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The Language/Action Perspective

Second International Workshop on Communication Modeling (LAP'97)

Veldhoven, The Netherlands, JUNE 9-10 1997

Working Papers

editors: Frank Dignum, Jan Dietz

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Preface

After the success of the first LAP workshop in 1996, the second international workshop on Communication Modeling will be organized in the Netherlands on June 9-10, 1997.

This two-day workshop is aimed at bringing together researchers from Business Administration, Linguistics and Computer Science, as well as potential industrial partners and users, who are interested in the theory of Communicative Action and the modeling of Business Processes.

Invited speaker for this workshop is James Taylor, Univ of Montreal, author of the inspiring "Rethinking the theory of organizational communication: how to read an organization" (Ablex, 1993).

The Language/Action perspective (for a large part based on Searle's Speech Act theory) introduced in the field of information systems by Flores and Ludlow in the early 1980's has proven to be a new basic paradigm for Information Systems Design. In contrast to traditional views of "data flow", the language/action perspective emphasizes what people DO while communicating; how they create a common reality by means of language and how communication brings about a coordination of their activities.

Now that the language/action perspective has been established as a fruitful direction of research it is time to extend the scope of application within the field of organizational computing. Examples of new application areas covered in the programme are:

- Electronic Commerce
- Workflow systems
- Meeting Support
- Virtual organizations and networks

We hope that the papers and research presented will lead to fruitful discussions and contribute to a better understanding and maturing of the language/action perspective.

At this point we would like to thank all authors for making this programme possible by submitting their papers. We would like to thank the members of the program committee for the reviewing and sorting out the (10) best papers.

We also thank Alice Kloosterhuis for her secretarial support and SOBU (Samenwerkings Orgaan Brabantse Universiteiten) for its financial support.

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PAPERS

Analysis and Design of Emerging Network Organizations

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Abstract

Due to the low costs of computer networks and IT, many small companies are stimulated to work together and form network organizations on a project basis. As quick as they expand, the network can diminish as soon as projects are completed. Because of the dynamic character of these type of networks the analysis and design of information systems supporting the activities, require a different point of reference: One has to consider how coordination of activities takes place in these networks. While in hierarchical organizations coordination is vertical in nature, in these network-like structures often only horizontal coordination applies. A suitable reference framework is formed by the language action approach to IS development. In this tradition, the DEMO approach is applied for the analysis and design of emerging dynamic network organizations. The DEMO method has proven to be practical in several studies, and is used here for modeling dynamic network organizations making use of its built-in abstraction mechanism. Parts of a larger field study carried out will be presented as the guiding example in this paper.

1 Introduction

Current interest in business networks follows almost naturally from the developments in the structure and the conditions under which the global market economy functions. More and more companies strive for the restructuring of their core business, while needing to create ever more complex webs of cooperative links with competitors, suppliers, and customers on a worldwide scale [Karimi-Konsynski91]. The success of these restructured organizations will come from the ability to couple to, and de-couple from, the networks of knowledge nodes [Jarvenpaa-Ives94]. This shift from traditional, rigid hierarchical organizational structures is often described as moving towards a dynamic network form or virtual corporation [Davidow-Malone92].

This trend is particularly interesting in relation to the low costs associated with computer networks and IT, which stimulates many small companies, often consisting of only a few employees, to work together and form cooperative network organizations with other small companies on a project basis. The dynamic character of these type of networks results in quick expansion, but the participants can also diminish the network as soon as projects are finished.

Research on business organizations used to be focused on the competition between firms and the relationships between these firms their suppliers and customers. In the current dynamic situation however, a significant shift is taking place in the nature of business interactions, with the focus changing to more cooperative longer term relationships [Clemons-Row92]. This change has proven important in the competitive dynamics of many IT applications, such as airline reservations systems [Copeland-McKenney88]. It is also in line with the results reported by Axelrod (1984), in which in long term relationships, cooperation instead of pure competition, mostly is the better strategy, resulting in the highest benefits for all parties.

Because of the transformation towards smaller, more independent organizations and as groups of professionals are working together in less predefined ways, coordination primitives such as described in standard organization theory and management science do not necessarily apply to these new network-like organizations. In [Desanctis-Jackson94], five functional coordination modes are defined applicable to the horizontal coordination between units, which do reflect this new way of thinking about coordination. The first and simplest mode is concerned with information passing. It consists of sending and receiving messages without extensive dialogs or follow-up exchanges between the coordinating parties. Complexity increases in the case of discussion of the relationships, the roles and responsibilities of the various partners. This also applies when

coordination is directed towards the formulation of procedures, such as creating a policy. A further increase in complexity is observed when the context of communication is aimed at task accomplishment. When coordination takes the form of issue analysis, communication will consist of a rich dialog among parties, directed more towards problem analysis than solution development. Often, this process is referred to as a discourse in the area of language philosophy (see e.g. [Habermas81]). Coordination in this last case is the most complex, since the amount of communication is high and the ease of structuring is low. These complex type of communication patterns are considered to be an integral part of networks.

In many cases, business networks also differ from traditional organizational structures in other respects, for example the type of background knowledge, the goals and their orientation towards task, product or process. They can be characterized as a goal-oriented, dynamic, and complex professional human network [DeMoor-VanderRijst95], sometimes also referred to as 'community of practice' (COP) [Brown-Duguid91]: "...naturally occurring groups that arise more or less spontaneously around a particular task, technology or enterprise. COPs are self-organizing; they emerge in response to changing conditions and opportunities in the workplace." [Jordan94:6]. In many aspects business networks are comparable with adhocracies. They can be viewed as very flexible organizations, including many shifting project teams and highly decentralized communication networks among relatively autonomous groups [Mintzberg79]. In these groups substantial amounts of unplanned communication and coordination take place. Computer support of these activities is essential, and lowering the cost of coordination and communication by means of information technology could result in a shift towards smaller firms and proportionately more use of markets, rather than internal decisions within the traditional firm [Malone-et al87].

In the tradition of the language/action approach several research project have emerged for the analysis of organizations. In this context the DEMO approach has already being developed for, and applied in more traditional organizations for Business Process Engineering projects (see e.g. [Dietz94b; Dietz-et-al96]). For maximum flexibility, we need a method that allows us both to analyze the domain-specific context of network organizations, and to translate the discovered entities into a useful representation of the important cross-organizational business processes. The thesis of this paper is that the DEMO method can serve this purpose. This formal method has proven to be practical in several studies, and can be used for modeling dynamic network organizations, due to its built-in abstraction mechanism. Parts of a large field study currently carried out will be presented as the example in this paper. This research project is aimed at the development of Internet-based tools for support of emerging dynamic network organizations. Here the emphasis is on the development of an organizational network model on basis of the DEMO analysis. This so-called reference model can be used for the implementation of the supporting information system created out of the available generic tools such as described in [VanderRijst97].

In the following sections the research methodology and the boundaries of the research will be described from the perspective of the traditional organization and the influence of IT on these organizations. Then a shift will be described from these often big organizations towards small businesses working together in alliances, which are currently supported by all kinds of IT-tools available. Following, the DEMO approach will be introduced and its relevance for the type of organizations mentioned in the introduction. Part of a larger study will be modeled with this approach. Some relating research projects are discussed at the end. The last section will present the conclusions and future research objectives.

2. Background: organizations in the network age

The influence of the use of computer networks in traditional organizations is very diverse. Boddy and Gunson (1996) for example, describe several case studies of large organizations in the UK undergoing major changes in the structure of their organization. Most interesting are the examples of companies cutting away layers in the organizational hierarchy, leading to flatter structures with more direct communication lines. Top management interest is still a delicate issue with respect to the topic of centralization versus decentralization. The most successful corporations are those who implement systems that either support the current way of working exactly, or provide a means of support for the newly evolving organizational structure. According to Boddy and Gunson the most important aspects of incorporating IT networks in organizations are the unquestionable support by top-management, giving users enough time to adapt to the implemented systems. It also gives these users influence on the design of the information system. Without question though is the issue of responsibility and commitment with the work.

The research performed by Boddy and Gunson is still very much focused on the traditional forms of organizations and relationships between those organizations. In these situations the transaction cost theory of Williamson (1979) can be applied to describe the situations under which a market or a hierarchy comes into existence as a coordination mechanism, depending on the cost of the transaction. Alternatively, Powell (1990) suggests that an alternative coordination structure is emerging: networks. Networks have traditionally been viewed as a hybrid form of a market and a hierarchy, but Powell argues that this is "historically incorrect" and it "detracts from our ability to explain many forms of collaboration that are viable means of exchange." [Powell90:298]. Network forms of exchange have completely different modes of coordination that is neither price or supervision, but are mutual interest and interdependence. In other words, cooperation and collaboration is seen as "...the new foundation for entrepreneurial success..." [Levinson96]. What this means is that these networks comprising of small businesses must seek opportunities for competitiveness by way of cooperative relationships or alliances for mutual profit.

In order for these cooperative networks to be successful, and thus to realize competitive advantage, they heavily depend on relationships based on communication: "Communication networks enable cooperative coordination among specialized firms and can become a substitute for hierarchical coordination" [Antonelli92:22]. Thus, modeling the communication between the participants in these type of network is of particular importance. The DEMO approach provides the means to do so.

In the following section the DEMO approach is outlined. Its three level abstraction mechanism provides an ideal basis for analyzing and modeling organizations without being constrained by the actual organizational configuration or strict boundaries between departments in organizations or between organizations as a whole. Above all, it provides several modeling techniques to ensure correctness in the models of all activities taking place in the network organization.

3. The DEMO Approach

Dynamic Essential Modeling of Organizations (DEMO) is the name of a cross-disciplinary theory about the dynamics of activities in organizations, as well as of an analysis method based on that theory. The disciplines on which it draws are the philosophical branches of semantics and scientific ontology [Bunge79], and the social theory grounded in language philosophy [Searle69], [Habermas81]. Next to these it incorporates the discrete dynamic system theory as described in [Dietz90]. A relevant set of fragments is constituted by [Dietz92; 94a; 94b] and [VanReijswoud-VanderRijst95]. For an extensive description of the theory and its application the reader is referred to [Dietz-et al96]. Here only a short introduction will be provided.

In DEMO terms an organization is understood as a social system, composed of social individuals called subjects. These subjects influence each others behavior through communication. In order to abstract from the particular individuals and to concentrate on the behavior exposed by them, we introduce the notion of actor. An actor accomplishes a particular function or activity, ultimately performed by a subject. In this view an organization is seen as a system of communicating actors.

The actors in an organization communicate about some world, called the object world. The object world encompasses everything where the communication between actors is about. Next to the object world, a system world is distinguished. A system world as well as its corresponding object world are at every moment in a particular state. The state of the system world represents the progress made in performing activities; the state of the object world represents the results of these activities.

A well-known distinction in levels of abstraction when studying organizations from the perspective of informatics is the distinction between the documental and the informational level. At the documental level an organization is viewed as a system of actors that produce, store, transport and destroy documents.

At the informational level one abstracts from the substance and the syntactic aspect in order to focus on the semantic aspect of information. What one observes now is a system of actors that emit and receive messages (semantic meanings) to and from each other. This is the level where most current methods and techniques (like e.g. the DFD and the ER-model) aim to be helpful.

It appears to be possible to abstract even further by focusing on the pragmatic meaning of these messages, i.e. on their role in carrying on the business activities. Language philosophy provides the necessary instruments for analyzing an organization at this level of abstraction, which we prefer to call the essential level.

What one observes when focusing on the pragmatic aspect is a system in which the actors carry on units of communication that have a particular effect. We call these units conversations. More specifically, they are

performative conversations, i.e. conversations resulting into an actual change of the state of either the subject system or the object world. We distinguish between two kinds: actagenic conversations, resulting in agreements about future actions (agenda of the subject system) and factagenic conversations, resulting in the establishment of facts in the object world. Because only in performative conversations, original new things are accomplished, we consider these conversations to represent the essence of an organization. Furthermore, we call the actions that are agreed upon in actagenic conversations and the results of which are established in factagenic conversations, essential actions, and the conceptualization of the system observed the *essential model* of the organization. Because of the very nature of an organization, essential conversations and actions can only be performed by responsible, authorized subjects. Other activities, such as reproduction and derivation of existing information could be performed by artefacts. These activities are viewed as being part of the informational level of abstraction.

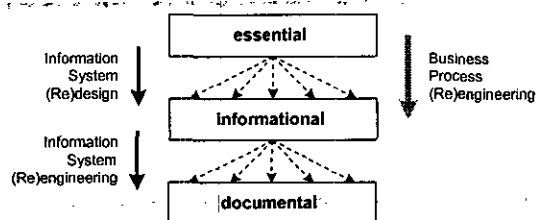


Figure 1 Levels of abstraction in modeling

The relationship between the documental, the informational and the essential level of abstraction is depicted in figure 1. For any organization there exists at any moment one documental model, one informational model and one essential model. In principle, one may conceive of a number of documental models, all realizing the same informational model. Otherwise said, there is a freedom of choice. According to Dietz (1994b), choosing and implementing a documental model is what information system (re)engineering is about. The choices are determined by the available information technological possibilities.

Likewise there is a freedom of choice when transferring from the essential level to the informational level. The choice concerns the purely informational actors, i.e. actors that only reproduce or derive information, and the particular messages by which the essential actors communicate in order to carry on their performative conversations. Choosing an informational model is what information system (re)design is about. It is part of the more encompassing activity of business process (re)engineering.

The core modeling concept in DEMO is the concept of the (essential) transaction. A transaction is considered to be the basic pattern of organizational behavior. It evolves in three phases: the order phase, the execution phase, and the result phase. Figure 2 shows this pattern.

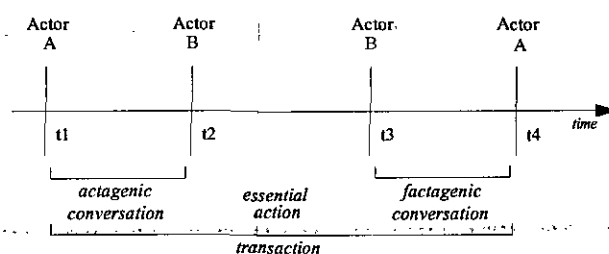


Figure 2 The pattern of a transaction

During the order phase agreement is reached between actor A and actor B about the future execution of an action by actor B. This phase consists of an actagenic conversation, initiated by actor A, starting at t_1 and ending at t_2 . The result is a settlement of the action to be performed by actor B (an action affects the state of the object world). During the execution phase the action is executed by actor B, somewhere between t_2 and t_3 . During the result phase actor A and actor B reach agreement about the things that have been accomplished as a result of the execution by actor B. It consists of a factagenic conversation, starting at t_3 and ending at t_4 . Actor A is referred to as the initiator of the transaction and actor B as the executor.

The behavior of an organization is thus conceived as consisting of carrying through transactions. Every action is embedded in a transaction and every established fact is the result of the successful carrying through of a transaction.

Carrying through a transaction can be viewed as a discrete event process, and can thus be modeled by means of a state transition diagram [Dietz94b]. Every state of a transaction process then is a state of the system world, as opposed to a state of the object world, which is the set of facts established as the result of the successful carrying through of transactions. For example, buying a car or a house is a (transaction) process that may proceed through a large number of distinct subject system states; its successful completion results into the transfer of property which is a fact in the object world.

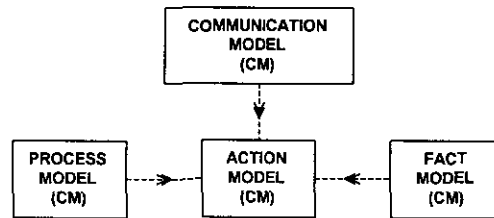


Figure 3 The partial models of the essential model

The essential model of an organization is an integrated whole of several partial models, as summarized in figure three. The communication model contains the identified transaction types and the actors that are involved as initiator or executor. The fact model is a specification of the fact types and the constraints that together constitute the state space of the object world. The process model is a specification of the possible transaction processes for every transaction type. The action model is the specification, as far as possible or known, of the procedures executed by actors.

The double arrows represent one-to-many relationships. So to one and the same communication model, process model or fact model, a number of action models may belong. Otherwise said, the action model is the core model; every other model can be derived from it. Modifying any of the partial models is considered to be a redesign of some business process.

The communication model of an organization is the specification of the influencing by the actors of each other behavior. It is said to represent the interaction structure and the interstriction structure between the actors. By interaction structure is understood the mutual influencing through being initiator or executor of transactions. By interstriction structure is understood the mutual influencing by means of the subject system and object world state elements that serve as data in the condition part of the behavior rules that are executed in carrying through transactions.

Every transaction is initiated during the carrying through of some other transaction, specifically during one of the phases of that transaction. Furthermore, proceeding a transaction may have to wait for the progress up to a certain status of one or more other transactions. The specification of the dependencies in time between transactions constitutes the process model. The fact model is the specification of the state space of the object world. It consists of a specification of all relevant fact types, and the specification of all static constraints. The action model is the specification of the rules for every actor that the actor has to follow in performing essential actions, i.e. in conducting conversations, and in executing objective actions.

4. Modeling IT-enabled Cooperation in Networks of Small Businesses

The study presented here draws on field data collected by the author over a period of six months as part of a larger project directed by one of the participating organizations in the network under consideration. Data collection was carried out through unstructured and focused interviews [Nachmias-Nachmias81] at the participants organizations and review of paper documents and on-line materials. Due to the small size of the participating organizations it was possible to interview most of the staff members in the period of this research.

Although the particular network organization described in this paper is unique in terms of its mission, its organizational structure and the use of technology, it provided an opportunity to generate new hypotheses about the development of cooperation strategies in dynamic networks and useful insights for corporations in similar supply chain situations (c.f. [March-et al91]).

The research problem as well as the research approach is illustrated by a field study based on existing networks of small companies. In this particular study several professionals work together to create books of art, on a project basis (the range of products offered by these networks are often much more extensive, ranging from brochures, flyers, personnel magazines, direct mailings, to advertisement campaigns, but in this example we only took one product for simplicity reasons). Each project is unique, not only in the sense of the product to be delivered but also because each time new type of networks (i.e. configuration of the network) emerge as a result of negotiations between a large number of available printer companies, off-set companies, copy writers, photographers, artists and editors. The often large geographical distances between the participants in this so-called virtual organization could benefit from computer networks to support not only the progress of the project, but also the start and finish of the particular project. Another important benefit relates to the improved competitive advantage and the insight in the progress of the project that can be provided to the current partners in the network.

Results regarding the current organizational structure of the network and interviews with participants show that the cooperative nature of the network (as described in sections one and two) can be regarded as supporting the hypothesis that these networks are more cooperative in nature than traditional organizations in a supply chain. But the actual data are too specific for the network to provide enough support for the initial hypothesis stated in sections one and two.

In this field study, it was observed that during execution of projects lots of changes take place due to additional demands by the customer and problems with the other participants. In many cases the actual negotiated order after offering is not fixed in all details, except for the price. Projects often start with a loose definition. The customer expects the involved company to help decide on the means of conveying the message and the type of product to be delivered. The dynamic nature and the continuously changing constraints require a choice for a modeling instrument that is capable of making a clear distinction between stable and variable features of the network configuration. For example, an important requirement of such a modeling instrument is that one abstracts from the partners cooperating in the network, but instead be able to represent the different functions executed for completing projects.

The network can be designed, by means of constructing the coordination structure on the basis of the communication patterns between the roles played by the participants. The concept of a transaction, as defined in DEMO, is a very useful structuring concept for this purpose. In the following section, an example reference model of such a coordination structure is developed on basis of the DEMO communication and process model.

5. A Reference Model for Network Configuration Management

Many examples of emerging networks show that one party plays the central role or hub in the network (see e.g. [Chesbrough-Teece96]). This party is often represented by the initiator. The hub is commonly referred to as the traffic organization. This doesn't mean this hub plays the key rôle, including with all the responsibilities that are implied with this role, but instead responsibility is more or less equally dispersed over the network. A slight variation can often be found in the contractual relationships between partners in the network. But in one aspect the dependency between partners in the network is clear: If one fails to deliver in time, it will have a negative effect on the on time completion of tasks of almost all the other partners which follow in the course of time. Therefore, identifying the hub in the network is not of primary importance. The actual challenge is to find the goals of the network and the roles participants play in the network associated with these goals.

For building a reference model of the network, the business processes are modeled at the essential level according to section 2. For that reason it is necessary to locate the transactions and actors involved in these transactions, and to abstract from the organizational configuration. The short description of the field study described in the previous section is only a partial reflection of all information gathered. In the field study extensive interviews with the participants revealed the business processes and the underlying conditions and dependencies. Table one summarizes the transactions and actors found in the field study. Note that the actors are an abstraction of the actual organizational configuration. Sometimes one or more functions are performed at one company (e.g. printing and binding, while this is not necessarily always the case but depends on the partner in the project under consideration).

Transaction	Initiator	Executor
T1 Make Offer	A1 Customer	A2 Potential-Editor

T2 Make_Order	A1 Customer	A2 Editor
T3 Create_Art_Work	A2 Editor	A3 Artist
T4 Create_Pictures	A2 Editor	A4 Photographer
T5 Write_Texts	A2 Editor	A5 Writer
T6 Book_Publishing	A2 Editor	A6 DTP
T7 Print_ArtBook	A2 Editor	A7 Printer
T8 Check_PrePress	A7 Printer	A2 Editor
T9 Bind_Books	A7 Printer	A8 Binder
T10 Ship_Books	A7 Printer	A9 Shipper

Table1: Transaction and actors in the field study

Each transaction and actor can be graphically represented in the communication diagram (see figure 4 for the symbols used in this diagram). The business process starts with a customer asking for an offer at various editors (or advertising agencies). The customer decides to choose one of them on basis of a competitive offer. In the diagram of figure 5 the offerings requested by the editor are not included, but are part of the offering process. The diagram focuses on the actual execution of a specific project. The editor in turn creates a planning of the project and passes the information to the various partners in the network, next to the explicit request of delivering part of the project. Deeper in the business process, the other partners are concerned with their part of the project, such as writing, and printing. The dotted lines in the diagram represent informative conversations. For example the writer needs to know when the photos are finished in order to write accompanying text describing these pictures.

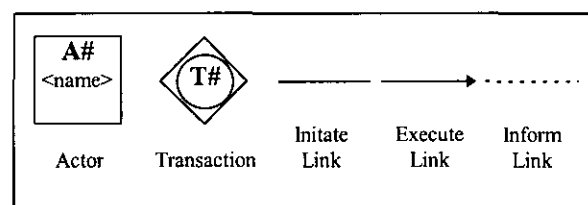


Figure 4 Symbols in the communication diagram

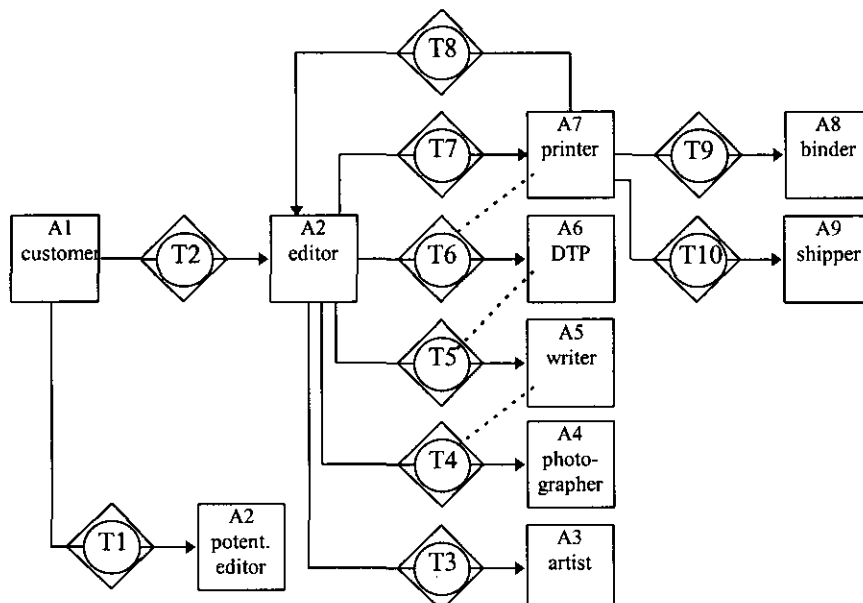


Figure 5 Communication diagram of the field study

Interesting to note is that in a DEMO analysis of a traditional organization normally one starts to distinguish the environment from the organization. In the following step, one would identify the transactions occurring inside

the organization. In the field study the organization's boundary can be placed any where among the represented functions in the network. Most probable this is a characteristic of a network organization.

While the business process depicted in figure 5 may seem a rather straightforward process of linked activities, the communication diagram only shows the success condition line from start till finish. Actually, some transactions show a complex pattern of negotiating between actors. These patterns of communication can be represented in the process model (see for an example: [Dietz-et al96]. The interdependence between the high level transactions and their transaction phases (i.e. opening, execution and result phase), is depicted in a process diagram (see figure 6).

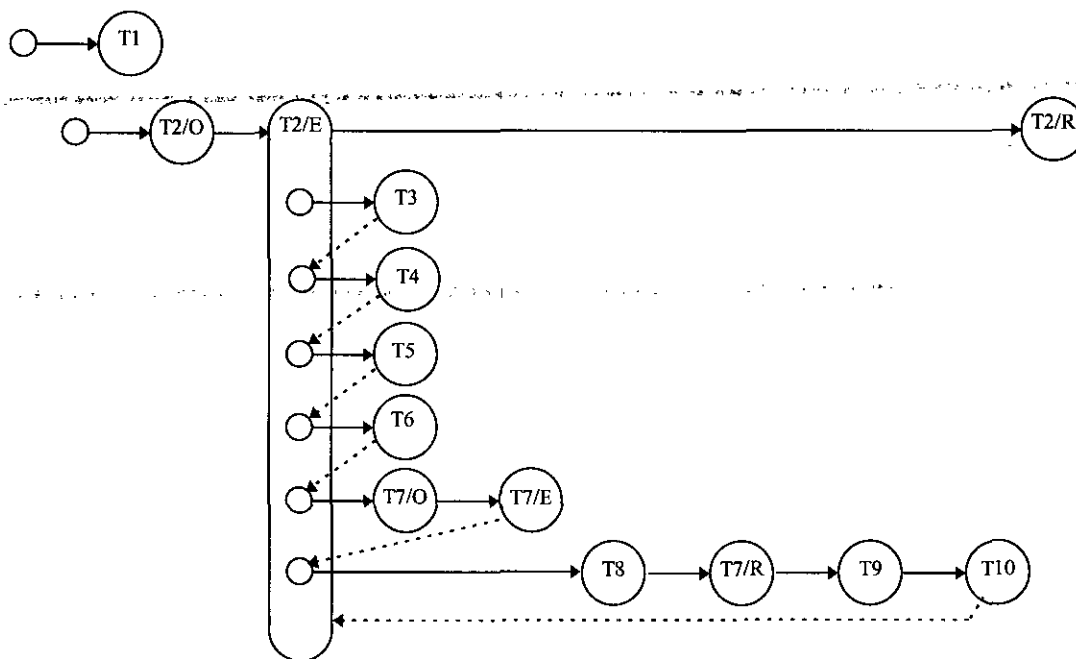


Figure 6 Process diagram of the business process

In figure 6, the abbreviations O, E, and R represent the different phases in a transaction (Opening, Execution and Result phase respectively). Transaction type T1 is included as a separate business process concerned with the offering process between a potential editor and a customer. It involves a different business object (or a fact represented in the fact model) than included in the other transaction types, i.e. an offer. Inclusion of this specific transaction type in the reference model is only useful for a specific editor, but will be excluded in the general reference model.

From the start of transaction type T2 the business process is concerned with the completion of a specific project. This part of the process model represents the execution of operational activities and is in this sense only a partial model for the reference model. For example, the financial structure of the network, such as the payments between the partners can be represented in the same way as currently done for the operational activities, but the initiation of the transaction will be in the opposite direction. Here we concentrate on the operational representation in the DEMO models.

In carrying through of the main business process it is observed that a strong dependency exist between the transactions. For example, transaction type T7 is pending until the editor has approved of the pre-press version (transaction T8). Only after this approval has been given the process will finish and the printer can request binding and shipping (transaction T10). Each transaction can be depicted in its three different phases, but in the diagram only those transactions are divided which function as a condition to another transaction. These conditions are depicted with a dotted line.

The two diagrams serve as primary input for a reference model of future configurations of the network organization. Another important contribution that can be made is reconsidering the current way of doing the business and propose other types with a change in responsibilities or commitments between partners in the network. Further progress in the current project will show the viability of the approach and generate new ideas for adapting the reference structure. An important next step currently undertaken is the translation of the

coordination structure in a supporting information and communication system. The general idea is to construct such a system out of existing (Internet-) tools which provide parts of the functionality needed in the network. A method currently used in this decision process is RENISYS (see next section).

