer or declines it” [ibid] and 3) ”in consequence of a an achieved agreement, the hearer directs his action according to conventionally fixed obligations” [ibid]. With his second level, Habermas has formulated an important operational principle for assessing validity claims. If a hearer accepts the validity claims, then he takes a ‘yes’ position. If a hearer declines any validity claim then he takes a ‘no’ position and when doing so he should present some ground for his rejection. What are the reasons for his rejection? I will use this principle for validity claims assessment in section 3 below when examining some examples of speech acts.

| **Validity claims** | **Functions of language** | **Worlds (domains of reality)** | **Speech act type** |
|---|---|---|---|
| Truth | Cognitive use | Objective world | Constatives |
| Normative rightness | Interactive use | Social world | Regulatives |
| Sincerity | Expressive use | Subjective world | Expressives |

Table 1 Validity claims and their relations to language functions, domains of reality, speech act types; building on [Habermas, 1979 p 68 and Habermas, 1984 p 329]

### 2.2 Validity Claims in Information Systems Research

There are several researchers in the information systems area who have taken an interest in the concept of validity claim as it is proposed by Habermas. [Dietz & Widderhoven, 1992] have made a comparison between Searle´s and Habermas´ theories. They claim Habermas´ theory to be superior and one of the main argument seem to be the importance of the validity claims. In their analysis they have related Searle´s speech act classes to Habermas´ validity claims and speech act classes. [Reijswoud, 1996] follows this comparison and conclusion in his analysis of business communication. He seems to agree concerning the importance of the vaidity claim concept of Habermas and this theory as superior to Searle´s.

[Ljungberg & Holm, 1996] comment on the analysis of [Dietz & Widderhoven, 1992]. They seem also to agree on the superiority of Habermas´ theory. They question, however, if this superiority should have any impact on the design of

information systems. In the spirit of [Suchman´s 1994] famous critique of adopting speech act concepts in IS design they question if the use of validity claims would be a good design framework. They are very hesitant concerning explicitly accounting for validity claims in communication supporting IT artifacts. [Ljungberg & Holm, 1996] propose another usage of Habermas´theory: ”An alternative approach, which we would like to suggest, is applying Habermas´ theory as a vehicle for reflection, rather than using his taxonomy in concrete design.”

Another researcher acknowledging the superiority of Habermas is [Eriksson 1999], although he ascribes some benefits of Searle. Eriksson has made a similar comparison between Habermas and Searle as Dietz & Widderhoven did. The analysis of Eriksson goes into more detail concerning speech act types, validity claims, directions-of-fit between word and world. He presents a communication model which he claims is a partial synthesis between Habermas´and Searle´s theories. ”The generic communication model presented cannot be considered to be a full synthesis of Habermas´and Searle´s models, this is not possible because the two models are based on different basic ontological assumptions” [ibid p 53].

There are researchers who do not want to give priority to any of these theories of Searle and Habermas and who do not see any great problems in combining the theories. [Auramäki & Lyytinen, 1996] and [Schoop, 1999] present such approaches. In an analysis of speech act success [Auramäki & Lyytinen, 1996] combine Searle´s speech act taxonomy and Habermas´ validity claims. Their approach is an ”integration of the best features of” the two theories [ibid p 11]. [Schoop, 1999] has also combined the two theories in her work to develop a methodological frameweork for the design of cooperative documentation systems. She claims ”Contrary to Dietz and Widdershoven, we do not see Searle´s and Habermas´ theories as contradictory. Rather we would argue that they consider different aspects of speech.” ”The two theories can be integrated to provide a powerful framework for communication analysis” [ibid p 70].

All these researchers, although their different standpoints in the Searle-Habermas controversy, seem to acknowledge the importance of the validity claim concept. There is no analysis of the validity claim concept as such and thus no questioning of it[1]. [Eriksson, 1999] has made an analysis of the different validity claims. He accepts the three universal claims proposed by Habermas, but he wants to add to these a claim for satisfaction. [Auramäki & Lyytinen, 1996] do not want to rule out power claims from an analysis of communication: ”Use of power is a part of everyday action, and we do not want to exclude communication based on the use of power (strategic action) from the analysis of communication” [ibid p 4].

[1] In the comprehensive debate concerning communicative action theory [e.g. Honneth & Joas, 1991] there are discussions concerning validity claims. [Seel, 1991] pursues an analysis of relations between different validity claims.

My conclusions from this examination of validity claims in information systems research are

- the validity claim concept as such is not analysed in depth and its importance is simply taken for granted
- the different universal validity claims proposed by Habermas are not contested; only some supplements are proposed

I will try to pursue such a critical analysis in the rest of this paper.

## 3 An Inquiry into Validity Claims

[Habermas, 1984] relates the three validity claims of truth, rightness and truthfulness directly to three different types of speech acts (table 1). Each validity claim can be seen as the primary claim thematized in each of speech act type. There is not however this kind of 1:1 relationship between speech act types and validity claims. Habermas emphasises that all three validity claims are at least implicitly raised in all communicative action. ”Every speech act in a natural context can be contested (that is, rejected as invalid) under more than one aspect” [ibid p. 306].

Habermas uses one example to illustrate this thesis of multiplicity of validity claims of speech acts. The situation is a seminar with a professor asking one of the participants to bring him a glass of water. I think this example is illustrative concerning validity claims. I will use this example rather thoroughly below. Habermas has used this example to show three types of objections made to this request; each of these objections challenging each of the three universal validity claims (truth, rightness and truthfulness). Habermas states as a conclusion of his illustration ”What we have shown in connection with this holds true for *all* speech acts oriented to reaching understanding. In contexts of communicative action, speech acts can always be rejected under each of the three aspects” [ibid p 307]. He is astonishingly sharp in regard to this thesis in connection to empirical evidence: ”This strong thesis can be tested against numerous cases” [ibid]. I can only notice that Habermas does not account for numerous cases, only some simple fictitious examples are shown.