6. Related Research

Research disciplines that serve as input to the research project reported in this paper are obviously CSCW [Greiff88] and its application in Groupware [Coleman92]. Current research issues in these fields are also directed towards development and implementation of Internet (or Intranet-) based tools. An important missing element is that they still do not cover the type of organizations mentioned in this paper. Either these tools are meant for loosely coupled groups of people (such as communities, described in [Harasim93]), or planned to be used in an, often globally dispersed, internationally operating company with more or less fixed boundaries.

In the same way, business networks do not form a common group with for example one clearly defined cultural background. Instead, the parties involved try to attain their own goals within the possibilities given in the network, such as striving for a high profit margin vs. accomplishment of the customer's request and the customer's satisfaction.

The same issues play an important role when companies along a supply chain try to integrate their business. Bowersox and Closs (1996) showed that organizations which aim at a high integration of their business activities will evolve from customer-supplier relationships towards more integrated networks when they start exchanging tactical and strategic level information (e.g. medium and long term production planning information).

A strongly related research project worth mentioning here is the development of the RENISYS framework [DeMoor96; DeMoor-VanderRijst95; VanderRijst-DeMoor96]. The aim of this approach is to build a specification method for research network information systems. Business networks and research networks share some important characteristics, such as horizontal coordination, independence of participants and establishing goals of the network as part of the ongoing activities in the network.

More related to business networks, the transaction cost approach [Williamson79] has focused on the determination of the boundaries of firms, and as such has been a source of inspiration for research of new organizational forms. The traditional dichotomy between markets and hierarchies has been replaced by electronic markets and electronic hierarchies [Malone-et al87]. A major problem with the research in this direction is that the attention is focused on modeling organizations and economic exchange relations rather than the analysis and development of network supporting information systems.

An interesting example of related research not aimed at professional networks is the negotiation protocol described in Chang and Carson (1994). This protocol is based on speech acts. Negotiation by means of speech acts is also part of the Transaction Process Model in DEMO. However, DEMO highlights the commitments of the participants resulting from successful transactions, making this approach more suitable for business communication modeling.

7. Conclusions

In this paper the analysis and design of a dynamic network organization have been described. Part of a large field study was used as the guiding example for the analysis phase. The design part of the study build further on the results of the analysis phase, and aimed at the development of a reference model for dynamic network forms. The reference model has been made on basis of the horizontal coordination structure between roles in the network. The DEMO communication model provided a suitable structuring mechanism for this task.

In relation to the aspect of cooperation strategies in emerging type of networks it is interesting to note that preliminary results show that such behavior can be observed in the network under consideration in this research project. More evaluating studies are needed to test this hypothesis. Here the research project was aimed at generating new hypotheses for future research as defined in section four.

Another important aspect mentioned in the introduction of this paper was especially concerned with the dynamic nature of the described networks. Because of this reason, the tools to be developed need to be radically tailorable from the view point of the future user (or network participant), but is also necessary to define the stable aspects in contrast to the more dynamic implementation issues. The essential model is a useful instrument to represent these aspects with a focus on the processes to be executed independent from current organizational

configurations. It also serves as the basis for the translation in the informational and documental levels as defined in section 2. Some results regarding this mapping process have been discussed in section four.

In the current phase prototype implementation platforms are chosen on basis of existing tools. In the following phase of the research, a first round of experiments with this prototype will be conducted. Results from these experiments will be fed back as input for a new prototype tool set and used in a different setting to ensure a more general applicability. Important issues to be addresses are concerned with a possible inclusion of customers as part of the network and problems associated with the security of the network information and communication system.

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Modelling the Dynamics of Contract Negotiation and Execution

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Abstract

The dynamics of contract negotiation and execution can be viewed as a sequence of deontic states in which certain contractual obligations hold. In the negotiation phase new obligations are introduced by negotiated contracts, and in the subsequent execution phase obligations disappear when they are fulfilled by performing the obliged actions. This sequence of deontic states can be represented in the Deontic Deep Structure Models that were introduced in [TT96]. The transition between the states in a DDSM was analyzed only informally. Here we investigate how the illocutionary dynamic deontic logic of Dignum and Weigand can be used to formally analyze these transitions. When we applied the illocutionary dynamic deontic logic to the transitions within a DDSM, it appeared that this logic has to be extended using persistence axioms. Such axioms guarantee that formulas introduced in one state will be true in the successor states. In this paper we discuss several persistence axioms.

1. Introduction

A contract life cycle can be viewed as a two-phase process; the negotiation phase and the execution phase. In the *negotiation phase*, the parties negotiate the content of the contract by communicating with each other. In the *execution phase*, each party fulfils his contractual obligations by performing the actions which he is obliged to do. In [TT96] a formal framework was introduced, the so-called *Deontic Deep Structure Model (DDSM)* in which the active obligations, induced by a contract, are represented in successive states within this model. Each state in the model represents the obligations that are active at that point of time. Once an obligation is fulfilled, it is deleted from the list of active obligations. Hence, at the end of the contract life cycle the list of active obligations is empty.

Electronification of trade procedures in electronic commerce; i.e., adapting trade procedures to make them applicable in electronic networks environments, can be viewed as a redesign process of procedures. In the case of redesign of procedures it is essential to understand the underlying functionality of the procedure. For what purpose was the procedure introduced? Why were certain documents introduced? And, more specifically for redesign, is the procedure still needed, or can the underlying functionality be implemented by a more efficient procedure. Currently, the usual redesign approach to electronification of trade procedures is simply to replace paper-based documents one-to-one by electronic data interchange (EDI) documents, but this approach does not make the best use of the potential of electronification (see e.g. [KW96]). In particular, electronifying every document in a procedure does not address the issue whether parts of or even the whole procedure is still needed in an electronic environment. One could describe the currently dominant approach to electronify documents one-to-one into their electronic counterparts as a type of superficial redesign. In contrast with a type of redesign, which one could call deep redesign, that is based on first modeling the underlying functionality of the whole procedure. In many procedures documents play a crucial role. For example, passport for identification, import or export clearance documents, bills of lading as proof of shipment in international sea transport. The purpose of most of these documents is fraud prevention or detection. In general, one could say that fraud means that somebody violated his obligation to do action p, while he pretends to have done p. These fraud prevention and detection functions of documents are best analyzed in relation to the obligations and rights that they are supposed to secure. Since obligations are essential for fraud analysis, it is an obvious choice that the underlying functionality of procedures should be analyzed using deontic logic. Deontic Deep Structure Models can be used to model the functionality of a procedure.

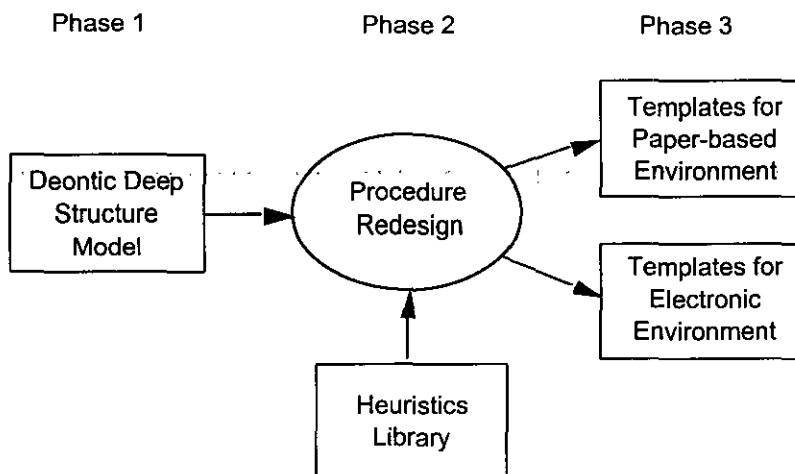


Figure 0. Procedure Redesign Methodology

The ultimate objective of the research at Euridis is to develop a computer-supported methodology for procedure redesign that consists of the following three phases that are represented in Figure 0. First, a deontic deep structure model of the existing procedure is developed. Secondly, to this model we apply a library of heuristics that can be used to reduce the risk of fraud related to this specific deontic deep structure model. These heuristics take as input this deontic model, and they produce as output a template for a procedure that include paper or EDI documents which give optimal protection against potential fraud. The third phase is that these templates are graphically represented as Petri nets, which are generated with the modeling tool INTERPROCS that was developed at Euridis (e.g. see [BLW95]).¹ The heuristics for an electronic environment might be different from a paper-based environment. For example, implementing a signature on a paper document is completely different from implementing an electronic signature on an electronic message. Another example is that in an appropriately secured electronic environment the EDI version of a passport might be no longer needed, because the communication protocol is defined in such a way that nobody can present himself on the network as another person.

In a DDSM deontic logic is used to represent the active obligations in a particular state. However, The transitions between the successive states of a DDSM are only modelled informally in [TT96]. In this paper we discuss how a formalism, based on speech act theory and dynamic deontic logic, developed by Dignum and Weigand [DW94], can be used to formally analyse the transitions in a DDSM. The basic idea is that the introduction of a new contract can be viewed as a speech act by which a set of new active obligations are introduced. Since the state transitions in a DDSM represent the dynamics of the contract life cycle, this formalism also models the dynamic aspects of the contract life cycle. When we applied the illocutionary dynamic deontic formalism to the transitions within a DDSM, it appeared that this formalism has to be extended using persistence axioms. Such axioms guarantee that formulas introduced in one state will be true in the successor states. In this paper we investigate several persistence axioms. We argue that the persistence axiom needed for deontic formulas is quite different from the persistence axiom necessary for factual formulas. The fundamental difference is that obligations persist until they are fulfilled, whereas factual formulas persist until they conflict with new facts. We also show

¹ The modelling tool INTERPROCS used to be called Case/EDI. This name was recently changed into the new name INTERPROCS.

how complicated problems can arise due to the interference between deontic and factual persistence.

2. The two phases of a contract procedure

A contract procedure can be viewed as a two-phase process; the negotiation phase and the execution phase. In the *negotiation phase* the parties negotiate the content of the contract by communicating with each other. In the *execution phase* each party fulfils his contractual obligations by performing the actions which he is obliged to. The following figure shows a contract life cycle:

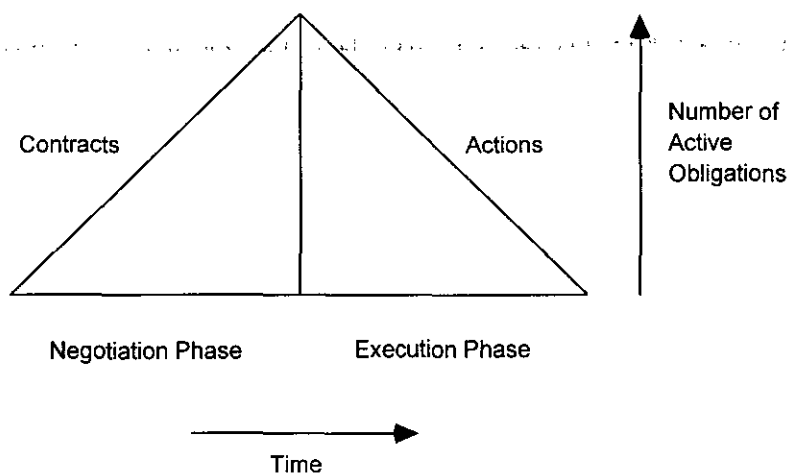


Figure 1. Model of a Contract Life-Cycle

We assume that at the beginning of a contract life cycle none of the parties has any obligation to the other. New obligations will be introduced in each state of the negotiation phase, which will be fulfilled during the execution phase. In the figure above it is assumed that no negotiation will occur after the execution phase has started. The content of the contract is the list of obligations produced in the final state of the negotiation phase, when no more obligation are added to the list. The execution phase starts at the end of the negotiation phase and stops when all obligations are fulfilled. The obligations are relativised and directed such that each obligation involves an obligor and an obligee.

Figure 2 shows an example from international trade where two parties, the buyer and the seller, agree on a contract. The example represents a simple trade transaction between a

buyer (agent B) and a seller (agent S) (for further details see [TT96]). In the initial state neither of the agents has an obligation to the other. The first step in the contract negotiation process is that both agents agree to the terms of a purchase order. This agreement creates an obligation for the seller to deliver certain goods which, in return, creates an obligation for the buyer to pay for the goods. The resulting situation is shown in state 1 of Figure 2. The seller can either deliver the goods himself (direct action) or hire somebody to do it for him (indirect action). Let us assume the seller does it indirectly. In the second state, the seller makes a contract with a transport company T for the goods to be delivered to the buyer after the seller has paid the transportation costs. In this example, we also assume that it is stipulated in the contract that T is not allowed to subcontract this transport. (Such a condition is frequently made if the transport company is chosen for its specific skill in transporting a certain type of goods, e.g., Horowitz's grand piano.) Hence, the transport is a direct action for the transport company. An interesting aspect of this example is that, in spite of the fact that the transport company has the obligation to transport the goods to the buyer, this obligation is not to the buyer, but only to the seller. In case of non-delivery of the goods, the buyer will make a claim against the seller, and not against the transport company. Of course, if the seller is sued by the buyer, then the seller in turn will make a claim against the transport company for non-delivery.

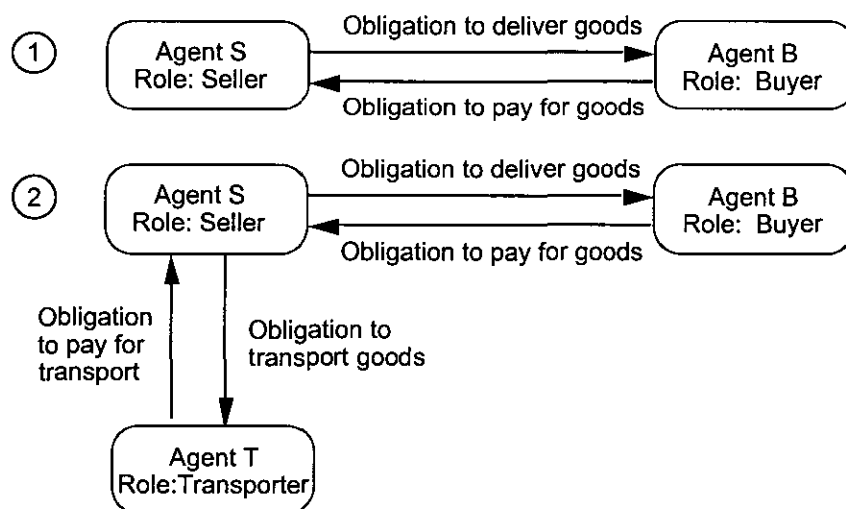


Figure 2. Transport Scenario

3. Formalisation of a contract life cycle

To formalise a contract life cycle as it has been presented above, we need a framework that allows us to express both the negotiation and the execution phase in a logical language. The use of speech act theory and illocutionary logic for formalising the communication between the parties in the negotiation phase of a contract life cycle has been advocated in various articles by Lee and Dewitz (see e.g., [DL89], [De92]). They use performative speech acts in order to express legal acts. An example of a legal act is given in [De92] as “ABC Inc. offers to sell one million shares of common stock at \$35 per share ...” which performs the legal act of offering to sell stock. The idea is that such a performative speech act results in a legal statement, i.e., an obligation will be created for an agent to perform a certain action.

Formalising the execution phase of a contract procedure requires a logical language which makes it possible to express the actual individual actions of the agents.

Dignum and Weigand have recently developed a logical language based on dynamic deontic logic for modelling the communication between the contract parties (see [DW94] and [WVD95]). Their ideas are presented below.

Propositional dynamic logic is a normal propositional language extended with modal operator $[\alpha]$ for each action α in the language (for further details see [Se93] or [Go87]). The expression $[\alpha]\phi$ means that performance of action α necessarily leads to a state in which proposition ϕ is true.

If Act is a set of actions then an action $\alpha \in Act$ can be in one of the following forms:

- (i). α elementary action,
- (ii). $\neg\alpha$ stands for the non-performance of the action α ,
- (iii). $\alpha_1 \cup \alpha_2$ stands for the choice between the two actions α_1 and α_2 ,
- (iv). $\alpha_1 \& \alpha_2$ stands for the parallel execution of the actions α_1 and α_2 ,
- (v). any stands for any action,
- (vi). fail stands for the action that always fails.

The syntax of propositional dynamic logic is given as follows:

1. Every propositional letter is a formula.
2. If ϕ is a formula then $\neg\phi$ is a formula.
3. If ϕ and ψ are formulas then $(\phi \wedge \psi)$, $(\phi \vee \psi)$ and $(\phi \rightarrow \psi)$ are formulas.
4. If ϕ is a formula and $\alpha \in Act$ then $[\alpha]\phi$ is a formula.

The formal semantics of propositional dynamic logic is given as a Kripke possible world model $M = (U, R)$, where U is any set of states and R is a set of binary relations in U . We write $M, s \models \phi$ to denote that the formula ϕ is true in a state s in a model M . An action α is understood as a binary relation in U . For each $\alpha \in \text{Act}$ there is an accessibility relation $R_\alpha \in R$. If $R_\alpha ss'$ holds, then we say that state s' is reachable by action α from state s . For example, action α to pay a bill of \$10 can be represented as a transition $R_\alpha ss'$ from a state s in which the bank account is $\$x$ to the next state s' in which the bank account is $\$x+10$. A formula of the form $[\alpha]\phi$ is true in a state s of a model M , written $M, s \models [\alpha]\phi$, if for all states s' reachable by action α from state s holds that ϕ is true in state s' , written $M, s' \models \phi$. The semantic definition of non-modal formulas is as usual.

By introducing a constant V which stands for Violation, the deontic operators O (obligation), P (permitted) and F (forbidden) can be defined in dynamic deontic logic [Meyer 88] as follows:

$$\begin{aligned} O\alpha &\equiv [-\alpha]V, \\ F\alpha &\equiv [\alpha]V, \\ P\alpha &\equiv \neg[\alpha]V. \end{aligned}$$

The informal meanings of the above definitions are: if there is an obligation for an action α , then not doing α will necessary lead to a violated state; if action α is forbidden, then doing α will necessary lead to a violated state, and if action α is permitted, then it is not the case that doing α will necessary lead to a violated state, respectively. In order to model the communication between two agents, the language of dynamic deontic logic is extended in [DW94] using the following elements:

1. A class of agents Ag .
2. Speech acts are added to the set of actions Act .
3. Actions are parameterized such that the first parameter represents the agent of the action.
4. Deontic operators are indexed, for instance $O_{ij}(\alpha)$ means that "agent i has an obligation to agent j to perform action α ".

The basic speech acts added to the set of actions are as follows:

$DIR(i, j, \alpha)$ - i does a request to j for α
 $COM(i, j, \alpha)$ - i commits himself to j to do α

ASS(i,j,p) - i asserts to j proposition p

DECL(i,j,p) - i declares and informs j that p holds from now on

The first (i) and the second (j) parameter represent the speaker and the addressee respectively, and the last parameter represents the content of the speech act. The set of all speech acts $SAct$ are defined as:

1. All basic speech acts are elements of $SAct$.

2. If $\alpha \in SAct$ then $IP(i,j,\alpha) \in SAct$ and $IP(i,j,-\alpha) \in SAct$, where $IP \in \{DIR, COM\}$.

The resulting language is called L_{ACT} .

Two different relations, namely a power and an authorisation relation, are defined between two communicating agents. The power relation is denoted as $j <_{\alpha} i$, which means that agent i has power over j with respect to action α . The authorisation relation is denoted as $auth(i,\alpha)$, which means that agent i is authorised to do α . For more details, we refer the reader to [DW94]. A number of axioms are given that stipulate how speech acts depend on the relation between the communicating agents. Examples are:

$$\begin{aligned} ([DIRp(i,j,\alpha)] O_{j,i}(\alpha)) &\leftarrow j <_{\alpha} i, \\ ([DIRa(i,j,\alpha)] O_{j,i}(\alpha)) &\leftarrow auth(i, DIR(i,j, \alpha)). \end{aligned}$$

3.1 Persistence axioms for obligations

We assume that there are no obligations in the initial state of the negotiation phase in the contract life cycle model. In each new state, one or more obligations are added to the set of obligations. The figure below shows the successive states of a contract life cycle. Each state represents the obligations between the agents that are active at that particular moment.

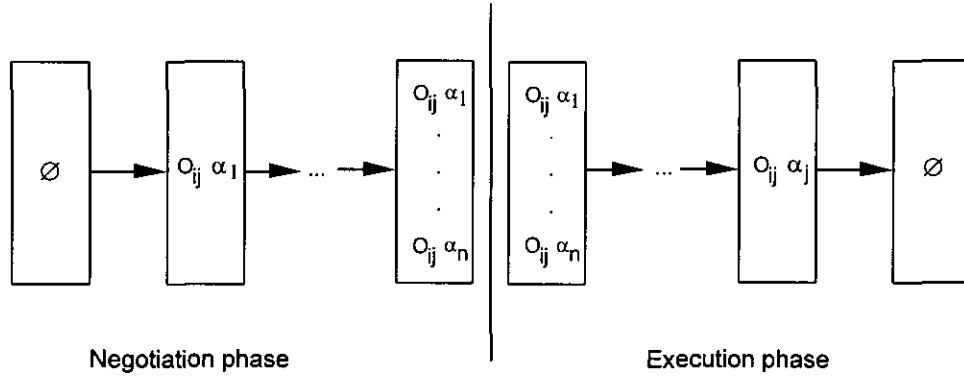


Figure 3. Deontic States of the Contract Life Cycle model

In [TT96], we introduced the concept of *Deontic Deep Structure Model* (DDSM) for this type of models. For the motivation and usefulness of such models for the redesign of business procedures, the reader is referred to [TT96]. Figure 4 is the deontic deep structure model for the Trade Scenario discussed in the introduction. In the initial state s_0 , none of the agents has an obligation. Contract 1 concerning sale of goods between seller S and buyer B yields the transition from state 1 to state 2. The symbol D represents the delivery action and M represents the payment action. In state s_1 is represented that both the seller and the buyer have an obligation. The seller S has the obligation to deliver the goods to the buyer B, i.e., $O_{sb}(D)$, and the buyer has the obligation to pay the seller for the goods, i.e., $O_{bs}(M)$.² Contract 2 between agent S and agent T concerning the sub-contracting of the delivery of the goods yields the next transition. In state s_2 , the seller S and the transport company T have new mutual obligations because of contract 2. The transporter now has the new obligation to deliver the goods, i.e., $O_{ts}(D)$, in return for which the seller has the new obligation to pay the transporter for this service, i.e., $O_{st}(M)$.

² In [TT 96], we gave a different semantics for the deontic operator $O_{ij}\phi$ than the dynamic deontic semantics of Dignum and Weigand discussed in this paper. We also use the action operators E (direct action) and G (indirect action) in the scope of the deontic operator. So, for example, the formula $O_{sb}(sGD)$ is used rather than $O_{sb}(D)$. However, since these differences are not relevant for the present discussion, we assume the dynamic deontic interpretation and we omit action operators.

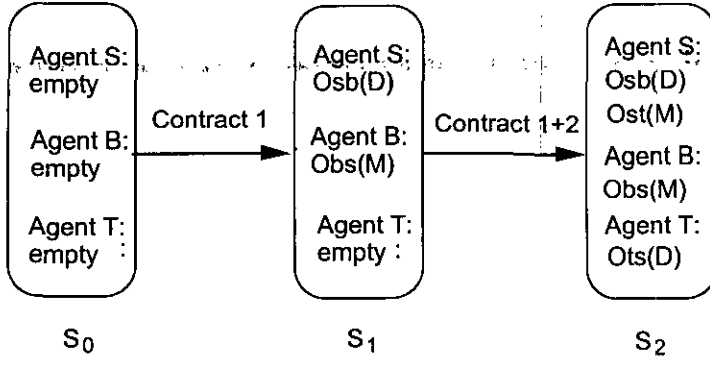


Figure 4. Deontic Deep Structure Model (DDSM) for the trade scenario

In [TT96], we gave only an informal analysis of the transitions between the successive states of a deontic deep structure model. Here we want to study if and how the illocutionary logic of Dignum and Weigand can be used to analyse the dynamics of the contract life cycle that is modelled by these transitions in deontic deep structure models. The basic idea is that the contracts that introduce new obligations are modelled as speech act operators. The most obvious choice for contractual speech acts is commissives (COM). For example, we could represent the signing of Contract 1 that induces the transition from state s_0 to state s_1 by the following sentence.

$$[\text{COM}(s,b,D)] \text{Osb}(D) \wedge [\text{COM}(b,s,M)] \text{Obs}(M).$$

The performance of these speech acts, i.e., the actual performance of the actions $\text{COM}(s,b,D)$ and $\text{COM}(b,s,M)$, is the signing of the contract. The states in a DDSM can be seen as states in a Kripke model of the logic L_{ACT} . Intuitively, there is the following correspondence between a Kripke model and the DDSM. If the transition between s_0 and s_1 in Figure 4 is an action of type $\text{COM}(s,b,D)$, i.e., the signing of the contract, then, due to the contract clause $[\text{COM}(s,b,D)] \text{Osb}(D)$, the obligation $\text{Osb}(D)$ is true in the next state s_1 . Technically, this means that s_1 is accessible from s_0 via action $\text{COM}(s,b,D)$, i.e., the relation $R_{\text{COM}(s,b,D)} s_0 s_1$ holds. This correspondence gives a formal explanation of the informal notion of transitions in a DDSM.

The problem with this formal analysis is the non-persistence of formulas in dynamic logic. This can be explained as follows. When $\text{Osb}(D)$ is introduced in state s_1 , we also expect this obligation to hold in all successive states in the DDSM, until it is fulfilled by the actual performance of action D . In dynamic logic, this can only be obtained by requiring that all these successive transitions are $\text{COM}(s,b,D)$ transitions. This is, however, unintuitive if we think of $\text{COM}(s,b,D)$ as the actual action in time of signing the contract. It is not the case

that contracts are only valid if they are continuously signed by all parties (e.g., every morning at breakfast time). In order to solve the problem of persistence in dynamic logic, we have to add persistence axioms to the logic L_{ACT} . The following persistence axiom (PA) is inspired by frame axioms from defeasible reasoning.

PA If a formula ϕ holds in a state s_i , then it will also hold in all successive states s_j (with $i < j$), unless the action that introduced state s_j results in $\neg\phi$ becoming true in s_j .

However, this persistence axiom gives some unintuitive results for obligations. First of all, PA makes sense for defeasible obligations, i.e., obligations that were assumed to be true, but that can be withdrawn if new conflicting evidence becomes known. For non-defeasible obligations this axiom is less convincing. Consider the following example. At some state, according to a contract X , agent i has to deliver goods to agent j , i.e., $O_{ij}(D)$. Subsequently, i also accepts a contract Y with a third party K forbidding i to trade goods with parties other than K (e.g. exclusive import contract). If we assume that this prohibition implies that i cannot be obliged to deliver goods to j , i.e., $\neg O_{ij}(D)$, then both $O_{ij}(D)$ and $\neg O_{ij}(D)$ are true, and we do not want $O_{ij}(D)$ to be withdrawn *only* because $\neg O_{ij}(D)$ was introduced. This would be an easy way for agent i to solve his conflict of interests. Clearly, agent i made a mistake, but in order to model this mistake we must be able to model what went wrong in a DDSM! ³ Another, and more serious problem is that PA does not capture deletion of obligations by fulfilment. In the deontic deep structure model, states represent the set of active obligations at a particular point in time. After the obliged action is performed the obligation is no longer represented in the next state, because the obligation is no longer active. Hence, there are cases where the persistence of obligations is cancelled due to confirming rather than conflicting information. We propose the following alternative persistence axiom for deontic formulas.

D-PA If an obligation $O_{ij}\alpha$ is true in state s_i , then $O_{ij}\alpha$ is also true in all the future states s_j (with $s_i < s_j$), unless the action that introduced state s_j results in α becoming true in s_j .

We say that an obligation $O_{ij}\alpha$ is fulfilled in state s_i , if α is true in s_i . We restrict the application of D-PA to formulas of the form $O_{ij}\alpha$, because fulfilment by an action does not make sense for non-deontic formulas.

³ This also shows that states in a DDSM are not deductively closed sets of sentences. In this respect, states in DDSM are different from states in standard dynamic logic, which are deductively closed.

The effects of the fulfilment of an obligation can be represented in two different ways in the DDSM; by deleting the obligation in the next states, or by deleting and introducing the negation of the obligation in the next state.

(1) If an obligation $O_{ij}\alpha$ is fulfilled by the action that introduced state s_i , then it will be deleted from the list of obligations in the next state s_{i+1} .

(2) If an obligation $O_{ij}\alpha$ is fulfilled by the action that introduced state s_i , then it will be deleted from the list of obligations in the next state s_{i+1} , and its negation $\neg O_{ij}\alpha$ is added to the list in the next state s_{i+1} .

Note that one way to obtain option (2) could be by introducing the convention that $[\alpha]\neg O_{ij}\alpha$ is always true for transitions in a DDSM. This formula contains the action α that fulfils the obligation $O_{ij}\alpha$. To distinguish these two different effects of fulfilment we will refer to D-PA with the first option as D-PA.1 and the second as D-PA.2. Note that the first problem that we discussed for PA also applies to D-PA.2. Hence, we prefer D-PA.1 to D-PA.2.

The non-persistence problem of dynamic deontic logic is related to another problem in deontic logics based on dynamic logics that was observed by several researchers (e.g. in [JA96]). We call this the *Immediate Fulfilment Property* (IFP). If an obligation $O\alpha$ is defined as $[\neg\alpha]V$, then this obligation has to be fulfilled immediately. If $[\neg\alpha]V$ is true at a state s in a model M , then the obligation is violated in any successor state s' in which the action α was not performed. Clearly, IFP is unintuitive, because, in many real world cases, fulfilment of obligations can be postponed. For example, payment is usually not something you have to do the moment you receive a bill, but there is a fixed period of, say, one month within which you have to pay the bill. In a DDSM, this immediate fulfilment property would imply that all obligations of a state s_i in the negotiation phase are violated, if the fulfilment of these obligations is postponed until the execution phase, and this phase starts later than s_{i+1} . The time difference between the introduction of an obligation and its fulfilment is a fundamental assumption of the contract life cycle model. Hence, the IFP of dynamic deontic logic makes this logic less suitable for modelling this time difference in a DDSM. Currently, temporal versions of dynamic deontic logic are being developed which do not have IFP (see [DK96]). These temporal dynamic deontic logics (TDDL) contain formulas such as $O(\phi < \alpha < \psi)$, which express that action α has to be performed after ϕ has become true, but before ψ becomes true. Such formulas are more suitable for modeling the

time differences in a DDSM than the deontic expressions in dynamic deontic logic. However, TDDLs have not yet been applied in the illocutionary logical framework of Dignum and Weigand. We hope this will be done soon. Here, it is important to observe that the solutions provided by temporal deontic formulas for the IFP problem do not automatically solve the non-persistence problem. Even in a TDDL we need the persistence axioms discussed above to make sure that a formula of the form $O(\varphi < \alpha < \psi)$ remains true until it is fulfilled, after it was introduced by a specific speech act.

4 Representing real world changes

In the trade scenario example we only modelled obligations in the DDSM. We assumed that every state transition in a DDSM is the result of a speech act or an action performed by an agent. However, many changes in the world are not brought about by any specific agent, e.g., real time changes or weather changes. These type of changes are not captured in the framework presented in this paper, which means that they do not cause any state transitions in our system. In fact, obligations in a contract are usually conditional in form meaning that the obligation is activated when its condition is satisfied. Consider the case that a condition of an obligation can be satisfied as a result of a real world change e.g., a transport company has an obligation to deliver some goods only if it is not raining. The fact that it is not raining is not a fact which is brought about by any agent. In order to formalise all aspects of a contract life cycle appropriately we need a framework in which also real world changes can be represented. If we want to represent this type of changes in a DDSM, we have to represent fluent facts in the DDSM. *Fluent facts* are facts that can change (even continuously!) over time. For example, the credit in your bank account typically changes over time, as does the position of transported cargo. In the dynamic deontic logic framework we need an explicit persistence axiom for fluent facts, for the same reason it was needed for the deontic formulas: otherwise there is no guarantee that a fluent fact does not change its value, unless an action changes it. For example, the cargo moves from one location to the other due to movement of the vessel carrying the cargo.

FF-PA If a non-deontic formula φ holds in a state s_i , then it will also hold in all successive states s_j (with $i < j$), unless one of the performed actions that introduced state s_j results in $\neg\varphi$ becoming true.

The problem with having two different persistence axioms D-PA and FF-PA in one logical framework is that they can interfere. First of all, it is not clear how one should treat complex

formulas that contain both deontic expressions as well as fluent fact expressions. An easy solution, and probably the only well-motivated one for this problem is that we do not allow for complex expressions in the states of a DDSM: only literal formulas are allowed. In addition, there is an even more complicated interference between the deontic and factual persistence axioms. Consider the example of someone obliged to pay tax if the credit on his bank account is above a certain threshold n . Clearly, if the credit is above n at state s_i , an obligation is introduced to pay tax. According to D-PA, this obligation will persist until it is fulfilled by the action of paying the tax. However, if, at the next state s_{i+1} , the credit is below n , then the reason for the obligation has gone, and one would expect the obligation to disappear as well. But this does not follow from D-PA. Hence, if an obligation is activated by a fluent fact, then its persistence should also depend on this fluent fact. This means that if we also represent fluent facts in a DDSM, then we have to add FF-PA, and, moreover, we have to modify D-PA in such a way that the persistence not only depends on fulfilling actions, but also on the facts that activated the obligation.

5. Conclusions

In this paper we have discussed how the dynamic aspects of a contract life cycle can be modelled in a deontic deep structure model (DDSM). We investigated how a formalism developed by Dignum and Weigand, based on speech act theory and dynamic deontic logic, can be used to formally analyse the dynamic transitions between the states within a DDSM. In applying the illocutionary dynamic deontic formalism to the transitions within a DDSM it became clear that this formalism had to be extended using persistence axioms. Such axioms guarantee that formulas that are introduced in one state will be true in its successor states. Several persistence axioms were investigated. We argued that the persistence axiom needed for deontic formulas is quite different from that needed for factual formulas. One difference is that obligations persist until they are fulfilled, whereas factual formulas persist until they conflict with new facts. We showed how complicated problems can arise due to the interference between deontic and factual persistence.

We did not address the more complicated question of default beliefs and their persistence axioms. For example, if you receive a shipment notification document, you assume that the shipment of goods has actually taken place as indicated in the document, unless you get information that the document was forged. This type of persistence of default belief is essential for modelling the fraud aspects in a contract life cycle. If the document is real, then shipment notification induces the obligation for the buyer to pay the seller for the shipped

goods. If the document turns out to be a fake, however, then the seller immediately revokes his payment obligation, and wants his money back. In future research we will investigate how deontic deep structure models can be extended to model also such default beliefs. Since, this type of fraud is related to communicating messages (e.g., shipment notification document) we expect that the speech act operators introduced by Dignum and Weigand could also be useful in modelling this type of fraud.

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Speech Act Based Modelling for Workflow Management Systems

A Case Study

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The automation of workflows has attracted an increasing attention in recent years. However, most of this attention is aimed at the technical design of these systems. Significantly less attention is aiming at the understanding of environment in which these systems are implemented. In this paper we present the DEMO modelling approach as a way to understand the workflow environment as a network of commitments with essential, informational and documental characteristics. In this paper we present an extract of a larger case study in which DEMO is used to provide a better understanding of the workflows with the aim to implement a workflow management system

1. Introduction

Since the conceptualisation of organisations has become more process oriented, workflow and process management have become important areas of research and development in the last few years. Kremers reports that this increasing attention has materialised in more than 300 different applications in the Netherlands alone (Kremers, 1996). Most of the attention in the area of workflow management, however, is oriented at the technical design of workflow management systems, while significantly less attention is paid to the modelling of the organisational environment in which the system has to operate. Like different kinds of automation, a successful implementation of a workflow management system also needs to be founded in a sound understanding of the business process (Basu, Blanning, 1997). In the first place this understanding is necessary to get a good fit between the organisation and the implemented system. In the second place, and this is especially the case with the implementation of workflow management systems, the understanding is needed to evaluate whether the current situation needs to be optimised with a business process reengineering project (Schäl, 1995; Bitzer, Kamel, 1997).

According to Kwan and Balasubramanian (1997) a modelling approach for workflow management has to be flexible, expressive and structured. The modelling approach

must be flexible enough to describe variety in a process design and to accommodate exceptions. The modelling approach needs to be expressive enough to allow both analysts and users to specify workflow relatively quickly and easily. Finally, the approach must be structured to facilitate workflow analysis. In this paper we present the DEMO approach (Dietz, 1996; 1995) as a modelling approach in the language action area that meets these requirements. In the first place the DEMO approach describes the workflows in terms of essential transactions that instantiate at an informational and documental level in the organisation. Herewith it integrates both a stable description with a flexible understanding. Recent comparative research (Reijswoud, Heuvel, 1997) as well as the experiences in the case study indicate that the approach is both expressive and easy to use. Finally, the DEMO approach is also a suitable approach for the analysis of business processes for the purpose of optimising business processes (Dietz, 1994a; 1994b; Reijswoud, Rijst, 1995; Reijswoud, 1996).

The paper is organised as follows. In section 2 we present a brief introduction to the traditional perspective on workflows and workflow characterisations. In section 3 we describe the language action perspective on workflow modelling in general and the DEMO approach in particular. In section 4 the DEMO analysis of a case study is presented. The analysis and the DEMO model is part of a larger study that covers all phases of systems development. Because of space limitations, a full description of the subsequent phases is not included in the paper. Finally in section 5 the results of the application of this method are evaluated and some conclusions are drawn.

2. Workflows

Organisations and their members are traditionally viewed as being engaged in series of activities that produce inputs of value to a certain customer. An organisational process is in that view a set of logically related tasks that transforms a set of inputs into outputs of value to a customer. In line with this conceptualisation of businesses, the most commonly used definition of workflow is that of a flow of information and work through one or more organisational entities involved in business processes. Within anyone business process, the workflow may span a set of activities conducted by one or more groups of resources (people, machines), with the activities occurring in some meaningful schedule (Basu, Blanning, 1997). Joosten et al. (1994) state that the emphasis on men and machines is necessary to understand the dynamics of the work.

Workflows are often described in terms of activities, processes and triggers. Activities need to be understood as a collection of actions that are supervised. A set of activities is defined as a process, while the notion of a trigger is used to explain the start of the execution of an activity. Some researchers emphasise that a trigger needs to be a tangible object, like forms or declarations. An activity is performed by or under the responsibility of an actor (man or machine) and activities are triggered by events. On the basis of these terms a workflow is defined as a system of activities that are related by means of a trigger relation (Joosten et al., 1994).

There are various ways in which the workflows in organisations can be characterised. Joosten et al. divide the characteristics of workflows into three categories:

- Ad hoc versus structured;
- Task-oriented versus process-oriented;

- Technology-oriented versus organisation-oriented.

Structured workflows exhibit a predetermined pattern, while an ad hoc workflow is considered to be dynamic and with an unpredictable structure. A workflow is process-oriented when it focuses on the route that is followed by that workflow while a task-oriented workflow focuses on the activities. When workflow management is considered from a technological point of view, the technology to support workflows are the main focus. Organisation-oriented workflow management focuses on the aspects related to the co-ordination of the involved human activities.

Kwan and Balasubramanian (1997) characterise workflows along two dimensions: variety and interdependence. Processes in which there are successive stages of production exhibit sequential interdependence. Processes in which various techniques and resources are employed in an ad hoc manner based on feedback from other tasks exhibit reciprocal interdependence. The dimension variety is based on the research of Perrow (1967) and relates to the inputs of the production process. The dimensions are displayed in table 1 and some examples of workflows are added.

<i>Variety</i>			
High	Clinical services for chronic diseases, software services	software development	
Low	order processing, claims processing	Budgeting hiring	
	Sequential	Reciprocal	
	<i>Interdependence</i>		

Table 1 Workflow characteristics

A workflow model is a representation of those aspects that relate to the co-ordination of the activities that constitute one workflow process but also the co-ordination between the different workflow processes. Based on the components of workflows, a model of workflow needs to contain a specification of activities, processes, triggers, actors, and events. Together these components need to allow the characterisation of workflows but also need to be rich enough to allow management and optimisation of these identified workflows.

In the next section we describe a new model of workflows. This model, that is based on the language action perspective, differs fundamentally from the traditional approach in the fact that it considers networks of communicative commitments the basic components of workflows in organisations. The conceptual roots of the language action perspective trace back to the Anglo-Saxon philosophy of language and action (Austin, 1962; Searle, 1969; 1979). For an overview of the foundations of the language action perspective see: Winograd and Flores (1986), and Reijswoud (1996).

3. Analysing Workflows with DEMO

3.1 Workflows in the language action perspective

The attention for workflow management within the area of the language action perspective is based on the work of Winograd and Flores (1986), but has matured in the action workflow approach (Medina-Mora et al., 1992; Schäl, Zeller, 1993; Schäl, 1995).

The foundation for workflow modelling in the language action perspective is the division of the activities that are performed in an organisation into three different domains (Medina-Mora et al., 1992; Schäl, 1995):

1. Material processes
2. Information processes
3. Business processes

Material processes comprise the human activities that are rooted in the physical world. Information processes focus on the flow of information in an organisation. The domain of business processes extends the domain of information processes in the fact that it focuses on the commitments people make, which result in actions and information. It describes the way in which people enter into language actions that have consequences for their future activities. Material and information processes are considered to be supportive to business processes.

The distinction in the three domains, in particular the introduction of the domain of business processes, provides the basis for a more thorough understanding of the structure of workflows. The structure is defined through the language acts with which people co-ordinate the actions done by the individuals to meet the conditions of satisfaction. The key difference between this approach and the approaches sketched in the previous section is the shift from task structure to the structure of co-ordination.

In the action workflow perspective workflows are defined by requests and commitments and are expressed in the so-called ActionWorkflow Loop (see figure 1). The ActionWorkflow Loop is general in that it occurs whenever there is coordination among people; regardless of what they are doing and it is universal in that it is independent of any culture, language, or communication medium in which it is conducted.

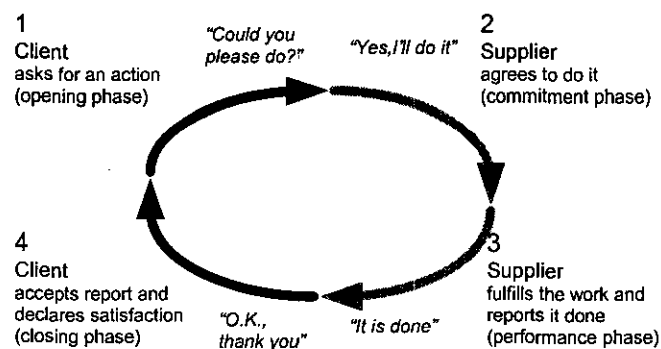


Figure 1 The basic action workflow protocol (Medina-Mora, et al., 1992)

The ActionWorkflow Loop is the atomic element that is used for the modelling of workflows into business process maps. This loop is used to describe the business processes at all levels. Complex processes are broken down into sub workflows according to the four-phase model. The resulting interconnection of loops depicts the co-operative network in which a group of people, playing various roles carry out an organisational process. The interconnection of loops is displayed in figure 2 a more thorough introduction to workflow modelling with Action Workflow can be found in (Schäl, 1995).

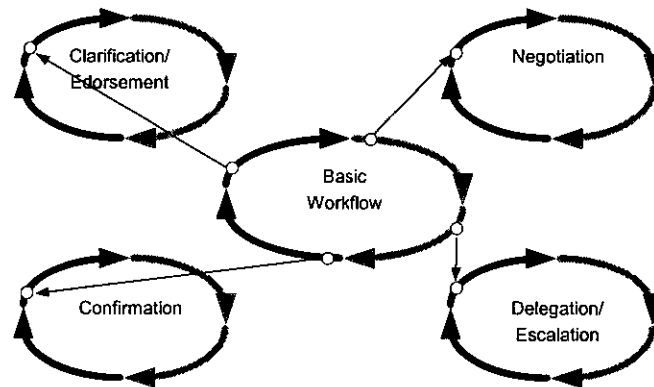


Figure 2 The interconnection of ActionWorkflow loop in articulated processes

Although the Action Workflow method is firmly founded in the theory underlying the language action perspective and therewith extends on the traditional material and information process understanding of workflows, there are two points that need consideration. In the first place, the modelling approach does not differentiate between socially responsible subjects and supporting tools (Denning, Medina-Mora, 1995). This implies that the ActionWorkflow approach does not address the question of responsibility for the completion for an action. As a consequence the approach does not abstract from the current organisational implementation, the method therefore seems to suggest incremental change rather than rearticulation (Spinosa et al., 1996) of the conversation on the premises of new technology or organisational agreements. Secondly, because the Action Workflow approach is designed to analyse the current situation from a language action perspective, and although practical trial and error experience with process redesign and reconfiguration is gained with the ActionWorkflow tools and techniques (Medina-Mora, Denning 1995), the theory does not provide model based formal techniques for the optimisation of the described processes.

In the next section we introduce the DEMO approach as a theory that is founded in the same basic understanding, but that is equipped with a complete range of modelling tools that we believe is more suitable for modelling workflows.

3.2 DEMO

Like the Action Workflow approach, DEMO is a speech act based approach for the conceptualisation of processes in organisations. DEMO is a cross-disciplinary theory describing and explaining the communicational dynamics of organisations, as well as an analysis method based on this theory. A relevant set of fragments describing DEMO is constituted by (Dietz, 1994a; 1994b; 1996a; 1996b; Dietz, Mulder, 1996;

Reijswoud, 1996). The functioning of organisations is viewed from three levels: the documental, the informational and the essential level. At the documental level, an organisation is viewed as a system of actors that produce, store, transport and destroy documents. At the informational level one abstracts from the substance (i.e. document) and focuses on the actual meaning. The organisation is observed as a system of actors that send and receive information, and perform calculations on this information in order to create derived information. At the essential level an organisation is conceptualised as a system of actors that are engaged in the executions of transactions.

The essential transaction is a core concept in DEMO. A transaction is a pattern of activity that is performed by two actors. It is important to note that actors are roles in an organisation and not persons. A transaction is composed of three phases: the order phase in which two actors come to an agreement about the execution of some future action; the execution phase, in which the negotiated action is executed; and the result phase in which the actors negotiate an agreement about the result as brought about in the execution phase. The successful execution of a transaction results in a change in the object world (Universe of Discourse) in which the actors exist.

The execution of an transaction in an organisation can be described and consequently modelled at all three levels of abstraction. At the essential level the transaction is described as a pattern of performative communication. At the informational level the execution of a transaction is described as the exchange of information (information flows), and at the documental level the materialisation of the transaction in tangible objects (documents, file etc.) is described. The DEMO approach hypothesises that the transaction at the essential level allows multiple instantiations at the informational level and the documental level. It is important to realise that these instantiations are ideally deliberate organisational choices. The principal idea is displayed in figure 3.

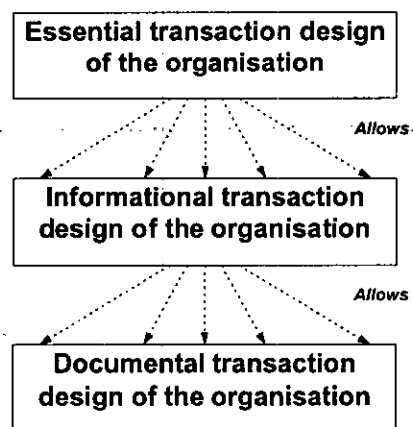


Figure 3 Transaction design and levels of abstraction

The transactional structure of an organisation is modelled in five partial models: the action model, the interaction model, the process model, the facts model and the interstriction model. The interaction model contains a description of the transaction types and the actors in an organisation. The actors are displayed as transaction initiating or transaction executing actors. The graphical notation used for the interaction model is the communication diagram. The process model is used for two purposes. In the first place to display the causal and conditional relationships *between*

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4.1 A description of the current way of working of SGC

A request for mediation of the Conciliation Board for Consumers needs to be started with a letter of the complainer in which the nature and the magnitude of the complaint is explained. There are about 8000 of these letters received by SGC every year. On the arrival of the letter, a file is opened by the secretary. The file contains the first letter of the kind of complaint, a unique identification number of the complaint, the name of the complainer and the date that the complaint was submitted. In the course of the procedure the file is used to archive additional information. On the basis of the first letter a first selection is made as to whether the complaint is taken into consideration.

When the complaint is taken into consideration, the complainer is requested to fill out a questionnaire, to pay a complaint fee (based on the amount of the invoice of the complaint), and to deposit the remaining amount of the invoice. When the questionnaire is returned and the money is transferred, the procedure continues. When the complainer fails to meet (one of) these conditions within one month, the request to mediate in the conflict is turned down. In some circumstances exceptions on this rule are made, but the complainer has to submit a request for dispensation with reasons within this one month period.

Next to exclusion to the basis of failing to meet the requirements of the standard procedure of submitting complaints there are some other reasons for turning down a request for mediation by SGC. A complaint is turned down when the article the complaint relates to is in use professionally, involves physical injury, the supplier has suspension of payment or has already gone bankrupt, or when the supplier is not a member of a branch organisation. These rules are laid down in the regulations of SGC.

When the request for mediation by SGC is granted, the supplier is informed by mail and the official start of the procedure is filed in complaint book (this complaint book was set up for the purpose of progress monitoring). At the same time the supplier is supplied with reprints of the filed documents and is requested for his defence. Instead of a defence the supplier may also propose an agreement. Additional to the complaint of the consumer and the defence of the supplier, the board can initiate an expert examination.

The documents relating to the complaint of the consumer, the defence of the supplier and possibly the examination of the experts form the input for a sitting of a special committee of the board. All the parties involved are invited. On the basis of the sitting the committee reaches a decision. About one month after the sitting the parties involved are informed by mail about the judgement of the committee.

After the judgement of the committee, the financial matters between the customer and the supplier are settled. This winding up comprises the complaint fee, the deposit of the remaining amount of the invoice, and the expenses of the members of the committee and the experts. If the supplier fails to comply with his terms of payment, the consumer can appeal to a regulation that assures payment. At the same time the branch organisation of the supplier is informed.

The file is closed.

4.2 The DEMO analysis of SGC

When the workflows of the Conciliation Board for Consumers are analysed from a DEMO perspective, the workflows are first described at the essential level. This means that the business is described as a network of related transaction processes. The transaction processes are formulated at type level and are displayed in a transaction table. In the transaction table the results of the successful execution of the transactions are also included.

NB. Time variables like the date the complaint is submitted or the date that the committee passes judgement have been left out for reasons of clarity.

Transaction type		Transaction result
T1	Requesting_mediation	The complaint <complaint number> has been mediated
T2	Completing_questionnaire	The questionnaire concerning complaint <complaint number> has been completed and returned
T3	Paying_complaint_fee	The complaint fee <amount> concerning complaint <complaint number> has been paid
T4	Paying_deposit	The deposit <amount> concerning complaint <complaint number> has been paid
T5	Depositing_bank_guarantee	The bank-guarantee <amount> concerning complaint <complaint number> has been paid
T6	Judging_complaint	The complaint <complaint number> has been taken in for mediation
T7	Defending	The defendant <name/firm> has provided a defence on the complaint <complaint number>
T8	Providing_experts_opinion	The experts <expert names> have reported on the complaint <complaint number>
T9	Passing_judgement	The judgement <description> concerning complaint <complaint number> has been passed
T10	Paying_mediation	<name/firm> has paid for the mediation concerning complaint <complaint number>

Table 2 Transaction table SGC

The interaction structure, the network of transactions, is displayed by means of the communication diagram in figure 4 below. The actors are represented by numbered A-squares. The grey S-squares represent complex actors of which we do not know (or do not want to know yet) the composition. The transactions are depicted by the T-numbered circle-in-the-diamond. The communication diagram in figure 4 also displays the interstriction, the sources of information that are needed by an actor to execute a transaction. Interstriction is displayed by means of a dotted line. The external facts bank "rules for mediation" contains regulations of SGC, as formulated in the statutes. For more details on the graphical notation of the communication diagram see (Dietz, 1996a; 1996b; Reijswoud 1996).

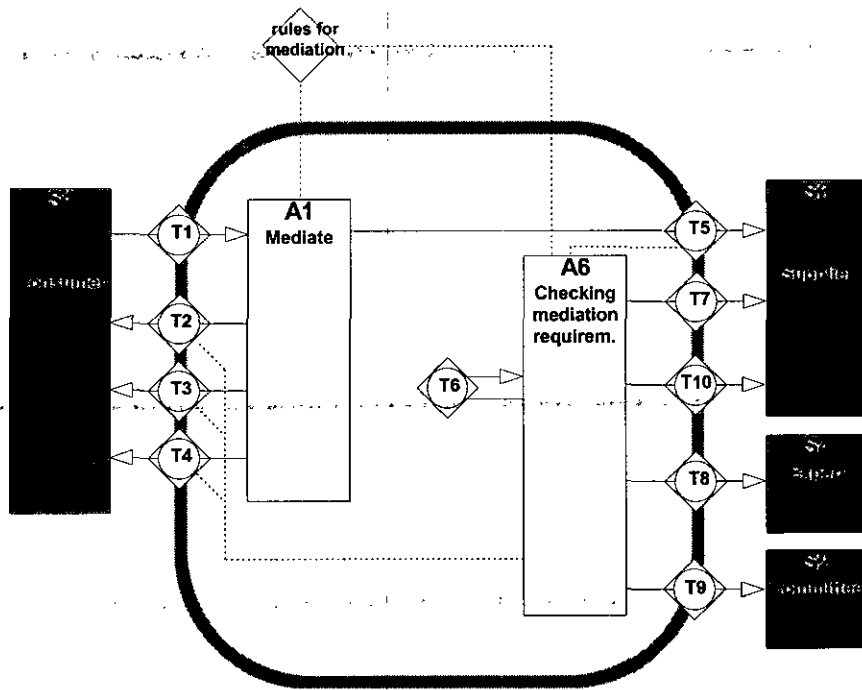


Figure 4 Communication Diagram of SGC

The DEMO communication diagram provides an overview of the organisation as a network of commitments. It does, however, not show the relationships in time and the mutual relationships between the transaction types. The process model is used to highlight these relationships.

Below the process diagram is presented (figure 5) in which the relationships between the transaction types of SGC, as displayed in figure 4 are depicted. Transaction types are represented by circles or stretched circles. The point of initiation is represented as a tiny circle. Causal relationships are presented as solid arrows while conditional relationships are presented as dotted arrows. Optional relationships are indicated with a small horizontal line on the causal relationship arrow. The different stages of a transaction (Orders, Execution and Result phase) are represented as a suffix with the number of the transaction type.

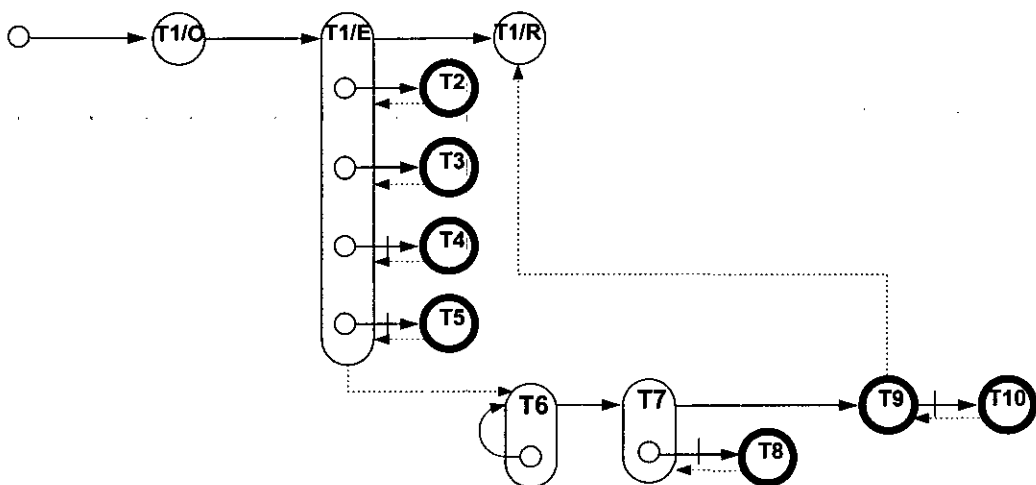


Figure 5 The Process Diagram of SGC

A further insight in the workflows in SGC was obtained with the Facts Model. This model provides a complete and precise specification of the fact types that are created and/or used as well as their mutual relations. The facts model is represented with the NIAM-like facts diagram (for details on NIAM see: Nijssen, Halpin, 1989; the Facts Diagram is explained in Dietz, 1996; Rijst, Reijswoud, 1995). In figure 6, a small part of the facts diagram of SGC is presented.

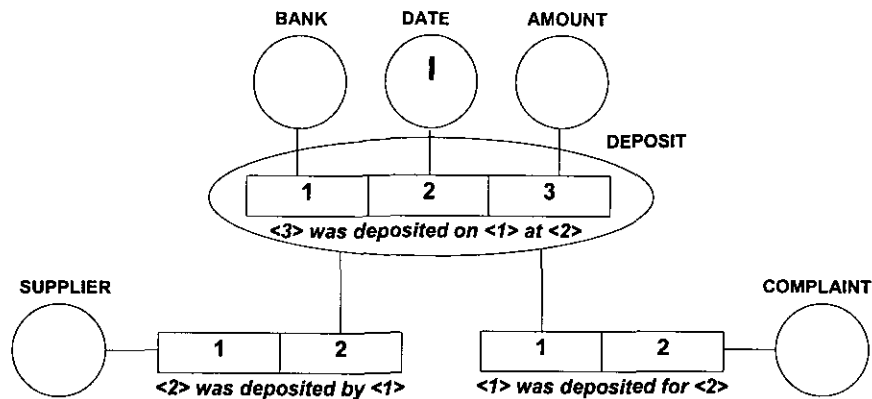


Figure 6 The Facts Diagram of actor A4

In the example below the facts diagram of the actor A4 is presented. The circles and ellipse denote object classes with their class names written above. The objects play different roles in a fact. In the facts diagram these roles are indicated by numbers in rectangles.