I will question Habermas´ examples for the three validity claims. I propose, in my opinion, some better examples; and I present several other examples of rejections of the request. It is obvious (which will be shown below) that Habermas has a very limited view of possible rejections of speech acts, when he adopts his three validity claims. My analysis points at a much richer bunch of possible claims in communication than the three validity claims.

The complete formulation of the request made by the professor (P) directed towards one seminar participant (S) is as follows [ibid p 306]:

*”Please bring me a glass of water.”*

In the analysis I will use Habermas operational principle for contesting utterances and their validity claim. ”A speech act may be called ‘acceptable’ if it satisfies the conditions that are necessary in order to that the hearer be allowed to take a ‘yes’ position on the claim raised by the speaker” [ibid p 298]. Later on Habermas expresses this as ”the options open to the hearers to adopt rationally motivated ‘yes’ or ‘no’ positions on the utterances of the speakers” [ibid p 306]. I will in this spirit of validity contesting examine different possible ways to decline a request of the illustrated type. I will use the principle proposed by Habermas and in doing so I will question his analysis and conclusions.

[Eriksson, 1999] has also refered to this example of Habermas. In doing so; Eriksson has no objections towards the examples of rightness and sincerity rejections, but he dismisses the truth claim example. I am questioning all three examples as can be seen below.

I have chosen to use Habermas´ own examples since it will then be easier to demonstrate my objections with clear references to Habermas´own formulations and quoted argumentation. This "water glass" example can be questioned to be a typical "armchair" example common in philosophical literature. At this stage of analysis it has, however, proved to be useful and illustrative for the purposes of this paper. For further research, I do think it is important with real-life examples.

### 3.1 Claims for Rightness

[Habermas, 1984 p 306] uses the following example to illustrate the normative rightness of the utterance. The seminar participant declines the request of the professor through the following utterance:

*#1. ”No. You can´t treat me like one of your employees.”*

Habermas says ”what is contested is that the action of the professor is right in the given normative context” [ibid]. I partially question Habermas´ characterization. Let us look closer at what seems to be done in the seminar participants utterance. This speech act consists of a refusal of the request and an explanation why S makes this rejection. In his explanation S makes a characterization of P:s action ”treat like one…. employee” and with reference to this characterization he declines the request. S interpretes P´s request as an attempt to establish a special kind of relationship between them; not a formal employee-relationship, but a relationship that at least resembles this kind of relationship. S declines the request because he will not be engaged in such an inter-personal relationship. To fetch a glass of water for P would be an act of an employee serving the professor according to S´ view. Accepting the request would mean that such an undesired relationship was imposed on S.

I would not characterize this rejection primarily as one against the normative rightness[1]. A more apposite characterization would rather be a rejection of the implicitly suggested *inter-personal relationships* between P and S. Another way to put it is to say that to S the utterance is not *respectful* enough. S rejects the request since he considers it to be disrespecfully to him in his role as seminar participant.

I think that Habermas could have chosen a more appropriate example to illustrate rejections with reference to normative rightness. I will give one such example below:

*#2. "No. I can not leave the seminar room. Participation at seminars is mandatory according to faculty rules."*

In this rejection, S gives a clear reference to an *established rule*. This norm is not subject to subjective interpretations (as can be seen to be the case in #1). The mentioned norm can be checked according to its written formulations[2]. S rejects the request because the bringing of water to the professor should imply that he had to leave the seminar room since there is no water tap in the seminar room. Performing such an action (leaving the room) is not permitted (according to social rules) and would be negative to S. I find this example (in relation to Habermas´ utterance #1) a more straight-forward example of questioning an utterance because it is not considered to be in alignment with established social norms.

### 3.2 Claims for Sincerity

Habermas uses one example to illustrate rejection of the claim for sincerity (truthfulness). The seminar participant declines the request of the professor through the following utterance [ibid]:

*#3. No. You really only want to put me in a bad light in front of the other seminar participants.*

Habermas says in relation to this example that "what is contested is… that the professor means what he says" [ibid p 306-307] and Habermas adds in parenthesis the following explanation "because he wants to achieve a certain perlocutionary effect" [ibid p 307]. I question if this rejection should mainly be seen as a contest of lacking sincerity. This reaction of S is rather similar to #1. It has to do with *lack of respect* from P. S characterizes the action of P "to put me in bad light". He

[1] I do not deny that S could claim that P violates a norm like "do not treat seminar participants as employees". This norm can however seem to be constructed from the actual situation and it can be disputed in different ways. P could claim the existence of an opposite norm like "do not treat seminar participants and employees differently" and thereby deny the general existence of the norm claimed by S. This is also an example that many norms are contextually negotiated and that situationally conflicting norms must be evaluated with reference to existing circumstances and expected consequences.

[2] I do not presume that social norms must or should be recorded externally. Many norms exist only as parts of the intersubjective field of a community [Berger & Luckmann, 1967].

declines the request because of its negative effects on himself. The primary concern does not seem to be a question of sincerity (”you really only want”) which is a presumption made by S concerning the intention of P. S explains his rejection with reference to the negative effects to him. In this case S refers to the *inter-personal relationships* which he has to the other seminar participants. These relationships will be influenced in a negative way according to S. One can suspect that the *self-respect* of S would *be hurt* if he performed the requested action. It seems also to be an implicit reference to the inter-personal relationships between P and S. S does not want to be treated in this way by P.