A complete understanding of the transaction structure of SGC is achieved in the Action Model. In the corresponding action diagram procedures of the subject system are described. In figure 7 the procedure regarding the result phase of T1 is depicted (see figure 5 for its relation with the other transaction types). In the action diagram not only the transactions at the essential level are displayed. The diagram also displays the informational and documental instantiations of the transaction at the essential level.

Furthermore, DEMO focuses on the possibilities of redesigning the essentials of the business, instead of pushing towards ‘merely’ the reengineering information systems and leaving the business unchanged. The comprehensibility of the DEMO-models to the managers of SGC leveraged their commitment to reengineer the internal and external information handling processes of the organisation. When discussing the process diagram the relationships in time and the mutual co-ordination between the transaction types reinforced the idea of automation and integration of the business processes in a workflow management system. By grouping the transactions into sets (figure 8) the analysis differentiated regularities from complexities in the current workflows.

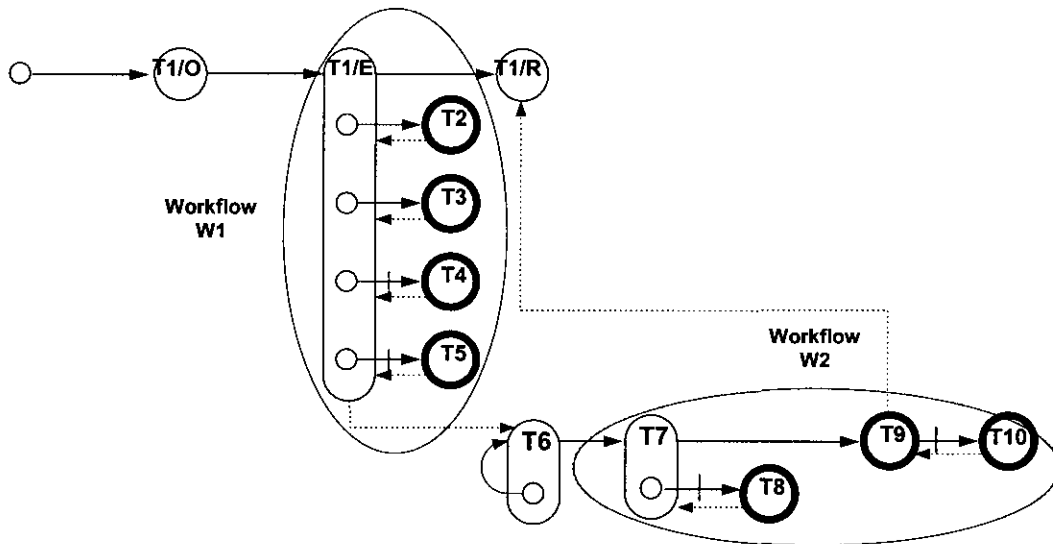


Figure 8 Workflows in the Process Diagram of SGC

The ellipses in figure 8 show the different workflows in the essential transaction design of SGC. The grouping of transactions into sets of workflows is based on the interstriction and interaction between actors in the communication diagram. This grouping is in a sense comparable to the measuring of tasks on the dimensions variety and interdependence by Kwan and Balasubramanian (1997).

In Workflow W1 the transactions T2, T3, T4 and T5 are related to the actor A6 ‘Checking_mediation_request’. This actor A6 is to no extent dependent on the actions of other actors to fulfil his role as initiator towards the consumer (S1). Actor A6 also uses the autonomously created fact types and is less dependent on interstriction from fact types created as a result of the execution of other transactions. Workflow W1 can be categorised, according to Joosten et al. (1994), by a regular and predetermined pattern, because the characteristics of the workflows are structured and changes to the dynamics are not likely. Workflow W2, however, consists of transactions, such as defending (T7), Providing_experts_opinion (T8) and Passing_judgement (T9). The interdependency between the involved actors is eminent, because the successful completion of the transaction T1 is based on their use of and contributions to the available information. The interstriction between the preceding transactions and the actors in workflow W2 and the variety in tasks and actors (i.e. Expert, Supplier and Committee) classify workflow W2 as complex.

The DEMO-models and analysis are precisely defined to understand the environment of workflows as well as to specify the systems requirements for the informational and

documental level. Based on these requirements a request for a proposal has been sent to several software houses. Most of the software companies were able to propose software solutions, in which available informational functions and data are shared, but in which the co-ordination and distribution of actions is being limited. Therefore a project is conducted in which a workflow management system is being developed based on the DEMO workflow approach.

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Positioning the Organisation: A Conversation Analytic Approach To Work Organisation

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Abstract

Using conversation analytic techniques, this paper focuses on how members of two ambulance control centres position themselves in emergency telephone calls; either as individuals or as representatives of an organisation. It is noted that positioning shifts during the course of emergency calls according to the nature of the interactional business and that the pattern of this shift is different in the two control centres studied. While many theories of organisational structure take the organisational boundary as a given, the data demonstrate that this boundary is itself negotiable.

1 Background

The adoption of Searle's formalised version of speech act theory by Winograd and Flores [17] is in some respects at odds with the Heideggerian motivation for their overall approach. From a theoretical perspective, the crux of the issue is that by advocating analyses of organisational structure in terms of Searle's taxonomy of speech acts the implication is that these speech act types should be understood as ontological primitives rather than elements of the contingent, socio-cultural structures that Heidegger regarded as belonging to the realm of the ontic. Although not expressed in these terms, Austin's original formulation of speech act theory was concerned with the characterisation of ontic structures. Austin emphasised the role of language in effecting certain institutional states of affairs such as saying "I do" to effect a marriage, or "I name this ship" to effect a christening (see [4] for further discussion). Austin was quite explicit on the relationship between speech act types and socio-cultural institutions, pointing out that the type of speech act performed by any given utterance is contingent on factors as nebulous as the "social habits of the society", [2], p.245, in which it occurs. This is not only a matter of academic archaeology, it has been recognised in the literature that the importance of such contextual factors undermines attempts to formalise speech act theory. For example, Levinson [8], argued that since speech act type cannot be determined from the form of an utterance, depending instead on in-principle unspecifiable contextual factors, the attempt to give a formal, speech act-based, discourse grammar cannot succeed.

Although the identification of a speech act type may well be problematic it is, of course, an open question whether a particular typology does indeed reliably capture a set of ontological primitives. However, on a practical level two concerns emerge. Firstly, the difficulties with giving a clear formal account imply that a critical element in the success of such analyses is provided not by the framework itself so much as by the skills of the analyst in applying it in particular cases. Secondly, and of more direct concern here, it appears that a great deal of what is important about the structure and organisation of work falls within the ontical, socio-cultural, domain. For example, critiques of the speech act approach to information system design, e.g., [3,14] have identified problems with assuming any ontological priority to notions such as 'role' since these are not static functions within an organisation but are themselves the subject of negotiation between members in a setting, cf. [6]. The COSMOS system developed by Bowers and Churcher [3], aimed to address this problem by allowing the specification of roles and associated tasks according to the prevailing circumstances in each work setting. Nonetheless, the COSMOS system was also criticised by users on the grounds that the ontology of roles and tasks it embodies is too rigid [16].

While concurring with the programmatic aim of characterising cooperative work through an analysis of communicative regularities in various work settings, it seems critical that information system design, especially the stage of requirements gathering, is also guided by an understanding of the socio-cultural institutions that influence work organisation. One promising analytical framework for addressing these issues is conversation analysis (CA). This approach provides a method of discerning the ontical patterns embodied in some

institutional state of affairs by focusing on members' own understanding of, and sensitivity to, putative institutional influences in any given work setting. Rather than assuming the universal applicability of analytical categories such as role, or role types, CA provides a way of establishing the importance of such structures through an examination of the actual practices of individuals in a given work environment.

This paper uses conversation analysis to investigate some of the ways in which individuals position their activities as those of an individual or those of the organisation. The analysis focuses on the transcripts of 999-calls to two ambulance control centres.

1.1 Positioning

In view of the sorts of problems outline above, Harré and Van Langenhove [5] propose a framework in which the notion of 'role' is replaced by the notion of positioning. Their aim is to capture the dynamic, discursively constructed, nature of each individual's mode of participation in a conversation. Intuitively, the notion of 'positioning' is similar to that used in marketing where a product is positioned as being of a certain quality or standard relative to its competitors. Similarly, they suggest, the parties to a conversation implicitly and explicitly position themselves relative to one another throughout the course of their interaction. An important aspect of their account is the observation that positioning and speech act type interact. Harré and Van Langenhove offer the example of a cry of pain; uttered by someone positioned as dominant it can be heard as a protest or reprimand, for someone position as subservient it may be more easily heard as a cry for help.

Harré and Van Langenhove distinguish five dimensions in which forms of conversational positioning may be discriminated; first or second order, performative or accountive, moral or personal, self or other and tacit or intentional. Not all of these distinctions are relevant to the current discussion. The most basic distinction they make is between first and second order positioning. First order positioning refers to the positions individuals, usually tacitly, take up within an ongoing storyline; a perceivedly normal course of events. For example, the storyline in a classroom might be rendered as 'teaching' and possible first order positions relative to that story line would be 'teacher', 'pupil', 'peer' and so on. First order positioning of this kind is performative; utterances have, within the storyline, immediate perlocutionary effect. Of course, the relative positions of specific individuals within the storyline can be realigned. It is often deemed a useful classroom exercise for peers to teach one-another. In this case one of them may position themselves as 'teacher' at certain points and the others as 'pupils'. Not infrequently, these realignments will be contested; a particular individual's peers may harbour deep objections to him positioning himself as 'teacher'. Where these objections are voiced, second order positioning occurs; the first order positioning itself becomes negotiable. In these circumstances, positioning may, for example, be contested on either moral or personal grounds. Moral here refers to the expectations associated with a particular position. Someone who positions themselves as 'teacher' is, amongst other things, ordinarily expected to provide reliable information on a particular subject. In defence of a challenge to someone's positioning as 'teacher', bald insistence that this is their appointed position is frequently unconvincing. Instead, appeal is often made to moral or personal circumstances that might provide for their apparent deviance from the expectations associated with that position. For example by stating that "it's not on the curriculum", i.e., is not a legitimate expectation, or that "I've had a long day" i.e., there are extenuating personal circumstances. A whole range of alternatives are possible and the different forms of positioning considered by Harré and Van Langenhove may interact in subtle ways. The focus of this paper is on examining the way call receivers in ambulance control centres position themselves as individuals or as representatives of an organisation.

2 Setting

Ambulance command and control centres are an instance of what Suchman [13] describes as "centres of coordination"; the individuals within these centres are concerned with managing the activities of a number of people, and associated resources, which are distributed in both space and time and the control centre itself constitutes a critical reference point to which those people can orient in carrying out their activities. The two ambulance control/communication centres that form the focus of this study have jurisdiction over areas with different basic characteristics. ACC1 serves a relatively dispersed and largely rural population whereas ACC2 is located in a major conurbation and serves a concentrated, largely urban, population.

	ACC1	ACC2
Total Population:	410,000	2,200,000
Urban Population:	30%	80%
Emergency Ambulances:	16	110

Roles:	Single Controller	Radio Receiver
		Call Receiver
		Dispatcher

Table 1: Basic Characteristics of ACC1 and ACC2

In both settings, 999 calls are directed to the control centre via a Telecom operator, located at one of several centralised switchboards, who makes some initial identification of the area the call has originated in and subsequently directs it to the appropriate control centre. The individual receiving the call then aims to establish both the precise location of the caller and the nature of the emergency. Once an ambulance has been selected for dispatch the relevant details of the job are normally passed to the crew on the radio in both settings. There are however many differences in the way calls are dealt with within each control room.

In ACC1 there is relatively little complex technological support. The controller, who operates alone, communicates principally by telephone or radio with ambulance crews, hospitals and callers, and deals with all the problems associated with taking calls and selecting and dispatching ambulances. By contrast, call processing in ACC2 involves the use of a number of additional technologies including; a gazetteer database for matching callers descriptions to addresses, an electronic map system for displaying the scene of emergencies identified by the database and an electronic tracking system that displays the location and status of ambulances (e.g., free, proceeding to an emergency etc.) across the region. Additionally, the activities associated with the single role of controller in ACC1 are divided into three separate roles in ACC2: Call Receiver, who deals with the incoming emergency calls; Dispatcher; who selects the most appropriate available ambulance, and Radio Receiver; who deals with radio and telephone communications between ACC2 and crews. This paper deals primarily with the activities of individuals taking the emergency calls and both controllers and call receivers will henceforth be referred to as CRs.

The technology which provides the data for this paper is the call logs. In both settings all communication on each telephone line and radio channel is automatically logged, with date and time stamping, on secure tape machines. These tapes are not used directly during the processing of a call (separate machines provide instant playback facilities) nor are they used to provide statistics such as average response time. Their principle role is as a resource for senior staff in each ambulance service in fielding queries from e.g., public representatives and legal representatives, concerning the conduct of, and events associated with, the handling of a particular call.

Methodologically, this paper proceeds by examining the ways in which the conduct of emergency calls deviates both from the normal conduct of routine telephone calls and from the normal conduct of emergency service calls [15,18]. The rationale for this is that a more secure basis on which to ground appeals to the importance of various contextual or institutional factors can be gained by demonstrating their relevance to individuals as displayed by their deviation from the routine procedures by which calls are usually managed [10,11]. The second element is to make use of a contrast between the processing of emergency calls in two quite different contexts, a rural ambulance control centre in Ireland (ACC1) and a metropolitan ambulance service in the UK (ACC2). Although, at some level of abstraction, the goal of call processing in these two settings is the same -namely the timely provision of emergency ambulances, a range of contextual and institutional factors vary between these two study sites and this provides additional constraints on the analysis. Firstly it allows for an examination of those aspects of the conduct of calls which are the same in both contexts regardless of the variation. Secondly, for any proposed contextual factor it allows for an examination of whether differences in the conduct of the calls and the factors to which they are attributed do indeed correspond to differences in the institutional setting of the calls.

3 The Conduct of Emergency Calls

Detailed analysis of an extensive corpus of emergency calls in the USA has demonstrated that emergency calls routinely, although not invariantly, display a regular sequential structure summarised in Table 2 [15,18].

Pre-beginning
Opening/Identification/Acknowledgment
Request
Interrogative Series
Response
Closing

Table 2 Configuration of sequences for managing emergency calls (after Zimmerman, 1992).

In order to elaborate on the way callers and call receivers orient to one another this procedural analysis can be supplemented by a consideration of the conversational means by which the relative positioning of the parties to the call is achieved. In the case of calls to ambulance control centres, storyline can be understood as the pattern of interaction in which there is a background assumption that the caller has a genuine emergency, that the call receiver has the means to respond and so on.

3.1 Opening Sequences

The recognition and greetings sequences familiar in the openings of non-emergency calls are routinely absent from emergency calls from members of the public where, after the controllers categorical self-identification, the call moves straight to a consideration of the first topic; the request for an ambulance [14]. With respect to the storyline for such calls, the absence of normal greetings and recognition sequences is provided for by the fact that they are not ordinarily considered relevant to the business of the call and that, in contrast to 'ordinary' telephone calls, the topic i.e., the request for assistance, is itself expectable.

106 P: Can I have an ambulance (please)

107 CR: (Thankyou) ambulance can I help you? (.)

108 P: Can I have an ambulance please at xxxx's carpets mainford road brigtown

Excerpt 1: Opening sequence from ACC2, Call 0092 (P=Caller. CR = Call Receiver).

In Excerpt 1 the deviation from the conduct of a non-emergency phone call is especially clear. Not only are the greetings and recognition sequences absent, the caller offers no explicit identification moving, instead, straight to the initiation of the request for assistance. Interestingly, somewhat contracted greetings and recognition sequences typically do occur in calls originating from individuals in services with whom the ambulance service recurrently cooperate e.g.; hospitals, police and fire brigade. This pattern is illustrated in Excerpt 2 where there is a ritual exchange of greetings on lines 36 and 37 followed by an informal form of address on line 38

35 H: Hello district hospital=

36 CR: =District how're you doin it's ambulance control (again)

37 H: (How) are ya=

38 CR: =Another nine nine nine for ya girl

39 H: Rightyo i'll take the details (down)

Excerpt 2: Opening exchange between hospital (H) and call receiver (CR). ACC1, Call 5.

This difference in the alignment of the parties to the call cannot be attributed to time constraints since this call, occurs prior to the dispatch of an ambulance and is therefore subject to the same time pressures as any emergency call. It is also salient that the parties to the call both identify themselves, and address each other, using the names of their respective organisations rather than personal names. This highlights the point that the use of such greetings/recognition sequences does not simply reflect the relative personal familiarity of the two *specific individuals making the calls* nor is it a straightforward reversion to the patterns evident in non-emergency calls. The inclusion of a greetings/recognition sequence provides an initial indication that, all things being equal, CR's orientation to individual callers is sensitive to whether or not they also have some official role in a cooperating service.

3.2 The Institutional "We"

A simpler conversational index of the extent to which individuals align themselves as individuals or representatives of an organisation can be traced by looking at the distribution of the institutional "we", deployed as a means of positioning a request or offer as coming from/to an organisation rather than an individual. As for opening sequences there is a clear contrast in the positioning of requests, informings etc. between calls from members of the general public and members of a service. In both settings, the interrogative series aimed at establishing the location and nature of the problem is conducted with members of the public almost exclusively as a transaction between individuals. Thus the controller or call receiver will typically position questions using the pro-terms "I" or "me".

CR: ambulance service can I help you?
P: .hh er: hello (.) do you think I could have an ambulance please for my husband
CR: right can I ask where abouts you're ringing from?

Excerpt 3: Opening Sequence, ACC2, log 0093 (P = member of the public, CR=Call receiver)

24 CR: Right and the name of the people I'm goin' ta?
25 P: Eh: sorry
26 CR: What's the name (whats your name)

Excerpt 4: Interrogative Sequence, ACC1, Call 6

This pattern is even observed where a member of the public places their own request on an organisational rather than individual footing as in excerpt 5. Here, the caller is ringing from a nursing home and places their own request on an organisation-to-organisation footing. Nonetheless, the call receiver positions their own requests on an individual footing.

P: could we have an ambulance please for a mr ron xxxxxx
CR: ron xxxxx
P: yeah,
CR: and where do I collect him from please?

Excerpt 5: Request Sequence, ACC2, Log 0094

The significance of the use of "I" as an index of positioning is reinforced by the fact in none of these cases is it true that the CR will actually be collecting the patient themselves; as would be suggested by a literal reading of the excerpts.

3.3 Response and Closing

The consistent use of an individual-to-individual footing in the interrogative sequence in both settings contrasts with a systematic difference in the distribution of the institutional "we" in the response section of the calls. In both ACC1 and ACC2 the confirmation of the decision to dispatch an ambulance typically occurs as a topic closing immediately prior to the end of the call. In ACC1 this is routinely positioned as a decision by the controller as an individual:

36 CR: I'll send an ambulance down to you now there pet=
37 P: =Thats great thanks a lot
38 CR: You're welcome indeed (bye bye) now
39 P: (bye) ((caller hangs up))

Excerpt 6: Closing Section, ACC1, Call 6.

26 CR: Alright xxxx um: now you'll be waiting a while er: town ambulance
27 are in maincity at the moment but there but I'll try and get something to
28 you as soon as I can so
29 P: Yeah um
30 CR: Alright will you keep some lights on to the front of the house now?
31 P: Yeah ()

Excerpt 7: Closing Section, ACC1, Call 5.

By contrast, in ACC2, as excerpts 9 and 10 illustrate, the corresponding topic closing is almost always performed with an institutional "we".

R: okay we'll get somebody out

CR: thanks (very much bye)
R: (okay thanks bye)

Excerpt 8: Closing Section, ACC2, log 0093.

CR: =alright then we'll get someone out to you what's his name please?
B: er: mr reginald xxxx
CR: mr xxxx okay love we'll get someone out to him=
B: =right thankyou (very much)
CR: (thankyou bye) bye
B: bye

Excerpt 9: closing Section, ACC2, log 0092

In contrast to ACC1, in ACC2 the response to a call from a member of the public is positioned as an organisational response to an individual request.

3.4 Responses to Requests from Services

Another difference between the positioning of CRs' responses in ACC1 and ACC2 is displayed in their orientation to calls from individuals with some role in cooperating services. In ACC1 discussions with e.g., Doctors requesting an ambulance typically involve positioning requests etc. as transactions between the individual parties to the conversation (see e.g., Excerpt 10). In ACC2, by contrast, the interrogative series is conducted with individuals from other services almost exclusively on an organisation-to-organisation footing with, for example, CR's asking "where do we collect 'im from" (cf. excerpt 5). In both cases, this occurs even though the caller, typically positions their requests on an individual-to-individual footing.

17 D: And I have found out who is to go out right but I'm waiting for
18 that doctor to ring me back but when I spoke to xxxxxxx again .hhh the
19 story sounds quite bad as if you know you he can't swallow the sugar
20 as if he's kind of you know I'm I'm afraid to wait any longer
21 (so I'd be) very grateful if you would ring her and maybe go out to her
22 CR: (right right)
((Turns deleted))
45 CR: Okay
46 D: He's not actually here and she rang me because she was having trouble
47 finding ()
48 CR: (Okay) listen doc um: I'll ring xxxxxxx meantime and we'll send
49 an ambulance unless we hear from you that the doc is going to arrive
50 there (fairly shortly)

Excerpt 10: Sequence from ACC1, Call 3 (D = Doctor).

4 Discussion

This brief survey of the patterns of positioning observed in emergency calls highlights a number of interesting points. At the most general level it is clear that the call receiver's activities are positioned in different ways according to the nature of the interactional business in progress. These differences in orientation provide analytic support for the significance of the notion of the 'organisation' and its relevance for one aspect of the conduct of ambulance control work. However, it also appears that, in some sense, the organisational boundary is altered during the course of the interaction. Most frameworks for analysing the nature of cooperative work take the 'organisation' as a given; it is the domain of analysis for which various alternative possible partitionings of functions, tasks etc. might be proposed. In determining this domain, criteria such as, the set of individuals on the payroll, or the set of individuals working in certain offices might be invoked. Indeed, organisations are quite sensitive to the need to maintain a clear 'corporate identity' and may invest considerable time and money in the

development and use of devices' such as 'mission statements'¹ and logos. The assumption that organisational boundaries are provided 'in advance' is common to a wide range of approaches including; structural models, information processing models and organism-environment models. In contrast, it may be more productive to view organisations as 'productions', a consequence of the way individuals manage the specific practical contingencies of their work [7]. The data presented here support this view; they highlight one process in which the status of an individual's activities as 'organisational' or as 'individual' alters as a function of the interaction with a caller. The same activity e.g., the confirmation of dispatch was observed, in both settings, to be positioned differently according to the interactional circumstances. In Harré's and Van Langenhove's terms, these are all examples of first-order positioning; it occurs within the canonical pattern or storyline for emergency calls and, in these examples, the positioning of a CR as an individual or an organisational representative does not itself become a topic of the interaction (second order) or the subject of subsequent discussion (third-order). Both forms of positioning discussed here are achieved tacitly and performatively, without any additional account being given.

Adopting a perspective on organisations as productions *per se*, leaves a number of aspects of the data unaddressed. The preceding discussion used simple conversational indices of positioning to illustrate a difference in the ways in which callers and call receivers orient to each other within the course of a call and to differences in the way this positioning occurs in two ambulance control centres. In both settings the CR's adopt a different orientation to requests for ambulances depending on whether the individual making the request (who is almost never the patient themselves) is also a member of some organisation with whom the ambulance service has regular contact. As noted, this is not dependent on whether there is recurrent contact with a specific individual, just the organisation they represent.

One candidate explanation for this pattern could be couched in terms of differences in the storyline in each case. For members of organisations such as hospitals and the police, making emergency calls is a familiar process whereas for members of the public it is a non-routine, possibly unique, event and they consequently have a less clear schema of how a call might normally proceed. This disparity can create critical problems for the conduct of the call where, for example, the relevance of questions about the medical nature of the emergency can seem irrelevant to the caller [15,18]. Although at a high-level of analysis the task of the calls is the same whatever their source, it might be more accurate to view calls from members of the public and members of other services as having somewhat different 'storylines'. However, this does not appear to be an adequate explanation for the forms of positioning noted here. As illustrated in Excerpt 5, even where someone calls from a nursing home (and introduces themselves using an institutional "we") the interrogative series is still conducted with the CR positioned as an individual, even though for this, and similar cases, the process of making an emergency call is a relatively routine matter for the caller.

A more promising means of addressing the patterns of positioning noted in the calls draws on Harré's and Van Langenhove's dimension of personal and moral positioning. Throughout this paper, a distinction between individual and organisational positioning has been used as a gloss on the two principle ways in which CRs activities are positioned in emergency calls. Individual positioning is distinct from Personal positioning. None of the cases considered above involve appeal to the Caller's or Call receiver's particular personal characteristics. Of course, problems with the process of requesting information and confirming dispatch could be understood in personal terms, for example, where someone has a strong dialect or perhaps a poor telephone manner. However the types of positioning discussed here do not seem to invoke these factors. Rather, what have here been termed 'individual' and 'organisational' positioning reflect two types of moral order with different associated expectations. Our proposal is that these, and in general all, types of moral positioning are most effectively discriminated by reference to the ways in which people are normally held accountable for their activities.

Activities will be positioned as 'individual' in those cases where their competent execution, in a particular setting, is normally deemed to be the responsibility of the person (regardless of their identity) who carries them out. For example, the process of negotiating a satisfactory description of the nature of an emergency and its location is, in part, an issue about the competence of the CR and something for which CR's are held to account. In contrast, accountability for, say, the maintenance of effective working relations between different services is distributed across all members of those services. Thus the interrogative series with members of the public tends to be conducted on an individual-to-individual footing whereas the interrogative series with members of another service tends to be conducted on an organisation-to-organisation footing. The staff in the ambulance control room regard themselves as accountable in different ways to members of the public and members of cooperating organisations even though they may be making the same request for assistance. This difference is not predictable from a consideration of, say, the callers ability to give a more or less accurate assessment of the clinical implications of the emergency or their familiarity with the 'storyline' of emergency

¹ Often identifiable by the occurrence of the word "excellence".

calls. Rather, it seems to depend on the confluence of two different ways in which the CR's activities may be called into account: as an individual and as a representative of an organisation.

Although, in both settings, there was a greater tendency on the part of CRs to position their activities as organisational when dealing with a member of a cooperating organisation than when dealing with a member of the public there were also salient contrasts. CR's in ACC2 use the institutional "we" far more frequently and consistently than in ACC1 when dealing with representatives of cooperating organisations. The number of factors that vary between ACC1 and ACC2 make explanation of this difference speculative. However, several observations point to the greater relative importance of maintaining a clear organisational identity in ACC2 (as opposed to an arbitrary coalition of individuals). In particular, changes in the organisation of funding in the Health Service in the UK have resulted in a situation in which ACC2 must bid for funding against other ambulance services. Accountability at this level does not operate in Ireland and ACC1 is more embedded within the structure of the regional health board. This difference is reflected in the CR's own perception of their activities. In ACC1, CR's emphasise their individual responsibility to each caller: "[...] they call the shots at the end of the day, and if you don't respond to their request you're in trouble"; in ACC2 CR's place less emphasis on personal responsibility to each caller and additionally refer to their activities at a more generic level; for example as "the provision of a service". It is also reflected at an organisational level through sensitivity to press reports on the operation of each ambulance service. In ACC1, press coverage of the service is compiled in a monthly report which is distributed to the staff whereas in ACC2 press reports are monitored by the chief ambulance officer but are not typically distributed to the control staff or crews.

5 Conclusions

Although studies such as the current one do seem to be relevant to the theoretical understanding of the organisation of cooperative work, their ability to generate specific design recommendations is much more controversial. It is frequently observed that ethnographic techniques are inherently conservative [7,9]. Although they may provide more reliable characterisations of existing work practices in a given domain it is not clear how they can, in general, inform the design of changes to those work practices. Nonetheless, the adequate characterisation of work organisation is critical to the effective design of information systems to support that work. This can be illustrated by a consideration of the cooperation between call receivers and the Telecom operators who route calls to them. Although this element of emergency call processing is critical to its success, it often falls outside 'official' definitions on which that work is called to account. The efficiency of call processing in the UK and Ireland is chiefly assessed in terms of response time; measured as the interval between receipt of the call by the control and arrival of the ambulance at the scene. This does not adequately address potentially critical problems in the initial routing of the call by the Telecom operators and does not promote the development of additional support for coordination between controllers and Telecom operators. Examining how individuals orient to one-another can provide important clues about various ways in which their activities are coordinated in practice and, in turn, a more complete picture of the activities that may benefit from technological support.