There is a reference in this utterance (#3) that the intentions of P is something else, but this does not seem to be the primary concern (and thus a thematized claim) for S. There is an implicit contestation of sincerity, but this is not in the foreground. The Seminar participant´s main concern seems to be the negative effects for him.

I have constructed another example which seems to be a more straight-forward illustration of contesting lacking sincerity:

*#4. No, dear professor. I don´t think you really want a glass of water. You only use that utterance as an illustration of your theory of communicative ac¸ion.”*

In the case of #4, S makes an interpretation (characterization) of the intention behind P´s action. S presumes that P does not utter his request in order to get a glass of water, but he uses the request with another purpose. In this case, S makes an assumption that P´s real intention deviates from the one that is inherent in the utterance (i.e. to get a glass of water) and thus S declines the request. P´s *sincerity* is questioned and an *alternative presumed purpose* is presented by S. In this response of S, there is not either any reference to negative effects to S. It is the lack of sincerity that is thematized.

### 3.3 Claims for Truth

Back to the examples given by Habermas! The third and last one is concerned with contesting the truth claim. The seminar participant declines the request of the professor by the following utterance [ibid p 306]:

*#5. ”No. The next water tap is so far away that I couldn´t get back before the end of the session.”*

Habermas says ”what is contested is… the truth of propositions the professor has to presuppose in the given circumstances” [ibid p. 306-307]. This explanation seems to be very far-fetched. I can not see that this rejection has anything to do with truth of the utterance made by P. Habermas translates the rejection of the truth claim in this case to a denial that certain presuppositions obtain [ibid p.306]. He does this obscure translation probably because it is obviously incorrect to say that P´s request is not true. A request can not be true or false. This is one oˇ the main

points behind Austin´s speech act theory[1] and it is astonishing that Habermas resides in this verificationist fallacy to put it sharply.

Let us look at the formulation of the utterance #5. In this case there is made a reference to *negative consequences* for S, which was also made in the two other examples of Habermas above (#1 and #3). Habermas classifies this rejection (#5) as a questioning of the truth claim. The rejection does however not seem to be concerned with truth issues. The refusal is not made with any reference to incorrect description of circumstances. There is rather an implicit reference to the goal of S which is to be present at the seminar. This is obviously a primary purpose for S. He declines the request, since the requested action is inappropriate for him. He does not decline the request due to any false or inadequate descriptions made by P. There is no such deviations in the request. The action (bringing a glass of water) is not impossible to perform, but *its consequences are inappropriate* since they interfere with the desire to participate at the seminar.

Objections made with reference to propositional contents are not restric¸ed to truth matters. I will show additional examples below; some of them are concerned with the material circumstances of fetching water. As will be shown, these are not to be seen as issues of truth. The material circumstances, as e.g. the distance to the water tap (in case #5) have significance for the efficiency and possibility of performing the requested action.

When talking about ”existential presuppositions” Habermas seems to focus aspects in the world talked about. The existential presuppositions in #5 did not make the action impossible per se, but they were in conflict with the goals of S.

I will show one example where the material circumstances (existential presuppositions) are preventing the performance of the suggested action:

*#6. ”No. The water is turned off in this building, so it is impossible.”*

This means a rejection of the request since the requested action of bringing water is considered not to be executable. Water is not available and therefore water can not be fetched as was presumed in the request. I think this is a better example of rejection with reference to existential presuppositions than #5. It is however not the issue of rejection of any truth claim of the initial utterance made by P. This request is considered to be *inappropriate* since it was made based on *inadequate knowledge*. P did not have adequate knowledge about the possibilities that his request could be fulfilled. In this case there is no reference to negative consequence for S. It is rather a fairly neutral remark on the *impossibility* to follow the request. S explains to P why his goal can not be fulfilled.

The last two examples (#5 of Habermas and #6 by me) was treated under the heading ”claims for truth”. As can be understood from my discussion I reject the

[1] Truth is only an appropriate claim for assertives/constatives. For all other speech act classes it is inadequate to evaluate the truth claim.

application of truth claims in relation to requests and also other directives. This is totally in line with the main ideas within speech act theory [Austin, 1962 and Searle, 1969]. The two examples were rather rejections concerning the appropriateness of the requested action. Appropriateness[1] is not a universal claim in speech acts according to Habermas. Below I will present some more examples of inappropriateness since we can learn more about possible claims in communication from these examples. Appropriateness seems to be an important claim.

### 3.4 Claims for Appropriateness of Action

Several of the examples given above mean rejection with reference to negative consequences for S, the one to perform the requested action (#1, #3, #5). One example did not involve any supposed negative consequences for S, but rather for P, since the requested action was declared to be not executable (#6). I will give another example with presumed negative examples for the requester P:

*#7. "No. It will take so long time for me to bring you the water. I have injured my foot. It is better that someone else with quick legs brings you the water."*

S declines the request made by P. S explains that the proposed way for P to get the water (by S bringing it to him) is not an appropriate way for P. This is done with a clear reference to *means-ends efficiency*. The proposed *means is inappropriate* (since it takes too long time) *to reach the goal* (P to obtain a glass of water). In his rejection S does not refer to any negative consequences for himself (as in case #5 for example), only to negative consequences for P.