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ENSURING the VALIDITY of ELECTRONIC COMMERCE COMMUNICATION

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Abstract. Business transactions, more specifically electronic commerce business transactions, typically involve a lot of communication. Hence modelling methods based on the Language/Action perspective, like DEMO and ActionWorkflow, seem pre-eminently fitted to model electronic commerce transaction.

In this paper we apply the L/A-framework to electronic commerce transactions. To this end, we need to extend the transaction pattern, the core concept of L/A-theories, with speech acts to ensure the anchoring between two or more domains. This anchoring is necessary to guarantee the validity of the business transaction.

1 Introduction

The community that is using the world-wide web steadily grows, and has an estimated 20-40 million users (Bell and Gemmell, 1996). This trend offers businesses the Porterian possibility to penetrate new markets and expand their activities by entering the electronic-commerce. Kalakota and Whinston define electronic commerce as 'an umbrella to integrate a wide range of new and old applications' (Kalakota and Whinston, 1996), like electronic funds transfer, electronic data interchange, e-mail, electronic catalogues etc. Electronic commerce implies a kind of delegation since the actors are supported by an automated system that can be thought of as consisting of communicating intelligent agents (Weigand, Verharen, Dignum 1996). In this paper we use the terms agents and subjects interchangeably to indicate 'participants in interoperable transactions' (Weigand, Verharen, Dignum 1996). Following Kalakota we can roughly identify three categories of electronic commerce transactions: customer-to-business, business-to-business and intraorganizational. In this paper we focus on the first category. Some examples of applications that fit into this category are book sales (Booknet) and flight ticket sales (for example KLM Holland).

The L/A-perspective has been introduced by Flores and Ludlow (Flores and Ludlow, 1980) and emphasizes the actions people perform while communicating. This perspective takes the transaction pattern as its core concept. The transaction pattern typically has a cyclic character, starting with an actagenic and

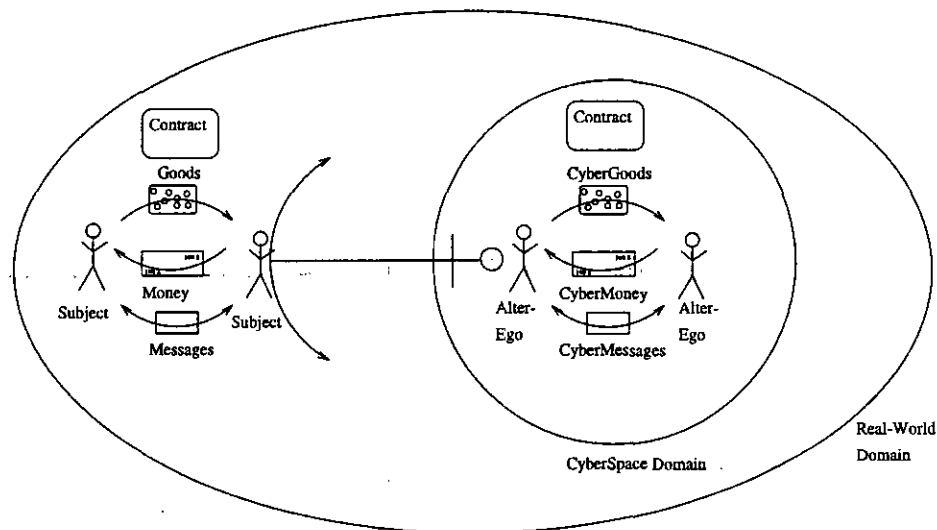


Fig. 1. Real world and Cyberspace

ending with a factagenic conversation. During the actagenic conversation an actor (for example a customer) requests something from another actor (e.g. a supplier), which (s)he can fulfill or accept. The factagenic conversation, which starts after the executor has created the desired state of affairs (i.e. the objective action) (Dietz, 1992), ends with a declaration of the executor that (s)he is finished. After the initiator (customer) has accepted this result, the transaction has been completed.

In this paper the L/A perspective is applied to Electronic Commerce transactions, i.e. transactions that take place in what is called Cyberspace. This raises the question what the relationship is between the actions going on in the physical world (the social world of the subjects) and the actions in Cyberspace (the communication between agents, or alter-egos) (see Figure1). As the figure tries to express, the actions in Cyberspace only make sense when this space is "anchored", or embedded in the physical world. In other words: the anchoring is one of the mechanisms to ensure the validity of a business transaction.

Furthermore, we try to investigate how these relationships and the electronic commerce transactions themselves can be formally represented. In order to come to such a representation, we apply and extend current work regarding the 'Communication Framework', as described in (Weigand, Verharen; Dignum 1996), and (Verharen, 1997).

This paper is organized as follows. In section 2, we define the notion of "communication domain" in the spirit of the Language/Action perspective. In particular, we argue that the domain is more than the (specifications of) the communicative actions. We also discuss the kind of relations that exist between domains. In section 3, this definition is applied to the problem of anchoring Cy-

berspace. We sketch a framework to represent electronic commerce transactions and their anchoring in other domains in section 4. The last section includes the conclusion and future work.

2 Communication domains

Communication structures, or business process models, in the L/A literature (DEMO (Dietz, 1996), Goldkuhl (Goldkuhl, 1996) , Verharen (Verharen, 1997)) typically describe a set of subjects and a set of communicative actions. It is supposed that these actions occur in some part of the world (called the Environment of Discourse in (Weigand, 1990)). That the model does not describe the whole world, but stops somewhere, is evident; the model only needs to describe what is relevant to the (business process engineering) problem.

However, this cannot be the whole story. What is ignored is that communicative actions are only effective in the right context. For example, an organization is a context in which certain communication structures have been implemented. Drawing on these structures, a manager can direct an employee to perform a certain task. Certain obligations hold for all subjects. However, these structures and obligations are only valid and effective within the context of the organization, and not, for example, when the manager is at home in the weekend. The exact boundaries are hard to specify, but that the context is not the whole world is clear.

The same point can be illustrated by looking at law in general, and business law in particular. Business transactions occur in some legal context provided by the national law, or some international trade agreement. However, these laws do have a certain scope. For example, it may be that they only apply to companies registered by the Chamber of Commerce.

In (Winograd and Flores, 1986) Winograd and Flores suggest that "[K]nowledge and understanding ... arise from the individual's committed participation in mutually oriented patterns of behavior that are embedded in a socially shared background of concerns, actions, and beliefs. ... Through language ... we create and give meaning to the world we live in and share with others" (p.78). We agree completely, but would only like to change the word *world* into *worlds*: we do not live in just one world, but in many worlds at the same time. Each world is built up by the language actions that we perform and defines the scope of the commitments and obligations that are made. Of course, these worlds are not visible, and sometimes confusion can arise when it is not clear to which world a certain communicative action pertains.

Worlds, in this sense, can be distinguished into 'natural' worlds and 'artificial' worlds. Natural worlds include, for example, the family we live in, the neighbourhood, or a religious community we belong to. Artificial worlds are created by nations, companies, and institutions in general. A game or match is a temporary artificial world in its own. Artificial worlds can also exist in Cyberspace: an Internet discussion group for example. In the following, we will talk about artificial worlds only. We will use the more mundane word 'domain'; another term

could be 'context', but would become confusing when we want to talk about the context of a domain.

2.1 The need for identification

Since domains are not visible with the eye, and people live in many domains at the same time, certain efforts are needed to make them explicit. The more a domain is institutionalized, the more explicit the boundaries will be. Firstly, it must be clear which subjects belong in the domain. To this purpose, subjects need an *identity*. The identity identifies them as (distinct) subjects of the domain, and at the same time excludes subjects without identity. So nations do issue passports, banks assign accounts, system administrators provide logins (with passwords), and the Chamber of Commerce provides a registration number. Secondly, it must be clear which actions belong to the domain. To this purpose, messages need an identity, or modality, to identify them as pertaining to the domain in question and excluding messages that are not qualified as such. If there is a risk of forgery, the identities should be protected somehow. So banks provide their clients with special transfer sheets and companies use special paper for their official communication.

The assignment of an identity is an essential speech act: it creates a new subject in the domain. Checking the identity (both the question to a subject to identify himself and the subsequent act of doing that) is not essential in the sense of "changing the domain", but it is a necessary ingredient of the domain. So one component of a domain description that we propose to add to the components distinguished traditionally, consists of the transactions of assigning and revoking identities. And one phase that could be added to the four phases of Goldkuhl (proposal, commitment, fulfilment and completion) (Goldkuhl, 1996) is a first phase of identification in which the subjects identify themselves and thus materialize the domain in which they want to communicate.

2.2 Anchoring domains in context

Domains are created in and persist in the context of other domains. Firstly, artificial domains typically anchor the identity they assign to subjects into encompassing domains. So we need a passport (citizen identity) before we can get a bank account, or a social security number before we can get a job. Secondly, norms can be inherited from one domain into another. For example, a business transaction takes place in a certain legal context, and hence there are rights and obligations of the subjects already before they start to negotiate. In some cases, for example, international trade, the legal context is not immediately clear, and must be determined beforehand.

The modelling of a domain should therefore include the specification of the context of the domain. This anchoring, or embedding, has two related but distinct functions:

- 1 it ensures that the communication in the domain makes sense with respect to the superdomain; for example, it ensures that a quote given by the supplier also provides the customer with a *legal* right to order the product for the given price;
- 2 it allows the inheritance of rules from the superdomain; for example, if the law specifies that the consumer has the obligation to pay the price after delivery, this will also hold in the domain created by the specific business transaction, although the parties can agree on details, for example, the date of payment.

Uptill now we have talked about domains and superdomains in a general sense. In the following, we will concentrate on the specific case that the domain is a virtual world (Cyberspace) and the superdomain is a real world (for example, the state of the Netherlands). Cyberspace is not necessarily one world: it consists of many domains. A domain may be a research network, or a domain set up and managed by a bank to support electronic commerce transactions. Cyberspace has not a central registration (at the moment); each site typically is a domain with its own user registration, and Cyberspace is the collection of these domains (as the real world is a collection of nations).

3 Anchors between the Virtual and the Real World

As explained in section 2, the Cyberspace could be interpreted as an artificial world, that can be divided into one or more domain(s). In this section we give a general description of the anchoring of CyberSpace domains into the Real-World. We used the main concepts of the 'Business as Action game Theory' of Goldkuhl (Goldkuhl, 1996) to structure our overview.

This framework identifies four elements of a business transaction (cf. Fig.1):

1. *Subjects*
We can identify (mostly two) different subjects during an electronic commerce transactions. Subjects can play one or more role(s). In electronic commerce transactions typically one plays the role of a customer and another of a supplier.
2. *Communicative actions*
Communicative actions, for example requests and promises, manifest themselves in the physical world by means of (more or less formalized) agreements, i.e. contracts.
3. *Material actions*
The material actions in EC transactions typically consist of transferring goods and/or money from one party to another.
4. *Context*
The context of a business transaction defines according to Goldkuhl 'the roles and relations of the parties and the other business actions and the total "action logic" of the business transaction' (Goldkuhl, 1996) (Goldkuhl, 1995). To avoid confusion with the context of a domain (its superdomains),

we will use from here the term Contract (as in (Weigand, Verharen, Dignum 1996)) to describe the roles of the parties and the rules that have been agreed upon.

3.1 Embedding Alter-Ego's in the Real-World

In Cyberspace, the subject is a virtual entity also called an agent (Verharen, 1997) or an Alter-Ego (van de Riet and Burg, 1996), (van de Riet and Beukering, 1994). These agents must be linked to real-world (human) subjects in order to make it possible to track down the (validity of) the actions. This can be done by a so called domain administrator, or gatekeeper. Domain administrators can give subjects access to the domain they control, by giving them a unique identification, for example constituted of a login and password. The new id's are typically issued on the basis of some 'real-world' identification, like a passport, or an id issued by an virtual trusted world, or Trusted Third Party (see 3.2). Secondly, the domain administrator can create new subdomains within the domain (s)he controls.

3.2 Embedding of communicative and material actions of Alter-Ego's in the real-world

Security issues like authenticity, integrity, confidentiality and nonrepudiability of messages play an important role to ensure the validity EC-transactions (Cooper et al., 1996) (Denning, 1996). These issues can be addressed at two levels, by means of channel or network security and transaction security. Network security can be implemented by means of firewalls. The transaction security is defined at a higher level (i.e. independently from the implementation), and covers mainly (validity) aspects like authenticity and nonrepudiation.

In (3.1) we described the embedding of alter-ego's in the real-world. We now proceed with the transactional security relating to the linking of the *actions* (being material as well as communicative) and the result of these actions in CyberSpace, to the 'real-world'.

We start our discussion with two kinds of authenticity: name authenticity and function authenticity (Dekleermaeker, 1996). The receiver of a message ensures himself by means of name authenticity that the sender is the same as the name that has been mentioned in the message. Furthermore, the receiver may want to check whether the sender is entitled (authorized) to perform the requested transaction; this is called the function authenticity. Besides the authenticity, the integrity of the message is an important security issue: the receiver wants to be sure that no information is missing or damaged. Lastly, the sender of a message often desires the guarantee that the receiver can not deny the receipt (to prevent non-repudiation).

Trusted Third Parties are specialized in providing a package of the transactional security services to ensure the validity of a business transaction. A Trusted Third Party can be defined as 'an impartial organization delivering business confidence, through commercial and technical security features, to an electronic

transaction' (S.01, 1993). Some of these features include: name- as well as function authenticity certificates (that provide in the homonymous security services), time-stamping, information registry and certification of the content of a message (integrity of the message).

Anchoring CyberGoods to the Real-World CyberGoods can be divided in two categories: material and non-material. Non-material goods (like software) do not have to be anchored to the real-world. Material goods can only be anchored to the 'Real-World' by means of words (or referents) that evoke concepts. Terms could be stored into one, or more coupled, Lexicon/Lexica, accessible to Alter-Egos and controlled by a TTP. In this way, the Lexicon ensures both parties that the content of the interchanged messages, exactly contains that what they meant. This CyberSpace-Lexicon could be maintained by a trusted third party or by the subjects themselves.

One of the problems we encounter when using representations of goods to refer to some real-world counterparts, is that of information asymmetry, because of the unobservability of private information of the supplier. This raises the fundamental question whether communication in CyberSpace has a communicative or a strategic character (Habermas). A well known example of information asymmetry can be found in the market of second hand cars (lemons), where only the owner has full knowledge about the state of the car (Akerhof, 1970). This information asymmetry could be solved by certification of these products (through a TTP), resulting in a reduction of the uncertainty for the consumer, and a more secure link between the Cyber- and real-world goods (Douma and Schreuder, 1992).

Anchoring CyberMoney to the Real-World Nowadays we can identify two payment systems for on-line electronic commerce payments (Kalakota and Whinston, 1996):

- Token-based payment systems
These systems are based on electronic tokens represented by electronic cash or electronic money, electronic checks and smart cards.
- Credit-card based payment systems
This category consists of more conventional methods of paying, from sending plain credit card details to payment using third-party verification.

Token-based payment systems must be linked to one of the following real-world counterparts 'cash, credit, electronic-bill payments, cashier's checks', etc. The credit-card based payment methods on their turn could be linked to the real-world by a trusted-third party. In the latter case, on-line user-involvement is needed to ensure additional security (Kalakota and Whinston, 1996); a consumer must for instance agree that the financial institution is allowed to withdraw money from his account and send it to the supplier.

Embedding Communicative-Actions in the Real-World Communicative actions, and their deontic effects, can be represented in contracts. A contract is a formally written agreement between two or more actors that describes the mutual obligations and authorizations. The cyber-contracts are embedded in the real-world lawbooks, international treaties and jurisdiction. This embedding can also be achieved by an identification speech act. However, from here, we will assume that the legal contracts are inherited by subdomains from the domain they are embedded in.

We can distinguish different kinds of contracts. Firstly, we identify transaction time contracts. This type of contract exists until the transaction has been completed; in our framework: when the customer has accepted, or refused the requested good(s). Besides one time (business) contracts, we discern a range of contracts that have a lifetime from two or more business transaction cycles (e.g. long-term standard contracts) until eternity. Based on this notion, we could build a hierarchy of contracts with two dimensions: time and power. Power used in this context, means the possibility to stipulate the validity of other contracts. We define contracts represented in local legal terms at the root of our hierarchy. This means that all other contracts must be made up conform the rules posed in this definition. In some cases, when explicitly mentioned in the lawbook, it is possible to deviate from these rules.

Our contract specification is in accordance with other theories in the L/A-perspective like (DEMO) (Dietz, 1996), BAT (Goldkuhl, 1996) and most closely with CoLa (Verharen, 1997). Dietz describes the background of communicative actions as a system of common norms and values. This background, he argues, is the reason for the fact that 'subjects must have the authority for the essential acts they perform, and must be responsible for the manner in which they perform them' (Dietz, 1996). The higher we get in our contract hierarchy, the more this contract represents the background of the communicative actions.

The authorizations and obligations could be represented using an extension of dynamic logic called deontic logic (Weigand, 1993), as discussed in section 4.

4 Formal Representation of Electronic Commerce Transactions

In this section we will give a formal representation of electronic commerce (EC) transactions. To this end we will apply to some end the communication modelling framework of (Weigand, Verharen, Dignum 1996) to Electronic Commerce. Our (formal) representation falls apart into three categories:

- *The Electronic Commerce Framework*

The Electronic Commerce Framework represents the static relations between and within domains, e.g. that relations between subjects and domains that exist independently from specific business transactions. Furthermore, the essential actions which have led to the state of our illustrative EC world will be described. The subjects use the EC-framework during an electronic commerce transaction to guarantee the other party the validity of (an element

of) the transaction. More concretely, this communicational validity is in our framework realized by the *identification speech act* that an Alter-Ego must perform before he can get access a domain. Besides subjects, also domains can be identified or anchored (by their domain administrator). In this way, AE's can check at a reliable, impartial party whether they can trust the other AE's of a domain.

– *The Contract in a Domain*

The contract in a domain can be represented by deontic logic. Deontic logic is an extension of dynamic logic and has already been used to represent interoperable transactions in (Weigand, Verharen, Dignum 1996) and (Verharen, 1997). We will not represent the actions that change a (legal) contract in a domain, or the result of these actions: the transaction-specific contracts, in this paper.

– *The Transaction*

A transaction is constituted of the smallest possible sequence of action(s) that leads to a certain deontic state. The transaction logic can be represented by a set of messages, subjects, constraints and goal and exit states, as stated in (Weigand, Verharen, Dignum 1996). We will only give a brief example of the representation of a transaction. We once more refer to (Weigand, Verharen, Dignum 1996) and (Verharen, 1997) for a in-depth discussion of this topic. The transaction logic is restricted by the (legal) contract(s) in a domain. When explicitly stated in the legal contract(s), the subjects can override specific legal (inherited) rules and/or add new ones to it.

In the following we will give an example of a consumer sales transaction. Consumer sales involve products that are used primarily for personal purposes. For the representation of the Electronic Commerce Framework we use a combination of predicate and dynamic logic. The contracts in the domains are represented by deontic logic. The business transactions on their turn are modelled by means of the transaction specification language (see (Verharen, 1997)). The (legal) contract has been defined on the basis of dutch law.

4.1 Representation of Electronic Commerce Framework

We will now give an example of a natural language description of the EC-framework. This description contains the actions that lead to a certain state (i.e. the identify speech act), as well as the state of the framework itself.

D_1 has contract LEG_1
 C_1 resides in D_1
 S_1 resides in D_1
 A_1 is the domain-administrator of domain D_1

IF subject S_1 resides in domain D_1 and A_1 is the domain-administrator of domain D_1 THEN A_1 creates domain D_2 in domain D_1 with A_2 resulting in the fact that domain D_2 is embedded in domain D_1 AND D_2

has domain administrator A_2 and the requester S_2 resides in D_2 .

IF subject C_1 resides in domain D_1 and A_2 is the domain-administrator of domain D_2 THEN A_2 identifies C_1 in domain D_2 as C_2 , resulting in the fact that C_2 resides in D_2 and the identification of subject C_2 as C_1 .
where:

D_1, D_2 : domains

A_1, A_2 : subjects with role domain administrator

C_1, C_2 : subjects with role consumer

S_1, S_2 : subjects with role supplier

This example can be described by means of dynamic logic. More details about dynamic logic can be found in (Harel, 1979), (Wieringa et al., 1989):

$$\text{contract}(D_1, \text{LEG}_1) \quad (1)$$

$$\text{subj}(C_1, D_1) \quad (2)$$

$$\text{subj}(S_1, D_1) \quad (3)$$

$$\text{da}(D_1, A_1) \quad (4)$$

$$(\text{subj}(D_1, S_1) \wedge \text{da}(D_1, A_1)) \rightarrow \quad (5)$$

$$\begin{aligned} & [\text{create-domain}_{A_1}(D_2, D_1)] \\ & (\text{da}(D_2, A_2) \wedge \text{anchor}(D_2, D_1) \wedge \\ & \text{subj}(D_2, S_2)) \\ & (\text{subj}(D_1, C_1) \wedge \text{DA}(D_2, A_2)) \rightarrow \quad (6) \\ & [\text{identify}_{A_2}(D_2, C_1, C_2)] \\ & (\text{subj}(D_2, C_2) \wedge \text{id}(C_1, C_2)) \end{aligned}$$

Expression (1)-(3) describe the state of our world. Expression (5) represents the embedding of a new domain (D_2) in an existing domain (D_1). Expression (6) on his turn, shows the action to embed subjects in a domain, the preconditions to execute these actions and the state reached. A_1 plays the role of a CyberSpace domain-administrator or TTP. We want to remark that in domain D_2 this role could be played by subject S_1 (leading to $\text{da}(D_2, A(S_2)_2)$ in expression 5).

4.2 Representation of Legal Contracts

As discussed in the above, we will use deontic logic to represent the legal contract in a domain. We tried to represent dutch law concerning consumer sales, but these law rules seemed ambiguous and multiple-interpretable. That's the reason why we had to derive a more unequivocal deontic statement from dutch law.

We will only give a representation of the Context LEG_2 in domain D_2 . Besides the subjects in a domain, the domain-administrators also have to hold themselves to certain rules. We will not discuss these rules, but instead refer to (Froomkin, 1996) and (Greguras et al., 1995).

An agreement is realized by an offer and it's acceptance. (Book 6: article 217)

A sale is an agreement in which one (X) agrees to give an object and the other (Y) to pay a price for it. (7:1)

A consumer sale is the purchase of a personal properties, performed by a vendor that acts out of the occupation of his business and a purchaser, who does not act out of his occupation. (7:5: sub 1)

X is obligated to pay price (7:26)

Y is obligated to transfer property with appurtenances (7:9)

where:

X: subject playing the role of consumer, and

Y: subject playing the role of supplier

Based on these legal definitions of consumer sales (book 7 of dutch law) and agreements (book 6 of dutch law), we have defined the following rule:

IF X requests product G for price P from Y and if Y promises X to deliver the product G for price P *THEN* X is obligated to pay price P for good G to Y and Y is obligated to deliver the good G for price P.

Please note that this derived rule is not logically equivalent to the law-rules (6:217, 7:1, 7:5:1, 7:26 and 7:9) but an idealizing interpretation.

This rule can be expressed in deontic logic:

$$\begin{aligned} &[\text{DIR}(X, Y, \text{deliver}(X, Y, g, p)); \\ &\text{COM}(Y, X, \text{deliver}(Y, X, g, p))] \\ &(\text{OBL}(X, \text{pay}(X, Y, g, p)) \wedge \\ &\text{OBL}(Y, \text{deliver}(Y, X, g, p))) \end{aligned} \quad (7)$$

4.3 Representation of the Transaction

We use the transaction specification language (Trans) (Verharen, 1997) for the representation of the EC transaction of our example. Based on the definition of the EC Framework, we will work out a part of the EC transaction concerning the delivery of the good requested by the consumer. This example is an adapted version of the delivery example as used in (Verharen, 1997).

The order transaction is preceeded by two identification transactions. The first identification transaction leads to an obligation to the domain administrator to create a new transaction subdomain (here D_3), and to designate a domain administrator for this subdomain. The second identification transaction, which is not represented here, leads to an obligation to the subdomain-administrator to permit the subjects to his domain, and to create legal context in this domain.

C_2 identifies himself/herself to S_2

S_2 checks the identity of C_2 at A_2

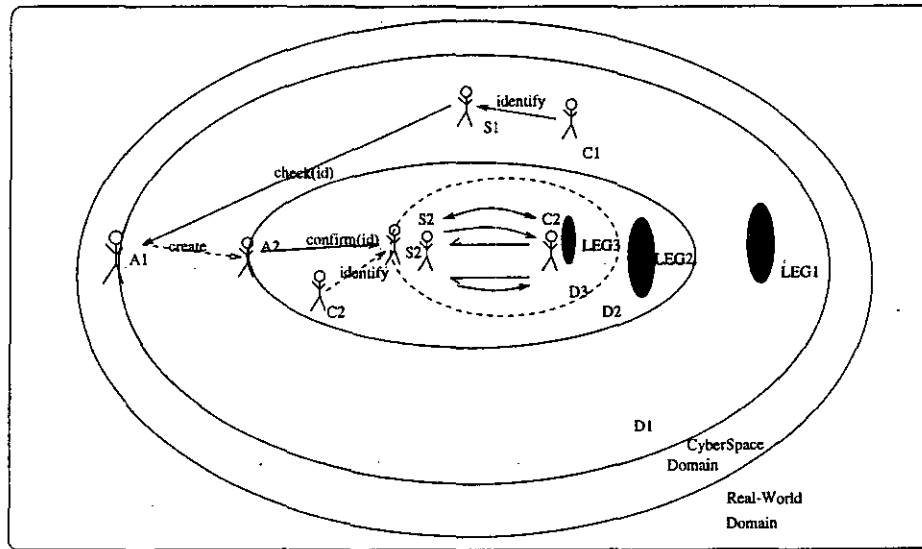


Fig. 2. Anchoring domains

A_2 confirms the validity of identification *OR*
 A_2 rejects/refuses the validity of the identification
 S_2 accepts the identification of C_2 *OR*
 S_2 rejects/refuses the identification of C_2

After the communicational context has been created, the order-transaction can start.

C_2 requests the delivery of product K with price P from S_2
 S_2 promises the delivery product K with price P to C_2
 S_2 asserts the delivery of product K with price P to C_2
 C_2 accepts the delivery of product K with price P from S_2

This leads to the following formal representation for the identification transaction (the other has been skipped):

transaction Identification (8)
agents
 C_2 : Consumer;
 S_2 : Supplier;
 A_2 : Domain Administrator;
 C_2 can send messages

```

    identify( $C_2$ ) to  $S_2$ 
 $S_2$  can send messages
    request(Validity-of-ID( $C_2$ )) to  $A_2$ 
    accept(identification( $C_2$ )) to  $C_2$ 
    refuse(identification( $C_2$ )) to  $C_2$ 
 $A_2$  can send messages
    assert(Validity-of-ID( $C_2$ )) to  $S_2$ 
    refuse(Validity-of-ID( $C_2$ )) to  $S_2$ 
constraints
    request(Validity-of-ID( $C_2$ )) BEFORE
    accept(identification( $C_2$ ));
    request(Validity-of-ID( $C_2$ )) BEFORE
    refuse(identification( $C_2$ ));
    identify( $C_2$ ) BEFORE
    accept(identification( $C_2$ ))
Goal
    accept(identification( $C_2$ ))
Exit
    refuse(identification( $C_2$ ))

```

5 Conclusion / Future research

The goal of this paper has been twofold. Firstly, we gave a theoretical description of the anchoring of subjects and their actions to other domains. This anchoring provides a means to ensure transaction security, more in particular name and function authenticity. The authenticity of (material and communicational) actions can be granted by Trusted Third Parties, e.g. impartial organizations that deliver business confidence. We concluded that this anchoring is realized in reality by means of an identification speech act. Furthermore, we focused on the anchoring of the context of domains into other domains, by means of the same speech act.

In the second part of this paper, we developed a (formal) model for electronic commerce transactions. We used dynamic and first-order logic to give a description of the EC framework, deontic logic for the contracts in domains and the Trans for the transaction logic.

In the future, we intend to work out our EC framework. We should for instance take the order of transactions into account. The precise interaction between legal and transactional contracts also needs further elaboration. A rather fundamental research question is whether ec-communication has a communicative or strategic character, and the possible consequences.

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Formalization and rationalization of communication

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Abstract. In Computer Science, conceptual modelling and formalization are the basis for developing automated systems, "intelligent" or not. It is often taken for granted that formalization is possible and desirable. In the Language/Action perspective, this assumption has been challenged. The L/A perspective promotes "communicative action", in the sense of Habermas, as the building block of inter- and intraorganizational communication. In this paper, we want to discuss the issue of formalization from the broader perspective of rationalization. In this way, both the positive and negative sides of formalization can be more clearly seen. We illustrate this by means of examples from group support systems, workflow systems and software agents.