As can be seen in this example there are no objections made to social norms, truth or sincerity of the requester. Neither of Habermas´ three validity claims is challenged. But S is taking a 'no' position towards the utterance of P. S is declining the request. The challenge is done with reference to the presumed *success* of the requested action. The success is questioned since the proposed means is found to be inappropriate. According to Habermas claim for effectiveness (for success) is an issue for strategic action and not for communicative action which is related to the three claims of rightness, truth and sincerity. To me the objection made by S in this case is a fair and legitimate one. Neither of the two utterances of P and S is made in a "strategic mood". It is obvious that S is adopting a helpful attitude towards P when proposing a better way for him to reach his goals.

I will present another example where S declines the request since he thinks the consequences are negative:

[1] In some situations Habermas uses "appropriateness" as a synonym to "normative rightness" [e.g. Habermas, 1979 p 54]. In these cases it is a question of whether the speech act is appropriate in relation to existing norms. It is not case of the appropriateness of proposed actions.

*#8. ”No. The water tap is in the other seminar room. I will disturb the people there.”*

S declares the means to be inappropriate. If he should fetch a glass of water he should influence other people in an undesirable way. The bringing means that he disturbs other people. Their goals will conflict with goals behind bringing the water. In this case S does not give any reference to negative consequences for P and S (at least not explicitly). The mentioned *negative consequences* apply *to other people*. Implicitly one can presume that the suggested action, if performed, should lead to deteriorated inter-personal relationships between S and the seminar participants in the other room.

One can claim that this refusal involves a reference to normative rightness; to a norm like ”one does not disturb other people”. I acknowledge this, but the rejection should not be reduced to just that. The main point is not that the bringing of water does not comply with a social norm. It is not a thematizing of such a norm in the rejection, as it was in #2 above. The negative consequences for the other people are emphasised as a legitimate obstacle for the requested action.

### 3.5 Claims for Appropriateness of Goal

There are several examples above where a rejection has been made with references to problems in perfoming the requested action. These rejections are concerned with the means of reaching the goal of a glass of water to drink. Some rejections have been concerned with inappropriate side-effects. No response has been directed to the beneficial of the aim. I will give one example with a thematization of the goal part, i.e. a glass of water for P to drink:

*#9. ”No. The water is poisoned. You can not drink it. You can be sick!”*

This refusal is not oriented to any problems regarding the fetching of a glass of water. S´ concern is about P when he should use the water for his purposes, which S presumes, is that P will quench his thirst. S´ objections is concerned with the *presumed goals* of P to drink a glass of water from this building. To drink such a water will not lead to any positive effects. The drinking of water would hurt P.

This rejection is also an example of the difference of knowing between P and S.

knowledge concerning the surrounding circumstances are grounds for rejecting the request, but there is no accuse from S towards P about not telling the truth. Having incomplete knowledge and communicating from this incompleteness is not the case of telling a lie.

### 3.6 Claims for Dialogical Adequacy

I have shown nine examples of communication between P and S above. Much of the analysis has been focused on reconstructing the rationality behind the utterances. All refusals of S can be found rational on grounds presented in each case. Let me present one example, with an illustrative purpose, where the rationality of S´ utterance can easily be challenged:

*#10:A. "No. I am not thirsty."*

In this case S rejects P´s request but on grounds which are easily questionable. P could respond in the following way:

*#10:B. "I am thirsty and I need a glass of water to drink. Please bring me a glass of water!"*

This response was needed since S´ motivation in his refusal was considered to be inadequate in this dialogue situation. P contests the motivation of S. In #10:B P is taking a 'no' position towards the refusal. He does not accept S´ refusal, since he does not accept the grounds for refusal. P finds S´ refusal inadequate in this dialogue. P had no idea (in his initial request) about S bringing a glass of water to S himself for drinking. P wanted a glass of water for himself to drink. S was a means for this purpose.

### 3.7 Summarizing Different Grounds for Contesting Speech Acts

I have now shown ten examples of contesting a speech act (a simple request for bringing water). In this section I will summarize and systematize the different type of objections. The requested action is considered inappropriate in different aspects. The responses of S are based on different apprehended deviations. There are deviations between the request and some other circumstances:

- desired inter-personal relationships (#1, #3)
- self-respect (#1, #3)
- established rule (#2)
- existential circumstances (#2, #6, #8, #9)
- interpreted purpose (#4)
- plans and desires of listeners (#5)
- proposed means (#7)
- plans of other persons (#8)
- motivation in refusal (#10B)

A request is a directive according to the taxonomy of [Searle, 1979]. It is an attempt by a speaker to get a listener to perform an action. This kind of speech act can be contested by the listener in several ways. Habermas has used this example to show rejections according to his three universal claims (#1, #3, #5). I have raised objections concerning the appropriateness of Habermas´ illustrations. The main point behind my expansion of Habermas´example is that *there can be other ways of contesting a request as a speech act*. These other examples *are not possible to fit into the three pre-defined validity claims* of Habermas. They are concerned with other issues than truth, normative rightness and sincerity. Most of the request refusals are made because the requested action is considered to be *inappropriate* in some aspect. I summarize these objections in relation to appropriateness of proposed action. The requested action was considered ¸o be

- inappropriate for the listener to perfom
- inappropriate for the speaker/requester concerning action efficiency (means)
- inappropriate for the speaker/requester concerning action result (ends)
- inappropriate for the relationships between speaker and listener
- inappropriate for other people (disturbing actions)
- not really requested
- impossible to perform

## 4 Beyond Validity Claims: General Communication Claims

One conclusion from section 3 above is that Habermas´ three claims for contesting speech acts are not complete. There are objections possible to make, which do not fit into the three valididity claims. This is partially due to the validity claim concept as such and partially due to the three validity claims.