1 Introduction

The Language/Action Perspective is a way of thinking that looks at communication in terms of what people DO with words: requesting, declaring, promising etc. Right from its inception, there has been discussion on the question how far one should and can go in formalizing communication models. For Winograd and Flores, formal models are associated with a classical rationalistic view of cognition and at least suspicious, although they do not go as far as certain opponents who dismiss formalization completely (Suchman, 1993). However, there is also the work of Johannesson (Assenova and Johannesson, 1996) and our own (Dignum and Weigand, 1994; Verharen et al, 1996), among others, in which formal logic is used to capture the semantics of communicative actions, and that places itself in the Language/Action tradition as well. The question that we want to discuss in this paper is whether and to what extent formalization is the right way to proceed. The question can be made more precise by distinguishing at least the following three situations for which we might want to use formal semantics of communication.

1. Formalization of communication between persons.

2. Formal semantics of communication between systems that are meant to support the human communication.
3. Formal semantics of communication between systems that is meant to replace human communication.

Although the situations are related, they each have their own characteristics and their own special topics of interest. E.g. indirect speech acts are an important topic for human communication but can be ignored for communication between computer systems.

Of course any communication between computer systems is formalized by definition. The question in this case is how to embed this formalization into a description of the human communication that it is supposed to support or replace.

Our conjecture at this point is that to do this, we also need some formal representation of (part of) the human communication.

We will answer the general question on whether to formalize the semantics of communication and to what extent to do this, by first looking at two major sources of inspiration, the work of Heidegger (as applied by Winograd and Flores) and the work of Habermas. Both philosophers touch upon the question of formalization and rationalization explicitly. After that, we will describe three types of applications in organizational computing, and discuss the feasibility and the usefulness of formalization.

2 Limits to formalization

In the following, we will use the term "formalization" for the process in which a certain piece of knowledge (for example, a business practice) is expressed in a unambiguous form. This unambiguity applies to both form and content. With respect to the form, formalization means that the expression obeys to a well-specified syntax. An example is the replacement of a free-text letter by a form with specific fields. With respect to the content, formalization means that the semantics can be described completely and unambiguously. Formal logic is one way of describing formal semantics, but there are of course other means as well. Formalization is a necessary condition for automation, since a computer is a formal device. However, the required degree of formalization depends on the degree of automation: in some cases, formalization of the form is sufficient (e.g. a Lotus Notes workflow application).

2.1 Understanding and cognition

In their influential book *Understanding and Cognition*, Winograd and Flores not only introduce the use of speech acts in modelling communication, but also present a fundamental critique of the rationalistic view of cognition that underlies most work in Artificial Intelligence and Computer Science. Drawing on philosophers such as Heidegger, they attack the idea that we are able to make

complete models of (parts of) the world that can be used subsequently for building intelligent systems incorporating these models. For example, they argue that (p34-35)

- our implicit beliefs and assumptions cannot all be made explicit
- practical understanding is more fundamental than detached theoretical understanding
- we do not relate to things primarily through having representations of them
- meaning is fundamentally social and cannot be reduced to the meaning-giving activity of individual-subjects

The world is encountered as something already lived in, worked in and acted upon before we start thinking and speaking about it. World as the background of obviousness is manifest in our everyday dealings and every possible utterance presupposes it. That which is not obvious is made manifest through language. That which is obvious is left unspoken, but is as much a part of the meaning as what is spoken (p58).

Taking such an ontological stance makes clear the futility of any attempts to arrive at complete formalizations. but it does not rule out the use of formal models. The point is that there are regularities in language use. "This does not mean there are no regularities, or that formal accounts are useless" (p64). The issue becomes one of finding the appropriate domain of recurrence. An example of such a recurrent pattern is the basic conversation for action that is found back in the Coordinator and also in for example the method DEMO (dietz).

2.2 An example: the Capability Maturity Model

The theoretical argument above can be exemplified by a model that has originated from the practice of information system development, the widespread Capability Maturity Model ((Paulk et al, 1995) of the Software Engineering Institute. This model enables one to evaluate the current situation in an organization with respect to system development. The CMM distinguishes five levels of maturity:

1. initial: nothing specified, ad hoc use of tools and methodologies
2. repeatable: there is some stability that makes that processes are no longer dependent on individuals.
3. defined: the design process has been defined and described explicitly. System developer are trained in this method.
4. managed: the design process is not only defined, but also managed according to explicit performance and quality metrics.
5. optimizing: continuous improvement of the process

The model not only gives a method of assessing the current situation in an organization, but also indicates the steps that have to be made in order to reach a next-higher level.

The focus of the Capability Maturity Model is on software development, but it can be applied to any process, including the business processes that information analysts are modelling. For example, the model suggests that learning is only possible after some repetition; in other words, the vantage point for analysis is the recurrent pattern, as Winograd and Flores indicated as well. A next step is to *define* and this is the point where an information analysis is most suitable. Definition can be regarded as a collective linguistic action that explicates what has been implicit in the background up to that time. It is a collective action, that requires the involvement of all the parties, even if there is only one person who does the actual writing. We also see here an important motivation for definition: to train new people that miss the experiences of the people already on the job. More in general, cultural reproduction is to be taken into account as one of the motivations for formalization (this point seems to be missing from the account of Winograd and Flores; and also in other language/action theories, "conversations for learning" have not received much attention).

After definition, further learning is still possible, not so much by theoretical analysis, but by systematic evaluation of the results in practice. The motivation is in this case economic: to increase efficiency and process control, in line with the Western rationalistic tradition (see below). Automation of the processes seems most feasible when the organization has reached the latter stages, although partial automation support can be given in earlier stages as well. We will come back on this issue later.

It is worth noting that the higher levels of maturity can only be reached in a more or less stable environment. As Winograd and Flores argued, the everyday practice is shaped against a certain unquestioned background. "Breakdowns" do occur when assumptions no longer hold. At such a point, the practice, and our interpretation, must be adapted. In a dynamic environment, this will happen continuously. In such a case, it does not make sense to define the process in all details, as this would only lead to inflexibility.

2.3 Why formalize, after all?

Although we basically agree with Winograd and Flores' way of thinking, we do observe at least one weakness in their presentation, the fact that they do not make a clear distinction between practical thought and theoretical (scientific) thought. It is not clear whether they write for information analysts and engineers or for information (computer) scientists. They note that much of the study of logic and language gives primacy to activities of detached contemplation (p33) and they do not want to disregard this kind of thinking but put it into context. The question is whether they view their own work also as "detached contemplation", thus putting it in the line of the scientific tradition, or prefer another position. For scientists, there is no other way of dealing with reality than by representations and formal models, also for those scientists that are well aware of the fact that this understanding is only secondary, and hence will also be modest in their claims about the application in practice. Scientific analysis is

only possible after abstraction. This is the source of its limitations but also its power.

The virtue of the Heideggerian viewpoint is that the requirements for formalization are put into context, rather than taken for granted. However, its weakness is that it does not give a positive incentive for formalization. Winoograd and Flores explicitly state that the use of formal models should not be excluded, but this is not really encouraging. As we have seen, positive incentives can be: scientific progress, and cultural reproduction (teaching). It may also be necessary for the identity of organizations ¹. The theory seems to be neutral with respect to these factors. In the next section, we will go into another pillar of the Language/Action Perspective, the philosophy of Habermas, that suggests a way of analyzing both the positive and the negative results of formalization by introducing the concept of rationalization.

3 Rationalization and communication

3.1 Rationalization processes

Rationalization is a key concept in the philosophical work of Habermas ((Habermas, 1981) (McCarthy, 1978) (Cooke, 1994) (White,1995)). Rationalization should not be taken here as "disguising or concealing underlying motives and intentions", as it is often used in everyday language, but refers in the first place to a particular development in Western society in which the reasons for actions are no longer primarily determined by traditions, but have to be given more explicitly. What Habermas (in the line of Weber) means is that modern culture has made available a "rationalized lifeworld" - one in which actors consistently carry the expectation that the various validity claims raised in speech are opened for discussion and cognitively distinguished ((White,1995)). As such a rationalized lifeworld emerges, an increasing number of spheres of social interaction are removed from the guidance by unquestioned tradition and opened to coordination through consciously achieved agreement. In other words, in the lifeworld we can notice an increasing independence of procedures of justification from traditional normative contexts and an increasing reliance on communicative action, also called "action toward understanding" (Verständigung). A good example in this respect is the participation of the employees in the decision-making process of a company. Traditionally the director of a company could make decisions without having to give a justification for them. Nowadays, this justification through tradition (and structure) does not work in the same way. Also directors can be requested to justify their decisions by the employees.

¹ Taylor (Taylor et al, 1996) makes a distinction between conversation and text, the former being fluent and context-dependent, the latter fixed and more objective. In order for organizations to be created, they need to transform the ongoing conversations into an "authoritative" text. This transformation is done by multiple "degrees of separation". There seems to be a parallel between the separation or distancing that Taylor describes and the formalization of Flores

Rationalization implies on the one hand that tradition loses its justifying power, and on the other hand that different validity claims are distinguished. According to Habermas, every communicative utterance simultaneously raises a claim to truth, a claim to normative rightness, and a claim to truthfulness. These claims refer to three different worlds (the object world, the social world, and the subject world, respectively), and hence should not be mixed up, as they often are in premodern societies. Nor should they be reduced to one, as in modern positivist thinking, where only the claim to truth is recognized. Such a reduction means in effect that everything is considered an object, including the human subject and normative grounds.

However, there is also a second process of rationalization that has been described by Max Weber as well, but which Habermas distinguishes sharply from the first process. Simultaneously with the advance in communicative rationalization, there also occurs an advance in the rationality of the society as measured from a functionalist or systems perspective. This means that there is an expansion of social subsystems that coordinate action through other means, namely, through the media of money (the market) and administrative power (the bureaucracy, or the centralized state). This rationalization process is ambivalent. It is beneficial to the extent that it releases the (growing) pressure on communicative action. Communicative action is rational, but also costly; it typically takes a lot of time to reach agreement in a group. The other coordination mechanisms are much more efficient. But the problem that Habermas notices is that these other coordination mechanisms increasingly invade *all* the areas of social life. This is called the "colonization of the lifeworld" that brings in its wake a growing sense of meaninglessness and dwindling freedom.

It is not the place here to enter a philosophical discussion on the differences between Heidegger and Habermas. A few short remarks must suffice. Habermas follows Heidegger in his critique of Western rationality, and for both philosophers this is related to a different view of "language". But whereas in Heidegger's (later) thinking, the human subject gradually disappears under the massive weight of Language and Being, the human responsible subject is central in Habermas' views. For Heidegger, truth is an anonymous process of unconcealment (cf. (Winograd and Flores, 1986) p179), whereas for Habermas, it is a claim made by a speaker that he should defend against counter-arguments.

3.2 Rationalization and automation

Let us now come to the question whether formalization (and automation) of communication processes is something to be pursued. The answer to this question depends heavily on the question what kind of rationalization is at stake here:

- is it a form of rationalization of the lifeworld, in which the level of communicative rationality is raised?
- is it a form of functional rationalization in which communicative action is replaced by something more efficient?
- is it a form of functional rationalization that threatens the lifeworld (its rationality and solidarity)

The preliminary answer that we want to give in this paper is it can be any of these three, depending on the kind of application and the context in which the application is used. In the next section, we will describe different applications and come back to this fundamental question with each of them.

3.3 Refining the concept of communicative action

In the following, we will also need a refinement of the concept of communicative action. Communicative action has two aspects: it consists of actions towards mutual understanding (*Verständigung*), and its goal is the coordination of the actions of the participants. One could ask whether these two aspects go necessarily together. Now Habermas also discusses consensual action and conversational action as special kinds of communicative action (borderline cases) ((Koningsveld and Meertens, 1986)).

In the case of consensual action, interaction takes place on the basis of an already achieved common definition of the situation (McCarthy, 1978). This means that actions towards mutual understanding are no longer necessary, and what remains is only the coordination. An example is the communication in a surgery team. The communication can be kept short, and, as long as no exceptions occur (that are avoided as much as possible, of course), there is no process of *Verständigung*.

Conversational action is just the opposite. In this kind of communicative action, the emphasis is on mutual understanding, and there is no (or less) urgency to coordinate actions. A typical case of conversational action is the informal talk that people have in the coffee corner. If its purpose is not to coordinate actions, one could question its utility. However, it can be argued that these kind of conversations do have a purpose in that they contribute to common definitions of situations. These situations may have a hypothetical character during the conversation, but they could become real later.

Taking all this together, we distinguish the following types of action:

- conversational action as informal communications that feeds the shared knowledge of the organization
- communicative action as the more formal (but still covering the whole spectrum of natural language) communication that is oriented at coordination. This kind of communication may draw partly on the pool of shared knowledge fed by conversations.
- consensual action in which a reduced and perhaps formalized language is used with the goal of coordination. This is only possible against a background of communicative action
- non-communicative action as coordination by means of money, bureaucracy, or technology.

Note that these types of actions also relate strongly to the situations of communication distinguished in the introduction. The inter-human communication pertains mainly to the conversational and communicative actions. The situation of communication support relates strongly to the consensual actions. And

the system to system communication can be seen as non-communicative action (human communication replaced by technology).

4 Organizational computing: some examples

In this section we want to take a closer look at some application types in organizational computing that involve communication. For each example we will show which type of communicative action is involved and whether formalization for this type of application is useful (or even necessary).

4.1 Meeting support

The applications that are concerned with support of meetings are electronic meeting rooms, research networks, etc. Meetings can be synchronous and asynchronous, and taking place at one location or over a distance. In the following, we will concentrate on electronic meeting rooms where the participants are together in the same room at the same time, although most conclusions will apply to the other cases as well. A well-known tool for EMR support is GroupSystems (Nunamaker et al, 1991). An EMR system does not try to replace the communication with technological means, but to provide support. An example is a brainstorming tool that allows parallel and anonymous input, and then presents the results to the group for discussion. This can speed up the idea generation and can also take away social obstacles for participation.

However, the basic motivation for the use of EMR tools in group meetings is not the increase of efficiency, but the minimization of productivity losses. The tendency for groups to become less productive as group size increases is known in the social sciences as the Ringelmann effect (Forsyth, 1990). It has also been attested in numerous experiments that in terms of creativity, groups perform lower than the best member. Argyris has pointed out that people are often unaware of their defensive, and ineffective behaviour in groups (Argyris, 1982). The question then becomes how meetings can be conducted in such a way that these undesirable effects are minimized and the result is satisfactory rather than frustrating. Measures that can be taken range from good facilitation, the adoption of effective decision procedures, thorough preparation, increasing awareness of one's behaviour (reflection) to the use of automatic tools to support some specific aspect or component. What is most important is not the tool, but a more conscious use of communicative actions. In line with Habermas, we can call this a rationalization process (of our lifeworld).

Although group meetings are often ineffective, it would not be a good idea to dismiss them completely. Meetings are a kind of communicative action that play an important role in coordinating the individual behaviours. Since it is through language that we give meaning to the world we live in and share with others (Winograd and Flores, 1986) p78, we do need meetings in which speaking as well as active listening can create new (shared) spaces of possibilities. Participation,

perhaps with the help of a coach, can also be an instrument in learning, in altering one person's interpretative framework (Bennett, 1996).

What kind of rationalization is useful in group meetings? Without trying to be complete, we want to discuss the following points:

1. identifiability and responsibility
2. transparency of commitments
3. transparency of validity claims
4. transparency of conversation type / meeting goals
5. transparency of authorizations

Identifiability

Forsyth (Forsyth, 1990) gives a couple of suggestions to avoid productivity losses in groups, such as involvement, mutual trust, personal responsibility and identifiability. Identifiability means that each member's contribution to the group project can be clearly identified. More precisely, it is not the identifiability per se but rather the possibility of evaluation that is the key to controlling social loafing.

Evaluation can be considered an aspect of rationalization, because it means that subjects are identified and recognized as subjects, rather than being objectified and reduced to instruments. Of course, the other extreme should be avoided as well, where the only goal is to promote one's own personality. This would be a reduction to the expressive aspect of communication.

Transparency of conversation type

Janson and Woo (Janson and Woo, 1995) compared different IS development methods from a speech act perspective. By looking at the kind of speech acts made by different participants - users versus analysts -, one can detect different conversation types underlying the user-analyst meetings. In JSD, the users describe the application to the analyst; the analyst may ask questions for clarification, and finally the analyst writes down the specifications. In SADT, the modelling technique that is used stimulates exploring the application domain in more depth. This can only be done by the users. Hence the conversations contain more commissives from the users (to investigate unsolved issues) and also directives to the analyst for clarification on the method.

The fundamental difference between the two methods, JSD and SADT, seems to be that in the former, the analyst is responsible for building the specifications, and the user is supposed to describe the domain of application, whereas in the latter, the user is responsible for building the specifications. The former can be described as a factagenic conversation from user to analyst, whereas the latter is a actagenic conversation from analyst to user and a factagenic conversation from user to analyst (thus making up a complete transaction, or conversation for action).

Evidently, a design meeting can be structured in different ways, leading to different conversation types. Transparency of the goals - who is responsible for

what - will increase the transparency of the conversation type. When the participants are made aware of this, it may reduce the number of counter-productive moves.

Transparency of commitments

Quoting Winograd and Flores, Bennett emphasizes that "to be human is to be a kind of being that generates commitment, through speaking and listening" (Bennett, 1996). Commitments are not always clear. Rationalization of the meeting means, for one thing, that requests for commitments are transparent as well as the commitments of the responsible actor. The last thing can be achieved, for instance, by putting a commitment on the "to do" list (published with the minutes of the meeting) only after consent of the responsible actor. Whether the transparency of the requests and commitments is supported by a tool, such as the Coordinator, or by linguistic means (the use of explicit speech act verbs), is less relevant than the transparency itself.

Transparency of authorizations

When people make requests to other people, there may be different claims with respect to the validity of the request. In (Dignum and Weigand, 1994), we distinguished charity, authorization and power. The most secure is authorization, since power is not based on rationality and charity depends on the goodwill of the Addressee. Transparency of authorization means that the requests made to participants during the meeting, are clearly authorized requests.

How is it possible to make authorized requests? Only by having asked for authorization at some point, during the meeting or before the meeting. Rationalization of the meeting thus includes that authorizations are not taken for granted, but asked explicitly. This point is stressed also by Bennett when he draws attention to "asking permission", for example, in the form of a prior "partnership" between participants. Such a partnership can enable "collaborative coaching", by means of which people can learn to recognize dysfunctional behaviour. This is a special case, since authorizations can apply to all kinds of actions, not just interventions.

Transparency of validity claims

For Habermas, rationalization of the lifeworld includes the distinction between different validity claims. When a speaker makes a communicative action, he typically makes several validity claims simultaneously: that the statement is true with respect to reality, that the action is legitimate with respect to the norms of the social world, and that he is sincere. We are not aware of an existing tool that supports making these distinctions, but such a tool could certainly help in avoiding useless argumentations where these validity claims are mixed up.

For Habermas, rationality also means that the participants are able to back up the validity claims that they raise. A method that supports structuring argumentations is IBIS and a tool that supports this method is gIBIS (Conklin and Begeman, 1988). Such a tool could be extended so that normative, cognitive and

expressive validity claims are clearly distinguished.

Summarizing, we conclude that group meetings can be considered as communicative action, and that there are several possibilities for rationalization. This will lead to a certain kind of formalization, for example, when a "to do" list is maintained, but this is formalization of the communication processes themselves, and not meant to replace communicative action.

4.2 Workflow Management

Traditional workflow management systems can be seen as a form of bureaucracy (cf (Lee, 1988)). They support the coordination of activities through technological means. The main emphasis of these products lays on the logistic aspects of the workflow. A workflow is depicted in a similar way as the production process in a factory. The consequence of seeing the workflow as an autonomous process in which the persons are used as resources is that explicit coordination between persons becomes superfluous. The coordination between the persons follows from their respective positions in the workflow.

What are the consequences of this viewpoint for the concepts of responsibility, commitment and authorization? The responsibility for a particular case in the workflow can hardly be attributed to one person any more. Each person in the workflow is responsible for a small part of handling the case. Although this might be a positive development for reasons of communication efficiency it also makes it more difficult to deal with "breakdowns". It is now a problem to decide which person should take action to handle the breakdown because no one is responsible anymore.

The commitments given in the workflow are completely implicit. The workflow determines the actions of the persons. Therefore they are committed to perform an action by the fact that they receive the case at a certain time. The need to give explicit commitments is therefore absent.

The authorizations are determined completely through the organizational structure in which the persons function. Thus also authorizations do not have to be given explicitly anymore.

The use of this type of workflow systems is limited to the cases where the activities of the organization are highly repetitive and very structured. In this situation the coordination of the activities can be determined largely through the organization structure ("bureaucracy", in terms of Habermas) and communication can be replaced by technology.

There is one workflow system that deviates markedly from the traditional workflow systems: Action Workflow (Medina-Mora et al, 1992). Action Workflow use the Language/Action paradigm as starting point to describe the coordination of activities within an organization. The main purpose of this tool is to make the commitments that persons make towards each other in an organization visible. By monitoring these commitments it is possible to enhance the efficiency of the workflow (on a more essential level than done in the logistic systems).

Instead of replacing the communication in the workflow by organizational structure and technology Action Workflow concentrates on the consensual communication in an organization as being of prime importance for the primary process. The physical workflow is modeled through the communication that directs this workflow. The communication loops that form the basis for the workflows in Action Workflow consist of four phases:

1. Proposal
2. Agreement.
3. Performance
4. Satisfaction

The first two phases indicate the transfer of a case from one person in the organization to the next. The third phase (Performance) signifies the assertion of the performer of the physical action that she has actually performed the action.

It may be clear that these communication loops are excellent means to capture responsibility, commitments and authorizations. Like the tools for meeting support, Action Workflow rationalizes the workflow through supporting the rules of commitment that underlay the workflow. This contrasts with the approach of other workflow systems that rationalize the workflow through formalizing it and fixing the structure of the workflow through the process structure and organization structure.

The four phases of the communication loops of Action Workflow are not defined formally. They can consist of many messages or can be implicit in some action. Each phase in the loop is supported, however, by giving the information needed to complete that phase, triggering actions and sending reminders. Of course, if the phases can be described formally, more (relevant) information can be presented at the right moment. However, the power of the present approach is that the phases can be more or less formalized and depending on this more or less support can be generated. It seems to prove the point that to support communicative action one should not try to formalize these actions in a rigid manner. One of the characteristics of communicative action is that it can be used to react to unsuspected circumstances which needs a high degree of flexibility, which in its turn does not go very well with a rigid formalism.

4.3 Software agents

The last example we would like to discuss are the so-called software agents. One important feature of all software agents seems to be a certain kind of "autonomy". I.e. the programs run for an extended period of time without interference of the person that started the program. The program reacts to events from the environment and can report back to the user or start up other programs.

For our purpose the software agents only become interesting when several agents coordinate their actions. I.e. an agent gets a task which it distributes to one or more other agents. In such an environment some type of "communication"

between the agents is necessary. The type of communication that is supported between agents is usually very limited because it is mainly seen as the transfer of information instead of seeing it as an action in itself. This limitation on the communication permits its use only in highly structured environments.

In recent years it was recognized that the coordination of tasks between agents is more than the transfer of information. Some effort has begun to define agent communication languages based on speech acts. The most well-known language is KQML (Finin et al, 1996). Although this language is based on speech acts it is not based on the Language/Action Perspective. Although many performatives are incorporated in KQML the pre- and postconditions of the messages are unclear and certainly not equal to the ones in human communication.

It is clear that the communication between agents should be completely formalized. Any communication between formal systems should itself be formally defined, otherwise the systems could not react (appropriately) to a message. Another question is which concepts should be involved in the formalization of this type of communication. This depends (completely) on the role of the type of agents that are involved. Agents can be used to fulfil many different roles. They can be used to replace non-communicative action, for support of consensual action, for support of communicative action, but also for the simulation of (parts of) these types of action.

In case the agents are used as a technology to replace non-communicative action, this action should be completely formalized. Usually this only occurs in highly structured environments, because the structure of the environment prevents the need of a very advanced communication mechanism. There is no need to introduce concepts such as goals, authorization etc. in the agent formalization, because they are fixed in the environment of the agents. We consider this kind of non-communicative coordination different from "bureaucracy", since the agents are installed by the human subjects themselves. It is also not a market situation, hence it might be considered a third way of coordinating behaviour without communication.

Another place where agents are used is in the support and replacement of consensual action. A good example for this area is electronic commerce. In this area the agents can autonomously "negotiate" with other agents. This can only be done when the negotiation protocols are simple and fixed. In order to support or replace more complex negotiation also more concepts are needed in the formalization of the pre- and postconditions of the communication. If the agent acts as a representative of its user it should also "know" about the goals and authorizations of its user in order to determine its possible communication moves.

The last role that we want to mention here, although it plays no part in organizational computing, is that of simulation. Agents are used in many areas to simulate human behaviour. In this role as much as possible should be formalized in order to make a proper study of the simulated situations possible.

To conclude this section it can be said that formalization of the communication involving agents is always necessary (because they are formal systems). The

type of concepts that should be included in the formalization depend on the type of role that the agents play (which type of action they replace). Although many concepts should be included to make the agents flexible and adaptive in complex environments, one should not confuse these formalizations with the actual attitudes ascribed to humans. In specific it is useful to include formalizations of goals, commitments, responsibility and authorizations in agents, but these attitudes can never be ascribed to the agents. (They might be ascribed to their users though.)

5 Conclusion

Is formalization of communication useful? And if so, how far should one go? In the preceeding sections we have shown that the answer to this questions depends on the type of communication that is modeled and also the purpose of the formalization (what type of rationalization is intended). In general we agree with Winograd and Flores that it will not be possible to formalize all human communication. However, a limited form of formalization of communication is useful if we want to support the rationalization of the communication process, like in meeting support and computer supported cooperative work. As remarked earlier in section 3.1. modern culture forces a rationalization of the communication through the deterioration of traditional power structures that can be used to justify communication. Therefore it seems that the formalization of the communication process for this rationalization purposes is useful and indeed preferred.

Also when communication is replaced by something more efficient, as it is the case in applying workflow management systems or software agents, it is important to have some formalization of the communication. At least one should know what part of the human communication is replaced through the automation and what are the consequences. If one agrees with Habermas that the high pressure on communicative action necessitates the use of non-communicative coordination mechanisms, the question remains only how far one should go with this replacement. The best strategy seems to be develop non-communicative coordination mechanisms where necessary, but always embed them in a communicative domain where human responsibility can be maintained. So for organizations, a system like Action Workflow can be applied fruitfully, but it should not totally replace the communicative action such as it can occur in meetings; and the latter can not do, in the end, without the backing of conversational action domains in the informal communication. A similar argument can be made for interorganizational communication, such as Electronic Commerce. Non-communicative coordination (e.g. by means of software agents, operating on electronic markets) can only be effective in very specialized and structured domains. In other domains, they can only be applied if there are supporting communicative coordination mechanisms as well, for example, in the form of "network organizations" or "virtual organizations". The idea of distinguishing different layers of communication can also be found in (Van Reijswoud, 1996), who uses the term "discourse layer" for the most basic conversational action.

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Reconstruction of Different Business Processes

- A Theory and Method Driven Analysis

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Abstract

When evaluating and developing organisations, the business process perspective is a popular one to use. Several methods exist and there are new ones being developed. When evaluating and/or developing organisations from a business process perspective, there is a need to reconstruct existing business processes. We have experienced problems in distinguishing and delimiting business processes in relation to each other. There is a need for criteria. Within the language/action perspective a more clear process notion can be formulated, which supports a clear process delimitation. In this paper we are showing a coupling between a method driven and a theory driven approach for reconstruction of different business processes. The business action theory, which is based on the language/action approach, gives us support in guidance for reconstruction of different business processes, i.e. asking questions based on communicative action theories. We also present a method for process and action modelling. The presented theory and method have been used in an action oriented case study, which is used to show experiences and drawing conclusions from one theory and method driven analysis of business processes.

1 Introduction

In contemporary organisational change approaches such as Business Process Reengineering (BPR) and Total Quality Management (TQM) the process notion is put into focus. Several different methods for process modelling exist. It is important to have adequate method support when reconstructing current processes and redesigning new ones. The different methods are however based on different conceptual frameworks and thus different process notions. There are many process methods/frameworks which tend to have a restricted "manufacturing" view; i.e. describing the transformation from input to output. This is of course important to describe, but it seems in many situations not to be enough. Language/action (L/A) approaches challenge this narrow view; c.f. e.g. Action Workflow (Action Technologies, 1993; Denning & Medina-Mora, 1995) and DEMO (Dietz, 1994). Such approaches emphasise the business process as a *mission*. This implies that different roles (e.g. customer and performer as in Action Workflow) must be identified and specified and that different activities/phases in the business process must be clearly related to the different roles.