There are claims raised during communication; claims which can be raised by speaker and hearer. All such claims are not concerned with what can be called validity. If we look closer to the validity claims proposed by Habermas, they are all related to the past or at least to something given and not to the future. An utterance is assumed to be valid in relation to some existing circumstance. Truth is concerned with ”existing states of affairs” [Habermas, 1984 p 88]. Normative rightness is concerned with ”the existing normative context” [ibid p 99]. Sincerity is concerned with ”manifest intention of the speaker” [ibid]. All these claims are thematizing *what exists*. They are not thematizing *what is to be*. This seems to be a fundamental deficiency in Habermas´ theory; an orientation towards that which exists. Communication is a lot about the future; what is intended or supposed to be. Contesting a request for a glass of water, because the water is turned off or the water tap is too far away, is not a concern for the validity of that request. The addressee does not say ”your request is not valid”, he rather contests that it is not *reasonable* due to the circumstances to act within. I would like to expand

Habermas´ concept of validity claim and instead speak of *communication claims*. Such communication claims involve both claims concerning *existing* states and *future* actions and states. They involve claims for validity and reason.

I find no problem with Habermas´ sincerity claim. I think it is easily justifiable in a communication theory. It thematizes the speaker. I have however problems concerning the other two claims. I have objected towards the truth claim several times above. Truth claims can not be universal[1] since it is only a feature of assertives and not of other types of speech acts [Austin, 1962; Searle, 1969]. I think that Habermas mixes truth with what I prefer to call *descriptive correctness*. It is possible to relate descriptive correctness with all types of speech acts and not only assertives. Truth is to be seen as one special kind of descriptive correctness and this feature is only valid for assertives. I distinguish between three types of descriptive correctness: Truth, linguistic adequacy and descriptive completeness.

I use a single example for illustrations of these three categories: Person A is uttering: *"I want something to drink"*. Person B is responding: *"There is a glass of water on the table"*. A can assess B´s response, i.e. evaluate the communication claims raised by person B. Concerning the communication claim of descriptive correctness, he can contest it in different ways. He can say: 1) *"No, I can not see any glass on the table"*. In this case he is contesting the truth of the utterance. He can also say: 2) *"Yes I see, but it is only some left in the bottom. I would not call this a glass of water."* In this case he is not accusing B for not telling the truth. There is a glass with some water on the table, but it is not considered to be enough to drink. He is contesting the lingusitical adequacy of speaking of a glass of water. He can also say: 3) *"No, I do not want to drink it. I think the water is poisoned"*. In this case he is contesting that the utterance of B is informative enough. B is not telling the "whole story". Some important information is concealed. A is contesting that B´s utterance is descriptively complete.

In all of these objections made by person A, he is evaluating it from an action view, i.e. from his interest to drink something. It is not only objections concerning desciptive correctness. The objections are concerned with appropriateness and efficiency. He is recognizing obstacles for drinking.

The validity claim for normative rightness needs also some commenting. I am not challenging that it should not be seen as a universal claim in the same way as I did with the truth claim. I do think it is important to assess speech acts concerning their concordance to social norms. The problem is that rightness sometimes seems to be a *residual* category. All that is not truth and truthfulness claims can be considered as rightness claims. Such a vague concept is not useful. Sometimes

[1] It is obvious that Habermas asserts truth to be a universal validity claim: "The validity claim of constative speech acts is presupposed in a certain way by speech acts of *every* type". "Truth is universal validity claim; its universality is reflected in the double structure of speech" [Habermas, 1979 p 52].

”rightness” is substituted by ”appropriateness”. This is made by Habermas and commented above (sec 3.3). Also [Schoop, 1999] is making such a substitution. I take this as an expression of a need for more exhaustive claims, as I have showed in sec 3 above. Normative rightness is the thematized claim related to the interactive and regulative use of language in Habermas´ theory. I think this is the reason why it is sometimes becoming a residual category for all aspects concerning social interaction. But all aspects concerning social interaction can not be reduced to issues of norm concordance. This objection is in accordance with the critical observation made by [Joas, 1991 p 100] concerning Habermas´ action theory: "interaction that is not normatively regulated, or is so only slightly, is lacking in Habermas´ typology".

Normative rightness seems, however, mainly to be concerned with existing normative background and I think that this claim should clearly be restricted to this. Such a normative background consists of ”institutions, roles, socioculturally habitual forms of life” [Habermas, 1979 p 54]. A speech act is said to ”actualize an already-established pattern of relations” [ibid]. A speech act with thematized rightness claims implies that it is ”covered by existing norms, and that means by (at least) de facto recognition of the claim that these norms rightfully exist” [ibid].

When describing it in this way I think it is rather clear that normative rightness is concerned with existing social rules, institutions etc. It can not be reduced to issues of contingent action appropriateness, as I showed several examples of in section 3 above. To avoid ambiguity I will rename this claim and call it *norm alignment*.

Besides these three partially reformulated claims from Habermas (sincerity, descriptive correctness and norm alignment) I would like to add some more communication claims. I present a list of general communication claims (table 2):

| **General communication claim** | **Communication aspect** |
|---|---|
| Sincerity | Speaker |
| Norm alignment | Norms |
| Descriptive correctness | Refered world |
| Addressee relevance | Addressee |
| Respectfulness | Addressee |
| Deliberation | Means and ends |
| Dialogical adequacy | Other utterances |
| Argumentativeness | Utterance itself |
| Comprehensibility | Language |

Table 2 General communication claims and corresponding communication aspect

This list is to be seen as preliminary. There remains more work to be done; both theoretically and empirically. I will briefly comment on the different claims which have been added. First a general remark. Instead of talking about universal claims a prefer to talk about *general claims*. By universal Habermas means that these claims are applicable for all possible speech acts. The concept of general claims is not as hard as that. By general claims I mean that these claims can *in principal* be raised for different *types* of speech acts; that is they are applicable to the different speech act classes. Every claim may not be appropriate to raise for every speech act due to its characteristics and context.

The different communication claims can be related to different aspects of the communication situation; not only the three worlds of Habermas. In table 2 the relations between the utterance and these important communication aspects are described. The claims can be seen as relational concepts, binding together the utterance and the communication aspect.

Habermas´ model is considered to be more symmetric (than that of Searle) since it considers the mutuality of speaker and listener. I think this is true but not in all aspects. I have found it astonishing that the (world of the) speaker is apprehended but not the (world of the) listener. The relations to the listener is in Habermas´ model reduced to be one (implicit) aspect of normative rightness. The listener (addressee) must be considered to be one important part to relate that utterance to and thereby to challenge its claims. I distinguish two claims which are related to the the addressee: Addressee relevance and respectfulness. It is possible to challenge a speech act for not being addressed correctly. The objection #1 (in the example in sec 3) can be seen to be such a case. S contests that he, as seminar participant, and not an employee, should perform the proposed action. In #1 and #3 it is contested that the speech acts of P are not respectful enough. One could claim that respectfulness should be special case of norm alignment, since it is concerned with ethical treatment in communication situations. I would like to restrict norm alignment to underlying norms, and having explicitly addressee respectfulness as a general claim since it is directly related to the addressee.

Another deficiency of Habermas´ model is his reluctance of bringing in means-ends rationality. Speech acts can be contested due to means and ends. In the example there were objections concerning inappropriate means (#5, #6, #7) and ends (#9). One way to put it is to say is that the request was not deliberate enough. Appropriate ends or means were not chosen. I call this claim deliberation. The speech act should be an expression of well deliberated ends and means. When explicitly adressing ends and means one is addressing intended perlocutionary effects.

Speech act theory has been criticized for being too narrow-sighted and only viewing isolated speech acts [Ljungberg & Holm, 1996]. Discourse aspects are mainly disregarded. A discourse is considered to be a collection of statements with

relations to each other [Coulthard, 1985]. A conversation is a discourse, in this meaning, that is consists of several inter-related statements from different participants. A text is a discourse when it consists of written inter-related statements. A compound utterance can also be seen as a discourse.

An utterance can be challenged from a discourse perspective [Kreckel, 1981]. What is said in one utterance can be questioned if it is not an adequate response to another utterance (#10:B). I call this dialogical adequacy. There can also be critique towards a single utterance for not being argumentatively lucid, transparent and complete.

The last general communication claim comes from Habermas. It is the comprehensibility claim. The utterance must be understandable in accordance with linguistic rules and competence.

When formulating these different communication claims I have used the powerful operational principle of Habermas for assessment of speech act claims. The intepreter can take a 'yes' or 'no' position against the speech act. The contesting position depends on what aspect is contested. I have above described that such a questioning can be made concerning the following aspects: The utterance´s relations to the speaker´s intentions, to social norms, to the refered world, to the addressee, to means and ends, to other utterances, to the utterance itself and to language.

## 5 Conclusions

The purpose of this paper was to critically investigate the validity claim concept of Habermas´ communicative action theory. This should be interpreted as an analysis of one important theoretical underpinning of LAP. The validity claim concept has been used by IS researchers without any deeper analysis of it. I have questioned if the validity claim concept is a valid concept in a theory concerning communication. I have questioned the concept of validity claim in different respects. The concept in itself is too narrow. Speech acts can not only be contested by "historical validities". Speech acts can be challenged concerning their presence and suggested future. An addressee can question whether the speech act is *reasonable*.

The concept of universal validity claims is transformed to general communication claims. The claim concept was made more restricted in the sense that these claims are not considered to be applicable for all speech acts, but applicable for different speech act types in principal. The claim concept was made less restricted in the sense that it covers other aspects than validity claims.

One of Habermas´ validity claims is the truth claim. This claim is rejected as universal. Truth is one subclass of descriptive correctness, which is considered to be a general communication claim. The rightness claim has been renamed norm

alignment. Besides the four claims emanating partially from Habermas (sincerity, descriptive correctness, norm alignment, comprehensibility) several other general claims were formulated: Addressee relevance, respectfulness, deliberation, dialogical adequacy, argumentativeness.

There is a need for future research along the lines presented in this paper. The different communication claims have been formulated based on a critical reading of Habermas and an investigation of some of his prototype examples. Empirical research is needed to further validate the communication claims presented in the paper. There is also a need to look deeper into other communication theo ies and compare the communication claims presented here with other theoretical constructs; e.g. the felicity conditions of [Austin, 1962], the speech act conditions of [Searle, 1969], the conversational maxims of [Grice, 1975] and the felicity conditions of [Allwood, 1976].

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# Habermas and Searle in University: Teaching the Language-Action Perspective to Undergraduates

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## Abstract

The Language-Action Perspective (LAP) has attracted much interest in an information systems context. Many research approaches have been presented and discussed. However, there have been no reports on teaching LAP to students. We argue that it is of prime importance to expose students to LAP if we want to attract new researchers to the area. In this paper we will discuss the results of two courses on LAP for undergraduate students in computer science. It was found that the best way to introduce students to the area of LAP is by teaching LAP concepts in an intuitive way using every-day examples and by combining LAP with a current "hot topic" such as Business-to-Business Electronic Commerce.