One important problem in process modelling is the delimitation of processes. This problem is discussed by Davenport (1993). Unclear criteria for process delimitation can give rise to varying amount of processes

when describing an organisation (ibid. and Goldkuhl, 1996). L/A approaches, with the roles and mission in focus, have a more clear process notion which supports a more straightforward process delimitation. A business process theory related to modelling methods give analysts support when to decide where a process starts and ends. This is claimed to be one important advantage for the L/A approaches to business process modelling (Goldkuhl, 1996).

The issue of process delimitation is also related to process division. As identified by Lind (1996b) many business process approaches tend to have a sequential process view: One main process is divided into sequential sub processes. Lind wants to supplement this view with "variant processes". This means that there will be alternative business processes in an organisation, i.e. there are different ways for performing business missions. An organisation usually performs different kinds of missions and this implies different types of business relationships between customer and supplier.

If there are different ways to perform business, such different ways ought to be identified and modelled in a business process development project. The different ways of performing business (i.e. different business processes) should be reconstructed and evaluated. In such a reconstruction there is a need not only to have good modelling methods. There is a need to have an appropriate business process theory as a lens for identification, delimitation and division of different current processes. The business process theory and the modelling method should be integrated in a proper way. In Goldkuhl (1996) there is a comparative analysis of two such approaches: Action Workflow (e.g. Action Technologies, 1993; Denning & Medina-Mora, 1995) and SIMM (e.g. Goldkuhl, 1992). Both these approaches are based on a language/action perspective. There are similarities and differences between these two approaches. In the SIMM approach there is not as tight a coupling between theory and method as in Action Workflow (ibid.). There is therefore a need to articulate the relationships between the theory level and the method level.

The purpose of this paper is to make such an articulation of the relationships between theory and method. In other words the purpose is to describe an integral usage of an L/A oriented business process theory and methods for business process modelling in the process reconstruction phase.

We will describe briefly the conceptual framework "Business Action Theory" (section 2) and parts of the business process modelling method (section 3). The usage will be illustrated by a case study (section 4).

2 Theory: A Generic Business Framework

There is a need to understand the making of business as action and interaction. Making business is not mere agent-less transportation of information and material. It consists of customers and suppliers performing actions of communicative and material character. Such different actions are related to each other in generic patterns. The Business Action Theory (BAT), presented by Goldkuhl (1996, 1997), is one such attempt to describe the generic business action logic. This theory is founded on communicative action theories (as e.g. Searle, 1969; Habermas, 1984) and business relationship theories (as e.g. Axelsson & Easton, 1992; Normann & Ramirez, 1993; Gummesson, 1996). As mentioned above, a comparison between BAT and Action Workflow is performed in Goldkuhl (1996). Verharen (1997) has made a comparison between BAT, Action Workflow and DEMO, and as a result he has followed BAT as his main theoretical inspiration when studying business interaction in his thesis (ibid.).

This generic business framework describes business processes as consisting of six phases. It starts with business prerequisites of customer and supplier and goes through business communication (with e.g. offers, inquiries, negotiation and contract) to fulfilment (through delivery and payment) and ends up with the satisfied usage or discontent and possible claims. The phases are:

1. Business prerequisites phase
2. Exposure and contact search phase
3. Contact establishment and proposal phase
4. Contractual phase
5. Fulfilment phase
6. Completion phase

These different phases were described in Goldkuhl (1996) and have been further developed in Goldkuhl (1997). The phases are depicted in figure 1.

The Business Action Theory emphasises that there are certain business actions which always have to be performed when doing business, as e.g. the communicative actions offer, order, delivery promise, contract. Such actions always have to be performed in principal, but in simple business situations, some of these actions can be implicit or integrated with other actions. The theory also emphasises that there is a certain principal order between different groups of actions within a business process. The different phases constitute such groups of actions.

The purpose of Business Action Theory is of course to describe and explain business interaction. But the purpose is also that it can be used as a theoretical lens in organisational change when developing business processes. The theory can be used as an interpretative framework when reconstructing, evaluating and redesigning different business processes. In such change situations it should be supplemented by congruent change methods.

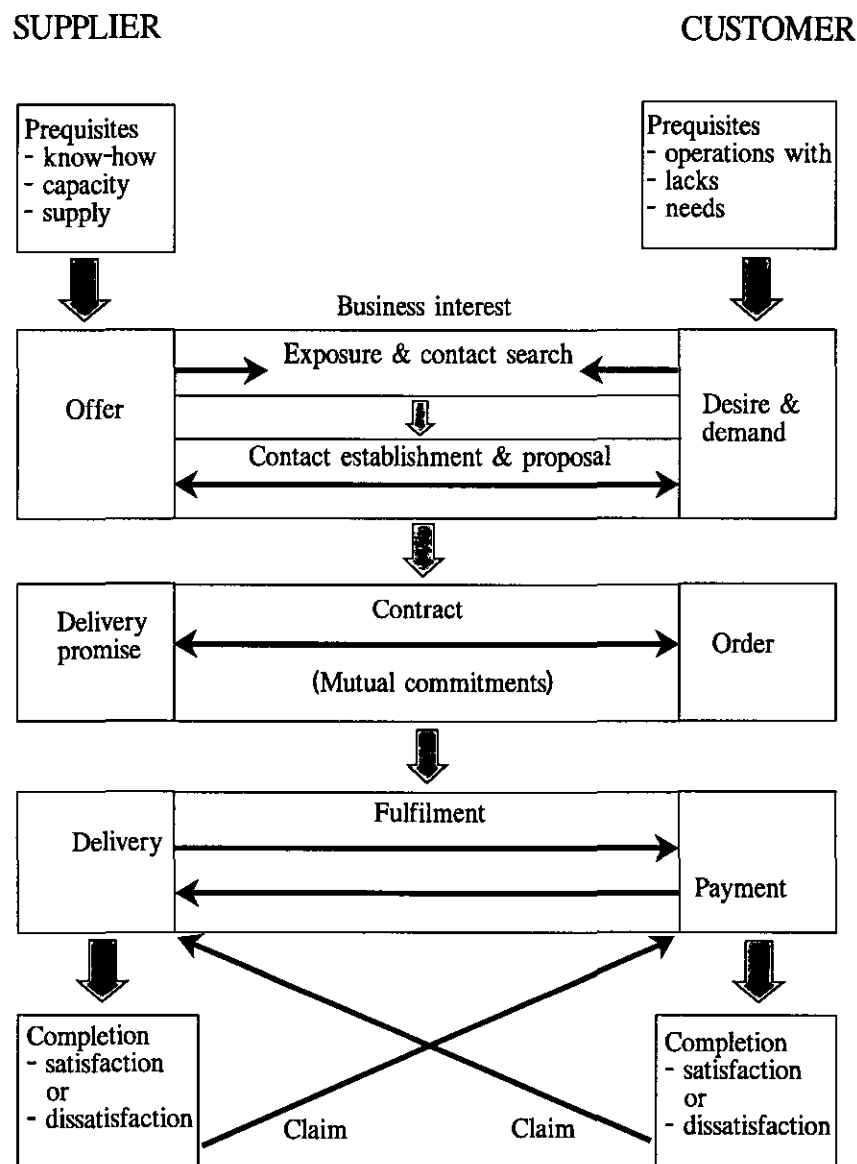


Figure 1: Business Action Theory: The six generic phases of business processes (from Goldkuhl, 1997)

3 Method: Process and Action Modelling

When performing a reconstruction of different business processes within a corporation there is a need for

the modellers to be supported by methods. Development methods consist of work procedure, notation and a conceptual structure. Methods are based on some implicit or explicit theoretical perspective (Goldkuhl & Cronholm, 1993; Avison & Fitzgerald, 1995). In this paper we argue that the L/A oriented business process theory (BAT) should actively be used in reconstruction, evaluation and redesign of business process. This theory should thus be an explicit supplement to process analysis methods.

When reconstructing a corporation's different business processes, we propose the use of two method components from the SIMM methodology. These are Action Diagrams and Process Diagrams. There are other method components in the SIMM methodology, such as problem analysis, goal analysis and strength analysis, which are important in business process analysis, but they are not described in this paper (cf e.g. Goldkuhl & Röstlinger, 1993). The purpose of using Action Diagrams is to capture the detailed activity pattern within a business process. The Process Diagrams are used to make it possible to regard the business process on a survey level. Below there is a discussion of the meaning and use of these two diagram types.

3.1 Action Diagrams

Action Diagrams are graphical models (Goldkuhl 1992, 1996). They have a well defined notation. They are intended to be used by systems analysts and IS users together in specifying and modelling information systems and their business contexts. Action Diagrams try to integrate a flow orientation (describing information and material flows) and an action orientation (describing the types of action performed) in one type of description (Goldkuhl, 1996). Therefore Action Diagrams are appropriate for business process modelling (see appendix 1 for an example).

The basic description elements are found in figure 2. An activity consists of performers, actions and action objects. There are human actors in specific activity roles (e.g. salesman, order clerk and customer). These actors are performing actions. Actors use resources and instruments in their actions. Actions are performed based on some prerequisites (basis for action), which can be of physical nature or information. Results of actions can be action objects of physical or informational character. Producing an information action object means a communicative action. A performer can be an actor as well as an instrument, such as a computerised information system. An important aspect of Action Diagrams is the semantic power to describe action logic. It is possible to describe sequential order of actions (i.e. the flow aspect), alternative actions (decision points), conjunctive actions, contingent actions (i.e. actions occurring only sometimes), trigger (initiation) of actions (by time or communication), interruption of actions (by time or communication), condition for actions, and parallel actions.

A contextual descriptive approach is mainly used when working with Action Diagrams (Goldkuhl, 1992). Each Action Diagram describes a business context within a business process. Different Action Diagrams are related to each others through descriptive connectors (i.e. links to other Action Diagrams). The limits of each Action Diagram (=business context) are arbitrary; i.e. the analyst has the freedom to choose the appropriate borders of the described context.

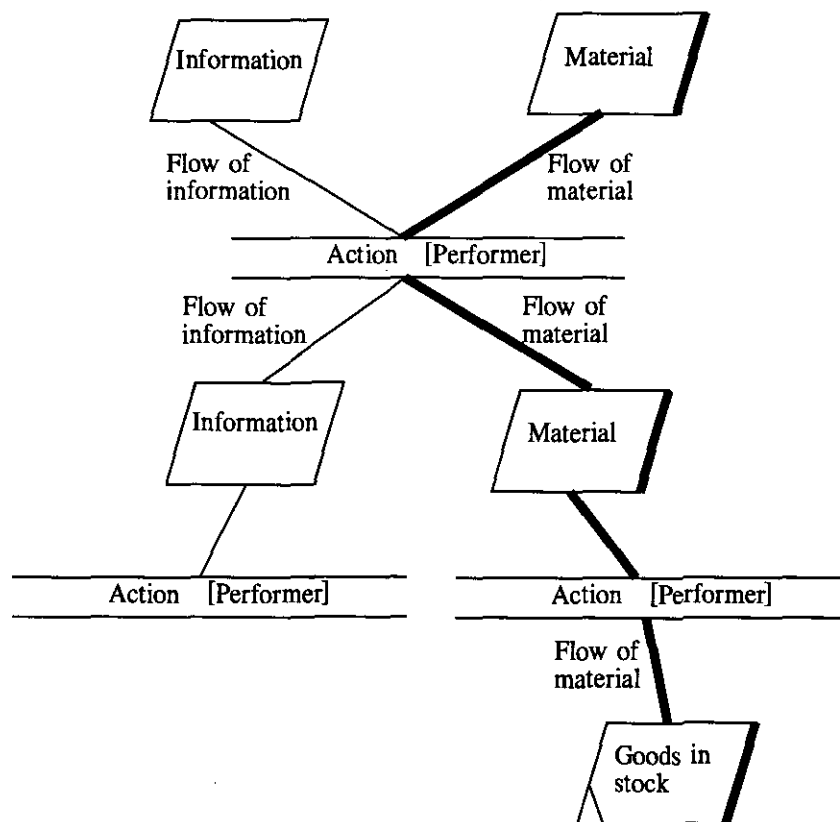


Figure 2: Basic description elements in Action Diagram (from Goldkuhl, 1996)

3.2 Process Diagrams

Process diagrams are used to make it possible to regard a business process on a survey level (see appendix 2-4 for examples). A Process diagram is a key map of a business process. The contents in the Action Diagrams, such as activities, flow and action objects (see figure 2) are grouped to more coarse-grained components.

We call these process components:

- customer-to-customer process
- side processes
- sub processes

Each business process consists of a customer-to-customer process and possible side processes. The customer-to-customer process consists of the business logic from customer inquiry or order to delivered products to the customer. The activities within a customer-to-customer process are performed for a specific customer, between a supplier and a specific customer. The side processes support the customer-to-customer process and its character is either a condition for or a consequence of the performance of the customer-to-customer process. The activities that a side process consists of are performed for a *potential* customer. The activities that a customer-to-customer process consists of are performed for a *specific* customer (Lind, 1996b).

The customer-to-customer process and the side processes consist of one or several sub processes. Each sub process consists, among other things, of several activities, which are contextually related to each other. The sub processes within a certain business process are, in the Process Diagram, related to each other by information or material flow in order to gain understanding of the business context on a survey level. A sub process can be performed by several actors who can be members of different organisational units. Each sub process can be a component in several business processes.

The Process Diagram excludes the fine-grained activities which sub processes consist of, i.e. the level of detail only runs down to sub processes. More details can be found in the Action Diagrams. Figure 3 is an outline to the principle structure of the Process Diagram.

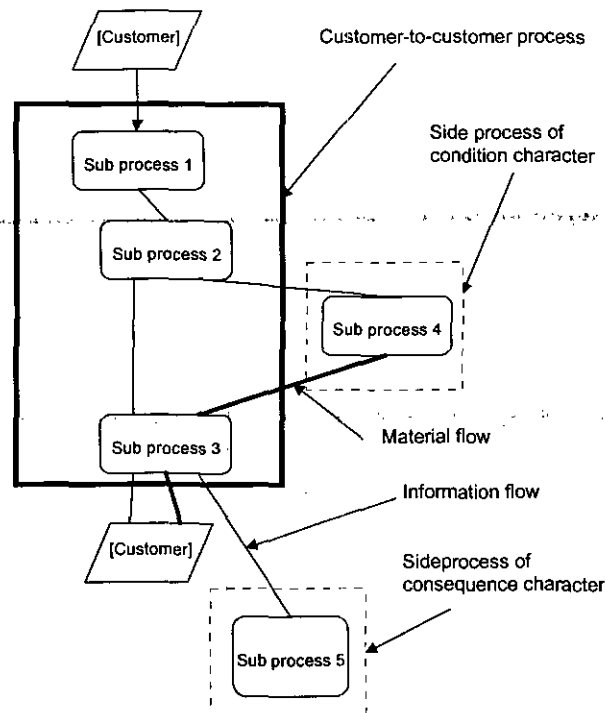


Figure 3: Basic description elements in Process Diagram (Lind, 1996ab)

3.3 How to Perform Reconstruction of Different Business Processes

As identified in Lind (1996ab) a corporation usually consists of several business processes (variant processes) and these coexist in a corporation and co-use the infrastructure of the corporation. This means that an organisation has different ways of performing business missions, where each business process consists of activities that are performed for a certain business mission. It does not seem that people in corporations often have a clear picture of which business processes the corporation consists of. These have to be reconstructed, which can be done by business modelling using Action Diagrams and Process Diagrams. A series of Action Diagrams and appurtenant Process Diagram describe the parts of a business process and how these parts are related to each other. In order to develop a corporation its business processes need to be reconstructed as a basis for redesign.

When using Action Diagrams in the business modelling process, information and material flows are identified (reconstructed). Action Diagrams are used to describe the activity pattern within the business processes in detail. These diagrams (activity contexts) are related to each other. A so-called "bottom-all" approach is applied to capture the different contexts (Goldkuhl, 1992), i.e. the different activities that are performed during business missions are studied on a detailed level in order to reconstruct the business processes (the contexts). The semantics of the Action Diagram notation makes it possible to describe the activities in great detail; e.g. different exceptions can easily be modelled. In order to gain understanding of the wholeness of the business process, we go from several detailed and related Action Diagrams and aggregate to one survey Process Diagram. A so-called bottom-up approach is normally used to produce Process Diagrams where Action Diagrams are used as a basis. The relationships between these bottom-all and bottom-up approaches are depicted in figure 4 below.

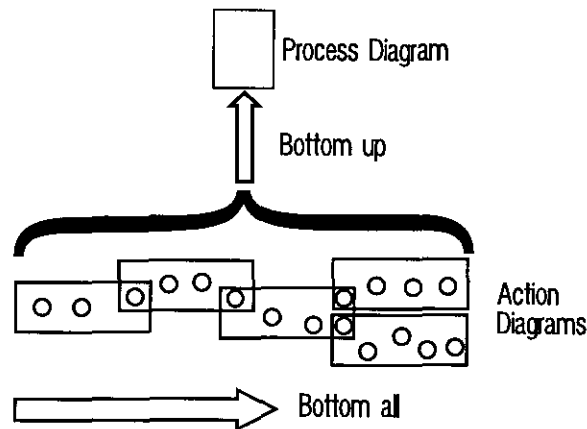


Figure 4: Bottom-all and bottom-up approaches when using Action Diagrams and Process Diagrams

When performing a reconstruction of a certain business process one starts with a typical business mission and reconstructs the business logic (activity pattern). We focus on the business logic and the business interaction within a certain business process. To be able to focus on the business interaction, Business Action Theory (BAT) is used as a theoretical lens. During this part of the reconstruction process Action Diagrams are used, where BAT is used as an aid to find the purpose for different contexts. We understand the business process through the business mission between customer and supplier.

The first series of Action Diagrams is the basis for finding other ways of performing business missions. These diagrams are used in order to find differences between ways of doing business. This way of reconstructing business processes is continued until all ways of performing business missions are described. Sometimes Process Diagrams can be used to find other ways of doing business directly. A Process Diagram is thus used as a basis to specify the contents of a business process in detail and this is performed by using Action Diagrams. Our experience is that the first business process which is reconstructed has to be done by Action Diagrams, but when identifying the following business processes one *can* apply this kind of a top-down approach.

When performing process and action modelling of a certain business process the generic business framework (see section 2) is used as a basis for asking questions. Therefore, the customer-to-customer process part of a business process is the first one to be reconstructed. Then one identifies which prerequisites that have to be fulfilled in order to be able to perform a business mission in the way that the description of the customer-to-customer process shows, i.e. identifying side processes with condition character. Finally one identifies the consequences that the given way has on performing business deals, i.e. identifying side processes with consequence character.

4 Case Study: Reconstruction of Different Business Processes

Between October 1994 and March 1995 we participated in an action research project, with the research purpose to develop and test a method for business process oriented change analysis (Lind, 1996a). The selected company for developing and implementing the method was Structo (with about 130 employees) in Storfors, Sweden. Structo is a manufacturing company, which mainly transforms steel into pipes for hydraulic cylinders. At Structo there was a need for integrating administration and production. Therefore a change analysis was initiated in order to reconstruct and develop the business processes of Structo. A project group was formed consisting of several persons from different departments of Structo and the two of us as researchers. We participated actively in the analysis process. In the research intervention approach we gathered different kinds of data through participant observation, documents and interviews (Gummesson, 1991).

One of the activities, when a corporation is diagnosed, is reconstruction of existing praxis. In the case study a reconstruction of the business logic was performed. During the diagnosis the goals, and instruments for achieving those goals, were clarified. This showed in what ways the business processes were instruments for reaching the main goals of the corporation. The existing praxis was reconstructed at two levels:

- At the activity level by using Action Diagrams.
- At the survey level by using Process Diagrams based on activities and their connections from the Action

4.1 Coexisting Business Processes

In the case study several of the business processes of the corporation were reconstructed. These covered 90 % of the operations of Structo. The reconstructed business processes were called:

- *special production customer*, which consists of activities to produce tailor-made products.
- *standard stock customer*, which consists of activities that are performed when Structo is selling products from the standard stock.
- *long-term agreement customer*, which consists of activities that are performed when the customer makes a prognosis of his future orders, in order for Structo to be able to plan their production.
- *whole trading customer*, which consists of activities that are performed when the subcontractors of Structo deliver products directly to Structo's customer. Structo is not able to manufacture those products itself.
- *long-term agreement - whole trading customer*, which consists of activities that are performed when the customer makes a prognosis of his whole trading orders.
- *long term agreement - half trading customer*, which consists of activities that are performed when finished products are delivered to Structo before they are delivered to the customer. The goal of this business process is to store bulk products that are cut when the products are delivered to the customer. The customer makes a prognosis of his orders.

Table 1 shows the delimitation of the business processes in the case study. These are six variant processes; i.e. different principle ways for Structo to perform its business. We use the two dimensions "Customer Relation" and "Internal Handling" to classify the business processes. These dimensions were appropriate to use in this case describing the differences between the variant processes (Lind, 1996ab); cf also section 4.5 and 5 below where the usage of the BAT framework in this respect is described.

Internal Handling Customer Relation	Processing (from raw material to finished product)	Whole trading (direct delivery from subcontractor to customer)	Half trading (processing by subcontractor, delivery by Structo)
Special production (project based development)	Special production customer	---	---
Standard stock sales	Standard stock customer	Whole trading customer	Missing, but is being developed
Long term agreement	Long-term agreement customer	Long-term agreement - whole trading customer	Long-term agreement - half trading customer

Table 1: The delimitation of the business processes (variant processes) in the case study.

Below we describe the contents of the business processes standard stock customer, special production customer and whole trading customer and how these have been delimited to each other.

4.2 The Business Process "Standard Stock Customer"

In appendix one there is an Action Diagram showing the details of the activity pattern for proposal and order handling concerning the business process "standard stock customer". The different communicative action types in the two sub processes are either explicit or implicit in the information objects that are used. As described in section 3 Action Diagrams are used as a base for the construction of Process Diagrams (grouping of activities to sub processes). The Process Diagram in appendix 2 shows the business process "standard stock customer".

The business process is initiated when the customer asks for an offer from the corporation. The offer is based on a price list, but the prices can be negotiated. This offer can result in an order. Alternatively, the

customer is already one of the customers of Structo and therefore an order could be made directly without asking for an offer. The acknowledgement of the order obligates Structo to fulfil its commitment to the customer.

After an agreement, the customer's order is picked from the standard stock and cut according to the agreement. The order handling ends up in the delivery stock and an invoice is written. The goods for delivery will be transported from the delivery stock with a suitable means of transportation to the customer.

The customer-to-customer process, as is implied in appendix 2, consists of activities that are performed for a specific customer. The activities cover the process from offer to delivery. One prerequisite for picking from the standard stock is that there are finished products in the standard stock. The standard stock is supplied by controlling the need for provision and deliveries. This takes place in a side process, which is a prerequisite for the customer-to-customer process. When the stock level is too low it needs to be supplied with products from the production unit. The planning takes place in another supporting sub process. The production unit has a need for raw material which is purchased from external suppliers.

After the delivery, the invoice aimed for the customer is looked after in order to make sure that payment is made. It is an assignment for a sub process within the customer-to-customer process. Within the business process there are side processes with consequence character such as dealing with suppliers' invoices, and customer claims.

4.3 The Business Process "Special Production Customer"

The Process Diagram in appendix 3 shows the business process "special production customer". The business process is initiated by the customer asking for an offer from Structo, where Structo together with the customer use an inquiry procedure to look through the customer's demands. The inquiry is a detailed specification of demands, which will later on be used in the production process. The offer, including specification of the customised product, hopefully ends up in an order from the customer.

The production has to be planned in order for Structo to fulfil their commitment (specified in the contract) towards the customer. The production is done exclusively for the specific customer, which is the reason why the sub process production is a part of the customer-to-customer process. As in the business process "standard stock customer" the goods for delivery end up in the delivery stock. It will be transported with a suitable means of transportation to the customer and an invoice will be written and mailed to the customer.

Different raw materials have to be purchased in order to perform the customer-to-customer process, i.e. the side processes purchase and stock-keeping of raw material are important prerequisites in order to perform the customer-to-customer process. The production unit refines (manufactures) the materials. Dealing with external suppliers' invoices as well as claims are consequences of the performance of the customer-to-customer process in the business process.

4.4 The Business Process "Whole Trading Customer"

The Process Diagram in appendix 4 shows the business process "whole trading customer". The business process is initiated through a discussion between the customer and Structo. The result from the discussion is a possible customer order, which results in an acknowledgement of order. The order is based on standard products and a standardised price list.

In order for Structo to fulfil its commitment, the production is relocated to one of the subcontractors of Structo. This is done by a simple order by fax from Structo. The subcontractor manufactures the product and delivers the product directly to the customer. Parallel to the subcontractor's delivery, the subcontractor notifies Structo about the fulfilment. The notification is the signal for Structo to have an invoice written and mailed to the customer.

Dealing with subcontractors' invoices as well as claims are consequences of the performance of the customer-to-customer process in the business process.

4.5 Comparison Between the Reconstructed Business Processes

As can be seen in the description of the three chosen business processes above there are some differences. The different business logic of the variant processes are emphasised. These differences can be looked upon from the different phases that a business process consists of (see section 2; Goldkuhl 1997). These phases are:

1. *Business prerequisites phase*, where prerequisites are established (both within the supplier's and the customers' organisations) for performing business (sales/purchases).

2. *Exposure and contact search phase*, where both parties, customer and supplier, seek contact. The supplier's ability is offered and exposed to the market. The customer's lacks and needs create demands.
3. *Contact establishment and proposal phase*, where the supplier presents available and possible offers to a specific customer. The customer is showing some needs and purchase interests.
4. *Contractual phase*, where the supplier and customer make commitments which are shown in an order from the customer and an acknowledgement of order from the supplier.
5. *Fulfilment phase*, where the supplier and customer fulfil their commitments. The supplier fulfils the commitment by performing a delivery and the customer fulfils by paying for the received delivery.
6. *Completion phase*, where the customer and supplier achieve satisfaction or dissatisfaction. Either the customer uses the delivered products with satisfaction and the supplier receives the payment, or certain claims are raised.

In the described business processes there are some differences in the different phases, which can be used to delimit business processes in relation to other business processes. Table 2 shows the differences in each phase (five of the phases included) in each business process.

Business process Phase	Standard stock customer	Special production customer	Whole trading customer
1. Business prerequisites phase	Own production of standardised products.	Flexible production equip- ment, design competence.	Established relationships with subcontractors.
3. Contact establishment and proposal phase	Standard products are offered. Price list exists, but prices can be negotiated.	Products are designed based on customer needs. Prices are negotiated.	Standard products are offered. Price list exists, based on subcontractors prices.
4. Contractual phase	Customer order based on an offer or a price list	Customer order based on offer including product specification.	Customer order based on a price list
5. Fulfilment phase	Production for potential customers. Picking from stock and delivery is done based on the specific customer order	Production based on order from the specific customer. No stock handling, only delivery.	Production and delivery are done by a subcontractor
6. Completion phase	Potential claims are handled by Structo.	Potential claims are handled by Structo.	Potential claims may be forwarded to subcontractors.

Table 2: Business phase matrix

5 Conclusions

Usually an organisation has different ways of performing business. From our point of view the different ways of performing business have its base in business relations between supplier and customer, and the internal handling for fulfilling commitments. This means that there will usually be alternative business processes within an organisation, i.e. there are "variant processes" within the organisation. In order to evaluate and develop an organisation there is a need to reconstruct such different business processes. The language/action oriented perspective will help us find criteria for such delimitation of different business processes.

In this paper the Business Action Theory (Goldkuhl, 1996, 1997) is used to describe the generic business action logic when performing business. The theory helps us to understand the performance of business as actions and interactions. The criteria used for distinguishing and delimiting different business processes are based on generic communicative action types, such as *offer*, *desire and demand*, *contract* and *claim*. Looking into the different phases that business processes consist of, one can see that these action types are used differently. We

have created a business phase matrix in order to be able to identify these differences (see table 2). The generic communicative action type *offer* can be used as an example: In the business process "standard stock customer" the offer to potential customers are based on an assortment of standardised products. In the business process "special production customer" the offer is based on products designed in accordance with expressed customers needs. To be able to offer products for potential customers there are business prerequisites, such as own production of standardised products (for "standard stock customer") and among other things design competence (for "special production customer"). As can be seen the offer is different within the two business processes, which is one reason for separating the treatment of these offers from each other, i.e. regard the business interaction and internal handling as separate business processes based on the differences between how the corporation offers its products.

We have much experience from method driven business modelling. We have preferred methods that are based on contextual thinking and communicative action theory. A method consists, among other things, of questions to ask when performing work of investigation. A supplementary theory is an aid to gain deeper understanding of the area that is studied. More questions are added to the method by using a supplementary theory. A method driven analysis is needed in order to achieve a structured documentation. A theory driven analysis is needed to aid the modeller to put more generative questions. The business models (Action Diagrams, Process Diagrams) presented in this paper are based on theory and method guidance, which have helped us to achieve higher understanding of business processes.