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## 1 Introduction

The Language-Action Perspective (LAP) has developed into a new paradigm for the design of information systems, focusing on communication in information systems. There have been many applications of LAP in the broader area of computer science since its introduction in the 80s by Ludlow, Flores, and Winograd [Flores and Ludlow, 1980, Winograd, 1988, Winograd and Flores, 1986] (see e.g. [Dignum and Dietz, 1997, Goldkuhl et al., 1998, Goldkuhl et al., 1999]). The important role of LAP in research is also shown by the annual international workshops on the Language-Action Perspective on Communication Modelling.

However, there have been no reports as yet to the best of our knowledge regarding experiences teaching LAP. It is vital to teach the Language-Action Perspective for disseminating its ideas and for generating more interest in LAP, thereby attracting new researchers. We have some experiences teaching LAP to undergraduate and graduate students in computer science. We found that the theories and the main assumptions underlying LAP are easy to understand if taught in an intuitive way with many every-day examples. Students were interested in LAP and could be motivated to start work in this area. We used LAP as the theoretical foundation for a practical course on a "hot topic" which in this case is Business-to-Business Electronic Commerce. The results will be discussed in the present paper.

## 2 Teaching LAP

The Language-Action Perspective was taught to undergraduate students reading computer science in their first or second year. The curriculum for the first and second year consists of courses providing a broad basis in computer science. For example, mathematics, theoretical computer science, and programming are among the taught subjects. All students take the same courses. From the third year on, the then graduate students are in the advanced phase of their studies. Here they are able to choose from a number of courses in different areas of computer science and specialise in a particular area such as databases or information systems.

The only possibility to introduce new courses for undergraduate students is to teach a theoretical seminar-type course and a practical course in which the students develop software on a certain topic. These two types of course are mandatory but the students can choose between different subjects. We see these course as the first opportunity to rouse their interest in LAP. For the students this means that they can experience possible areas in which they might want to specialise. During the advanced phase of the studies in computer science, there are many possibilities to introduce LAP to the students. For example, there could be a course specifically on LAP, LAP could be integrated with subjects of other courses such as document management, information systems design, requirements analysis, Computer-Supported

Cooperative Work, business process modelling etc. Finally, the graduate students can do their theses in the area of LAP.

We decided to start teaching LAP to undergraduates to be able to set up a group of interested students who would continue working in the area during their studies. We started with a seminar on Computer-Supported Cooperative Work (CSCW). Fifteen undergraduate students worked in teams of two on one research article each. When selecting the eight articles, we placed an emphasis on LAP and chose several of the most influential LAP applications, e.g. [Lyytinen and Lehtinen, 1984, Winograd, 1988]. After an introduction to LAP given by the lecturer, the students were required to give presentations about the research articles and write an essay summarising the main findings and elaborating on their critiques and remarks.

Some students developed well-founded critical remarks that are similar to some of the well-known critiques of LAP (such as [Bowers, 1992, Suchman, 1994]; see also [Schoop, 1998] for a discussion of the critiques). For example, the question was raised whether Searle's speech act theory alone is adequate for modelling human communication. On the other hand, some of the students developed ideas that went far beyond what was expected of them in the course. One student started to build a communication system similar to the Coordinator but with added functionalities. Many of the students expressed their interest in continuing work in the area of LAP and applying the theoretical LAP concepts in the context of practical tasks. The seminar provided the theoretical basis for the second type of course we held in the following semester.

The second course consisted of practical course work and will become the focus for the remainder of the present paper. The general subject of the course was the development of Java components for Business-to-Business Electronic Commerce (BtB EC). Eighteen students (many of them having attended the first course) worked together in six teams of three participants each. There were two different topics, each consisting of four individual exercises. Each group had to demonstrate their system and answer the lecturers' questions as well as their fellow students' comments. The aim of our course was threefold.

- On the *theoretical side*, the basic elements of the Language-Action Perspective were introduced and illustrated using examples from the area of EC. In particular, LAP was used as the theoretical foundation for a negotiation support system that was developed in the course. Thus, the theoretical knowledge gained in the first course could be applied to a current "hot topic" such as Electronic Commerce. One of our aims was to motivate students to continue their work in the area of LAP.

- On the *practical side*, the students were taught a modern object-oriented programming language, Java. Furthermore, the course aimed at showing

the students the software development cycle and in particular the phase of programming-in-the-small.

- Finally, the students experienced *team work*. LAP argues that language is used to coordinate activities which was emphasised by letting the students work in groups. Coordination played an important role since any team member had to be able to operate their system and explain the approach (e.g. programming techniques, documentation, notational standards) in detail. Coordination within and between teams was supported by using the BSCW-Server [et al., 1997] which is a well-known groupware tool.

As mentioned before, the main task of the practical course was the development of an *information system for a cooperation initiative of local companies in the area of Business-to-Business Electronic Commerce*. Three information spaces had to be designed and implemented by the students.

In the *public space* the initiative presents itself to the public. Information about all companies related to the initiative including details about contact persons and lists of future and past events are available.

The *semi-public space* can only be entered by registered members of the cooperation initiative. A login procedure ensures that only authorised persons are allowed in. All members of the initiative are organisations but not all organisations that appear in the list described above are members. Members can insert new events that they will organise in the future. There is a broadcast facility for sending emails to all other members, e.g. for notifying about changes in a company's profile, for announcing new events, for introducing new members etc. Organisations apply to become new members. If the application is approved then an administrator will enter the new member into the members' database.

The *private space* of the information system is concerned with structured message exchange for negotiations in a BtB environment. The private space can only be entered by members. Note that for reasons of simplicity we assume negotiations to take place between two partners. These two members are the owners of the information exchanged and only they are able to access the information. LAP forms the theoretical foundation of the private space.

Apart from the sender, the recipient, and the date, two other elements play an important role in the negotiation process. The message type (request, offer, counteroffer etc.) indicates the illocutionary force. The message content (i.e. the propositional content) is represented by free text or semi-structured phrases. Since peer-to-peer electronic negotiations are supported, both participants act as sender and recipient of messages.

A negotiation protocol is being implemented as follows. A negotiation can either start with an offer or a request. Both can be answered by the other partner

with a counteroffer, an acceptance, or a rejection. In the first case, the negotiation continues and the first partner has the same three possibilities to reply to the message. In the latter cases, the negotiation is terminated. A partner can only answer to the mails of the other partner, i.e. it is not permitted to reply to one's own messages. It is, therefore, clear to both partners who is obliged to act in the next step, what the exact obligations are etc. The whole interaction is stored in a database. The message-oriented view of each negotiation is visualised by displaying lists of negotiations (initial message as first element, replies are indented).

Each business partner is presented with a list of all open negotiations (i.e. the last message is neither an acceptance nor a rejection), a list of all successfully completed negotiations, and a list of all negotiations terminated by rejection. An administrator can monitor the interactions. It is possible for him or her to display all messages sorted by type, recipient, sender etc. For example, the administrator can query the database to view a list of all offers.

## 3 Results

In this section we will summarise the main results from the course on LAP in Electronic Commerce. As outlined in the previous section, we will review the three aims of the course and report on findings for each of them.

- On the *theoretical side*, we taught the students about the Language-Action Perspective. As mentioned before, LAP formed the theoretical basis of both courses but was not their main content. In the theoretical course, articles about some of the most influential LAP approaches were selected for the students' work. In the practical course, we used the experiences gained from the first course and introduced some elements of Searle's and Habermas' theories that were the most relevant ones for the context of the course's topic (i.e. Business-to-Business Electronic Commerce)[Schoop, 1999, Schoop and Wastell, 1998]. In particular the concepts of illocutionary force and propositional content, the classification into different categories according to the illocutionary point, and the concept of validity claims were introduced.
  The students were very interested in the Language-Action Perspective. They found the relevant elements of Searle's and Habermas' theories rather intuitive. Some wanted to know more about LAP and entered into discussions about the adequacy of the theories and LAP's main assumptions. A number of students continued work as students assistants, working towards possible enhancements of their systems.
  The implementation of the LAP concepts was successful. The illocutionary force is indicated by the type of electronic message. The possible structure of negotiations reflects the concept of transactions

(cf. [Weigand and van den Heuvel, 1999]). Possible problems during the negotiation (e.g. concerning the appropriateness of utterances, dealing with trust etc.) can be seen as being based on Habermas' validity claims (although these were not explicitly implemented due to time constraints).

- On the *practical side*, the students learned a modern programming language including the right way to document and to use notational standards. The six teams showed different approaches both to the theory and to practice so that very individual systems were the outcome. However, all teams were able to justify their particular strategies. Most of the systems offer more functionalities than required by the exercises.
- As the ability to work in a group and to coordinate one's activities with those of other students is vital to survive the pitfalls of university courses, we emphasised the importance of *team work*. The teams worked generally well together and managed to overcome their problems. The usual roles such as team leader, co-worker, individual worker etc. could be detected.
  In general, it can be stated that the experiment of working in teams of three students and, later on, integrating the work of two teams worked very well and led to encouraging results. The students thus experienced two of LAP's main statements, i.e. that language is used to coordinate activities and to provide a common ground for all partners.

## 4 Conclusion

In this paper we presented results on teaching the Language-Action Perspective to computer science students. After introducing the theoretical constructs both in a seminar course about CSCW and in an introduction to a lab course, we embedded LAP in a practical "hot topic" (in this case Business-to-Business Electronic Commerce). We found that by combining theory and practice, students could be introduced to LAP concepts easily and could be motivated to start work in this area.

Some of our students continue their work on communication management and negotiation support for BtB EC in the context of undergraduate projects. Once the students are comfortable with the LAP concepts, they will explore the theories behind LAP in greater detail. The fact that the business information systems developed by the students in the lab will be used for a local cooperation initiative of companies interested in Business-to-Business Electronic Commerce provided good motivation for the students.

Looking back on our experiences, we would choose a similar approach again. We found that undergraduate students are still very open to a new paradigm such as LAP. The area of Computer-Supported Cooperative Work seemed to be a good starting point for exploring LAP concepts since the roots of LAP lie in CSCW. We

plan to teach a similar type of course with a different subject, e.g. document management or systems design. However, our main emphasis is to continue teaching LAP to graduate students. We plan to teach LAP in the context of a lecture course on document management to students in their third of fourth year and to include an introduction to LAP concepts in a course on information systems and databases. The aim is to set up a group of students working in the area and to give further incentives to those already interested in LAP. So far, this has been achieved with good results. Some of our graduate students have started work on their MSc theses in the broader context of LAP, in particular about communication management and document management.

To summarise, the results encourage us to continue teaching LAP to computer science students. We argue that to initiate the introduction of new generations of academics to the LAP community it is vital that those of us teaching in university bring students in contact with LAP. One way to do so was illustrated in the present paper.

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