Acknowledgements

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Appendices

- Appendix 1: Action Diagram describing the sub processes *proposal* and *order handling* for the customer-to-customer process in the "standard stock customer" business process
- Appendix 2: Process Diagram describing the "standard stock customer" business process
- Appendix 3: Process Diagram describing the "special production customer" business process
- Appendix 4: Process Diagram describing the "whole trading customer" business process

ACTION DIAGRAM

Series: Standard stock customer

Prepared by: ML, GG

Date

1995-02-19

Version

1

Reference

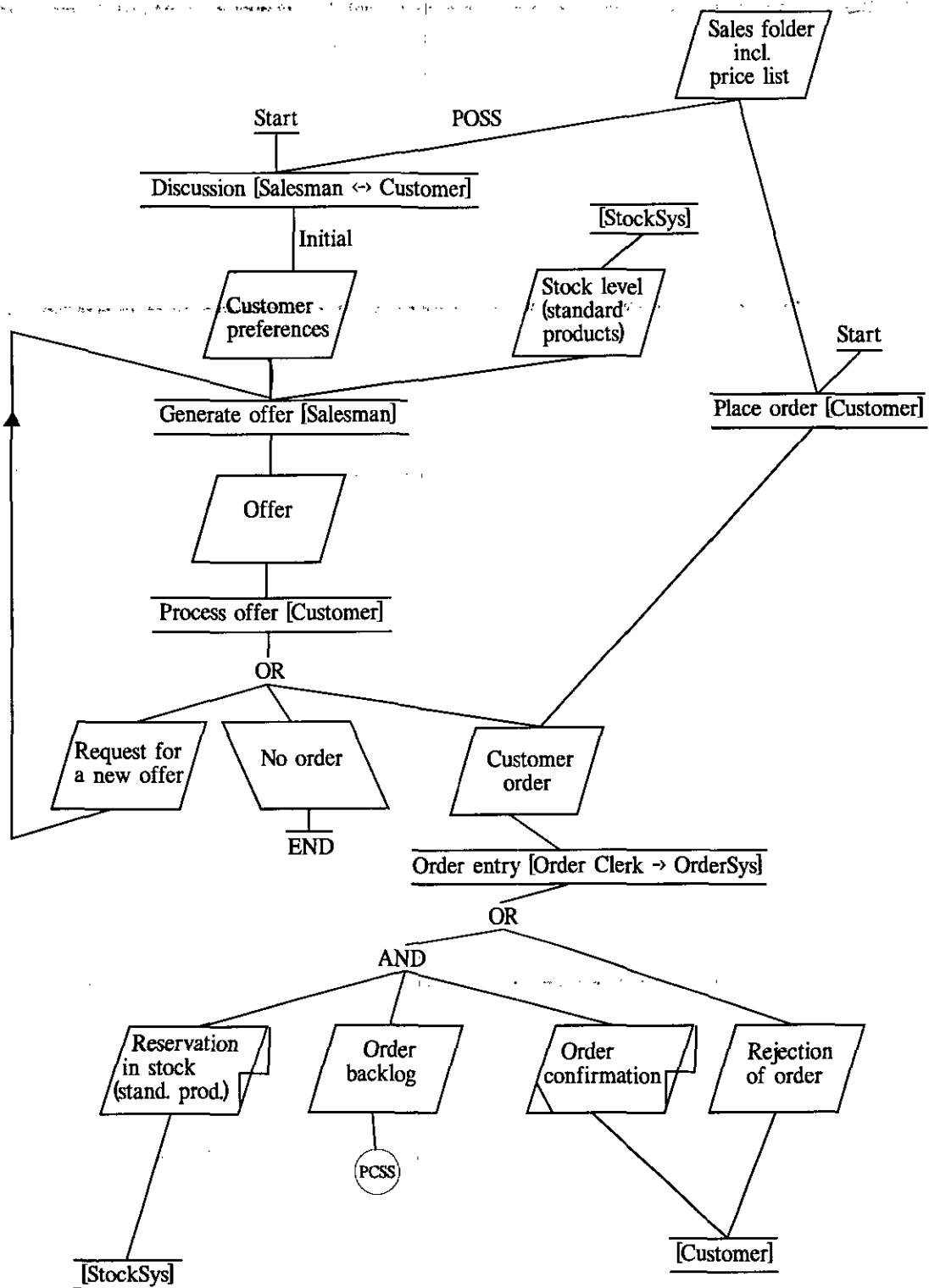
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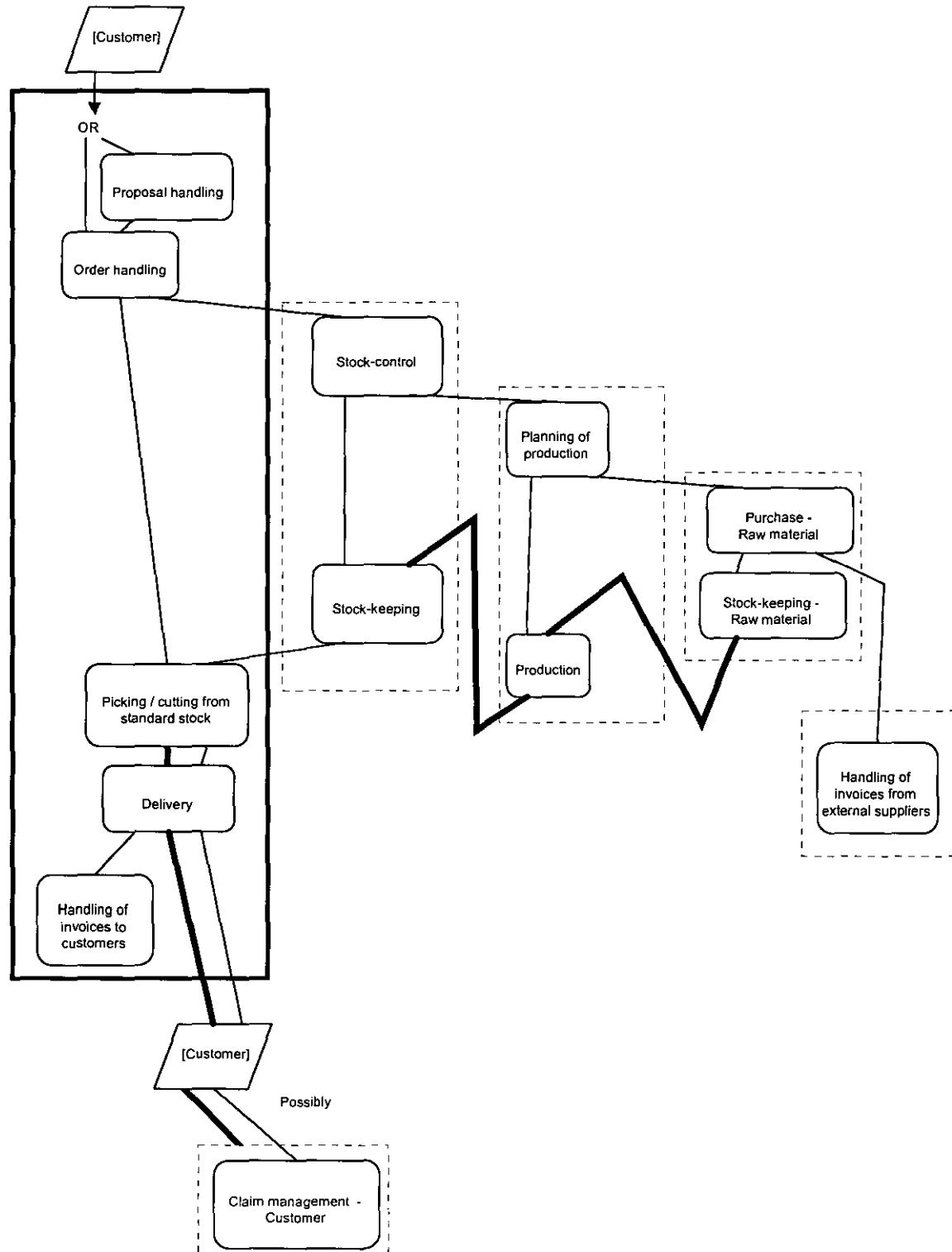
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Concerning: Proposal and order handling

Appendix 1



PROCESS DIAGRAM				
Prepared by: ML, JW	Date	Version	Reference	Page
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Concerning: Business process: Standard Stock Customer				Appendix 2



PROCESS DIAGRAM

Prepared by: ML, JW

Date
1995-02-19

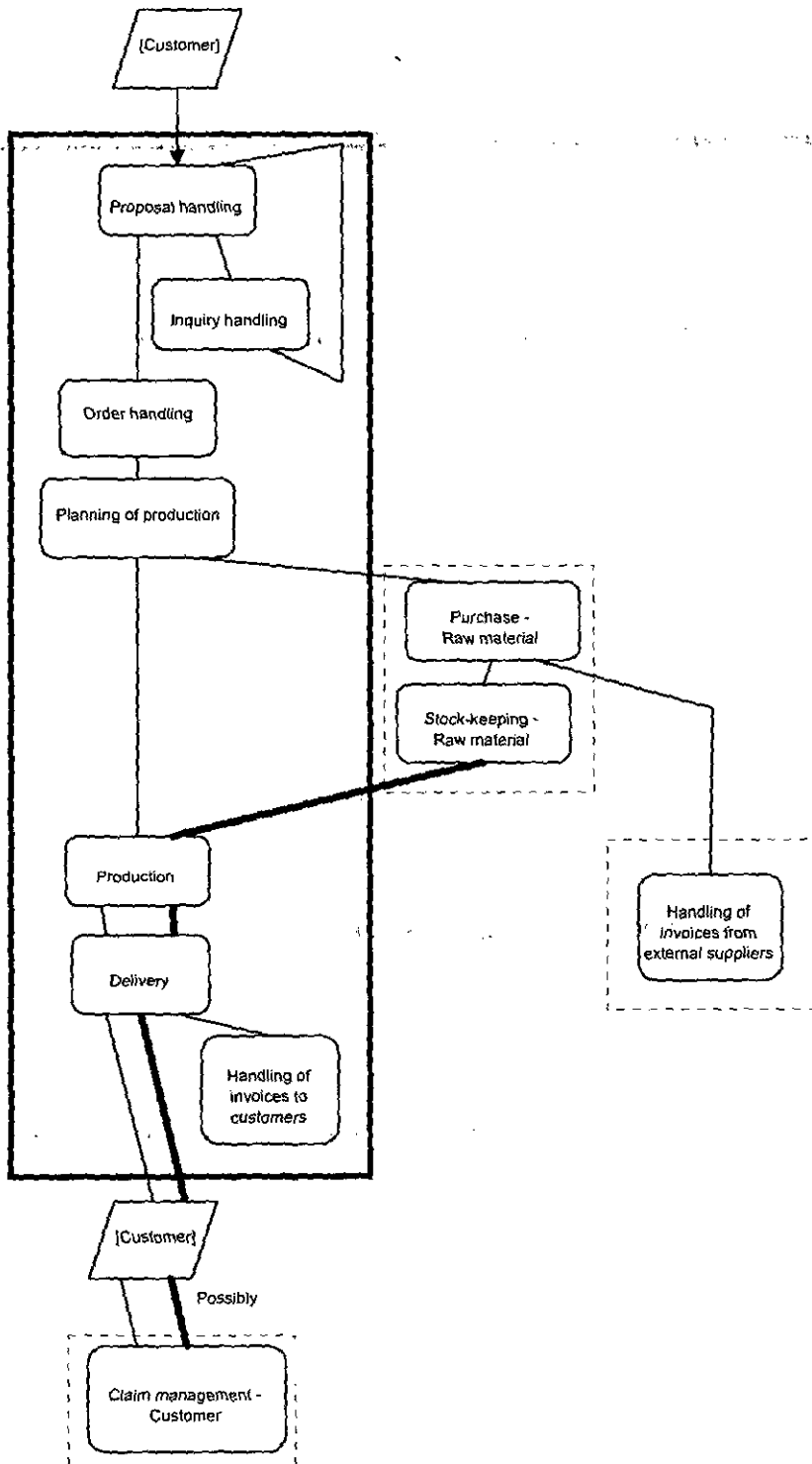
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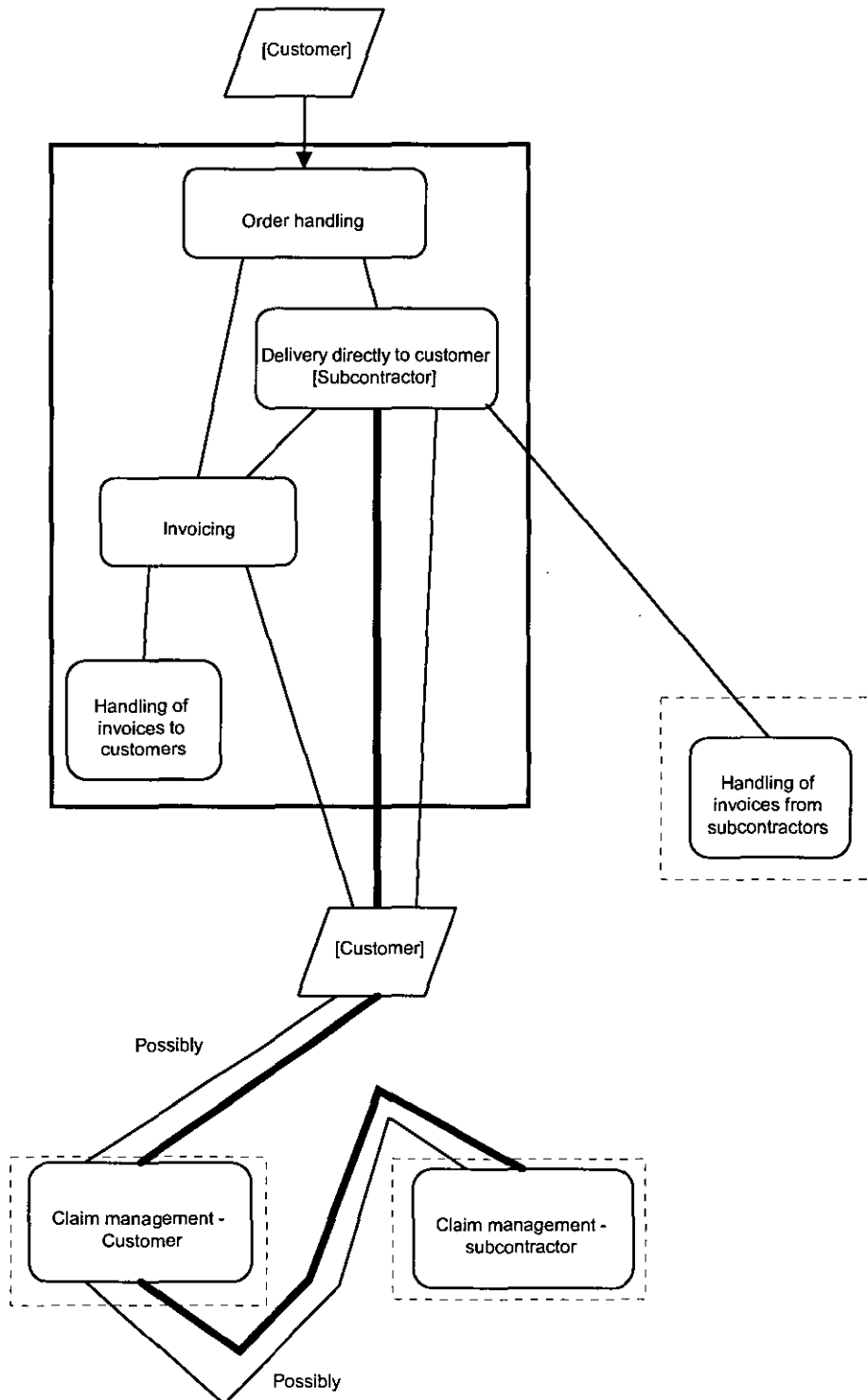
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Concerning: Business process: Special production Customer

Appendix 3



PROCESS DIAGRAM				
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	1995-02-19	1	Pdwtd	1
Concerning: Business process: Whole trading customer				Appendix 4



LAP-based Mechanisms for Maintaining the Contexts of Cooperation

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Abstract

The paper presents mechanisms based on the Language Action Perspective to extract from the handling of conversations information about the network of commitments they negotiate as well as about the linguistic objects mentioned in the conversation steps. These mechanisms serve as basis for the definition of functionalities aimed at reducing the linguistic opacity. The paper sketches how they can be used within workflows and in the domain of electronic commerce.

1. Introduction

Cooperation technologies are called upon to support the cooperative work of people in situations that show several dimensions of complexity: actors have different skills and competencies, belong to different - or at least highly distributed - organizations, collaborate according to flexible work modalities, are involved in processes that require a high degree of adaptiveness to the surrounding context. In these situations the role of communication is crucial in linking together the various actors and keeping consistent the processes where they are cooperating. On the other hand, these situations makes communication problematic as actors communicate over long periods and/or with varying frequencies, actors join/leave the cooperative group - temporarily (e.g., because of a delegation) or permanently (e.g., because of turn-over). Communication becomes problematic because of the difficulty of keeping consistent and updated the context in which it happens and takes its meaning.

These general considerations apply to two specific domains which are taken as reference points in this paper: business processes supported by workflow technology (e.g., (Medina-Mora et al., 1992)), and electronic commerce supported by the most recent communication facilities over the net (e.g., (Borenstein, 1996)). While in the former case the Language Action Perspective (LAP) already has a tradition, although a controversial one (Bannon, 1995), the role of LAP is neither obvious nor tested in the second case. In fact, at least in the commercial applications that are publicly known, the basic constituents of the technological support to electronic commerce are aggregations of WEB-like pages through which users can access multi-media data bases of products/services and retrieve information which is sometimes presented in a customized way, on the basis of predefined stereotypes or statistical data. Then, the current trend seems towards a use of the technology for a generic and quantitative more than for a richer and qualitative interaction, according to the metaphor of the "mall" or "supermarket" where clients are guided by the goods display and are supposed to be able to manage their needs by themselves. Obvious economic and organization considerations motivate the focus on product/services of low complexity and large consumption, where the technology can support the customers in virtue of its capability of recognizing stereotypes and establishing standard communication protocols, accordingly. The latter can be inspired by the LAP: however, our claim is that the capabilities of the LAP can be challenged in a more visionary scenario where the technology supports the commerce of a wider range of products/services thanks to its capability of adequately supporting a richer and more articulated selling process. In this case, as in the case of adaptive workflows, the communication between different actors again takes on a relevant role and challenges the technology to manage its inherent complexity. Our claim is that the LAP, thanks to its basic principles, can be used as a conceptual tool to identify the events that characterize,

^{*} This research was conducted when Monica Divitini was with the University of Milano

with a reasonable discrete approximation, the (continuous) evolution of the context(s) where the communication occurs and takes its meaning.

The rest of the paper presents how this claim inspired the construction of a prototype supporting the asynchronous, message-based communication of actors involved in cooperative activities. This construction is founded on the central role of commitments in communication, as widely discussed in (Winograd and Flores, 1986). A complete description of the prototype, called CHAOS, can be found in (De Cindio et al., 1986; Divitini and Simone, 1994b; Simone and Divitini, 1996): here the focus is on how the LAP can help in dealing with a phenomenon that we metaphorically call *linguistic opacity*. Linguistic opacity can be defined as the uneasiness people may have in "moving in a linguistic framework" which is perceived as unfamiliar and then "opaque", obscure. This opacity mainly arises from the discrepancy between the knowledge possessed by the cooperating actors and the knowledge needed in the interpretation of the messages they exchange. In CHAOS, the functionalities for reducing the above mentioned opacity are provided by a specialized module, called Group Language Module (GLM), which coexists and interacts with three other modules, as shown in Figure 1:

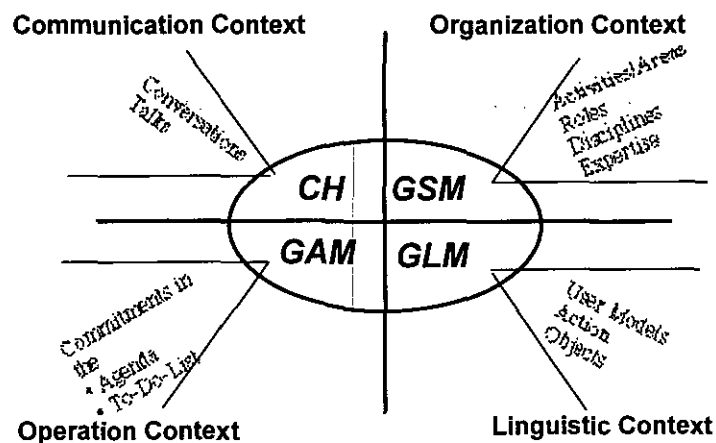


Figure 1 - The Conversation Handler (CH) collects all the functions for the management of communication; the Group Structure Module (GSM) concerns group structure and expertise; the Group Agenda Module (GAM) manages undertaken commitments and the Group Language Module (GLM) collects the functionalities concerning the communication experience.

2. About Linguistic Opacity

The above mentioned linguistic opacity is the product of what in cybernetics is called a negative feedback cycle. In fact, when people exchange messages to handle commitments (i.e., to define, modify, cancel, conclude them) it is likely that they have a certain knowledge about the entities they are referencing. This does not imply that those people share the same knowledge about the referenced entities. Indeed, knowledge sharing is just a product of communication since, in order to make the negotiation effective, people try at least to reach a minimal consensus on what the commitment is about, so that its fulfillment can start. If misunderstandings, ambiguities, breakdowns arise, then people react by activating new communications in order to solve them and make action possible. However, even if the harmonization of group's knowledge is part of the evolution of an effective organization, people still own different sets of references as communication does not always involve all of them at the same time. Such a situation can give rise to ineffective communication and misunderstanding between members of a group and of its possible subgroups, when they speak about the commitment at hand.

On the other hand, the harmonization of group's knowledge raises additional problems: in fact, the consciousness of sharing a common set of references leads people to simplify communications by exchanging ambiguous and incomplete information whose interpretation can again become difficult in the presence of different sets of references generated by individuals' or subgroups' experiences. This is especially so when the communication involves a lot of people, or is conducted over a prolonged period of time or not in a face to face situation (i.e. asynchronous communication). Failure to appreciate, or to act on, these factors may result in the design of a poor coordination support system.

A communication support aiming at the reduction of the linguistic opacity requires the modeling both of harmonized knowledge and of contradictions, and requires some conceptual framework for organizing them and making them usable. In order to deal with this requirement, one could adopt strategies and techniques defined within disciplines which devoted a big effort to these problems, namely computational linguistics at the level of natural language syntax and semantics, and human computer interaction. However, the rich amount of results documented in the literature and implemented in several systems were hardly applicable to the considered framework for a couple of basic reasons. First of all, irrespective of the limitations imposed on the syntactic form of the propositional content of a conversation step (in our case, the semi-structure¹ (Malone et al., 1987)), all the interpretation techniques that can be realistically applied rely upon a static semantic domain². This hypothesis is not applicable to cooperative settings, since in this case the semantic domain is necessarily dynamic due to two basic circularities (Figure 2, from (Bignoli and Simone, 1991)). The circularity represented by the big arrows is dealt with by the GSM, and is not discussed here. The second circularity emphasizes the fact that the exchanged words assume meanings within a group's structure and a linguistic domain both of which are dynamic. (Bignoli and Simone, 1991). Natural language processing techniques are of little help since they handle the evolution of the user knowledge but not the evolution of the linguistic domain³.

Secondly, dialogues between human beings and computers are asymmetric as the behavior of the latter is designed as a strategy for understanding and supporting the intention of the human interlocutor. Moreover, the computer knows about all the interactions between the users and the system. In work cooperation, dialogues are between human beings and thus, in this respect, fully symmetric. This fact brings in an obvious additional complexity: in fact, both interlocutors have a limited knowledge about their partner and have their own strategies and intentions. Again, the techniques adopted in human computer interaction are inapplicable to our purposes.

Thus, our main effort is devoted to the identification of functionalities helping the users in the negotiation and fulfillment of commitments: these functionalities are basically rooted in the capability of the system to keep trace of the user's communication experience and of its effects on the cooperative work arrangement. In other words, the system monitors the communication between its users, organizes the related information and is prepared to give it back in appropriate situations either in an automatic way or when the users ask for some specific help. In doing so, the system exploits very elementary capabilities to make inferences: to our knowledge, no logical system is able now to capture the complexity of cooperative situations and make inferences based on rules that are reasonably acceptable. Our approach goes in the opposite direction: to provide the user with pieces of information that are as much as possible contextualized in the communication that generated them, and then let the user exploit this information by making the appropriate inferences. In this restricted view, we will use the terms *knowledge* and *shared knowledge* (and the derived notion of *user model*) as key-words carrying a restricted meaning, and not in any other broader sense.

¹The propositional content of the messages constituting a conversation are presented in a semi-structured way that allows for a direct identification of the relevant pieces of information, e.g., the roles involved in the commitment, the action(s) that have to be performed, the objects involved, the deadlines.

² Some proposals do not explicitly refer to this hypothesis but presuppose an equally unrealistic thorough meta-knowledge about the dynamics of the semantic domain. A deeper discussion about this point is beyond the scope of the present paper.

³ We apply natural language processing techniques just to the very restricted context of use identified by the semi-structured representation of the message for the identification of each referenced object and not for the definition of its role in the propositional content, as this latter is provided by the semi-structure.

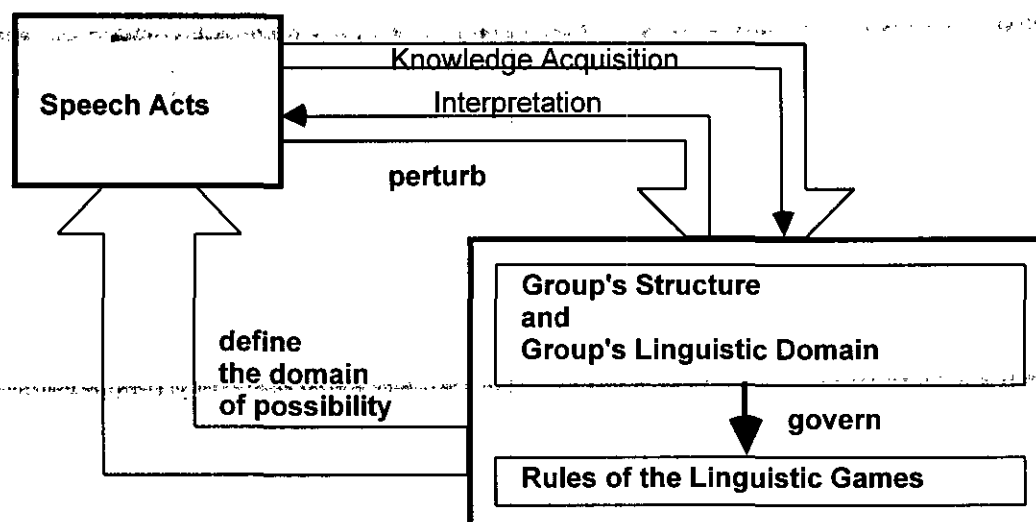


Figure 2- The two circularities.

3. Dealing with a dynamic linguistic domain

The dynamicity of the linguistic domain depends on the fact that commitment negotiation and fulfillment creates, modifies, deletes the entities constituting this domain. For example, a new document can be produced, the acquisition of a resource can be planned and so on. In our context, these entities are the (abstract and real) objects and the actions characterizing the work setting in which people operate. By consequence, knowledge is defined as sets of references to those entities. In this view, the main focus is on the link between entities and the values their attributes dynamically assume in consequence of commitment negotiation and fulfillment: in fact, the latter modify both their characteristics and their level of existence. To deal with this dynamicity, we adopt the concept of ontological levels (Hirst, 1989) in order to characterize the different stages of the entity life cycle. We use five ontological levels. **E1** denotes an entity that exists in a world 'under discussion'. Objects at this level do not exist in the physical world but they have some characteristics which are recognized by one or more members of the group. **E2** denotes an entity that could become actual in the future. This means that one or more members of the group have accepted a commitment that implies the creation of the entity itself. Though the entity has yet no physical actuality, it is expected that it will reach it. **E3** denotes an object that exists in the present real world. This means that the object has reached a physical level of existence. **E4** denotes an object that is expected to no longer exist in the future. This means that one or more members of the group have accepted a commitment that implies the destruction of the object itself; **E5** denotes objects physically existing in a past world. For example, if a file has been canceled, it does no more exist in the physical world, but as it existed in the past, people can still talk about it.

As commitments contain references to actions to be performed in order to fulfill them, and since actions can modify the work setting, it is useful to characterize actions in terms of their ontological behavior, i.e. on the basis of how the execution of the action modifies the ontological level of the involved objects. The characterization is based on the objects playing as:

- input, i.e., the object (s) on which the action is performed (e.g. remove *a file*)
- output, i.e., the object(s) resulting from the execution of the action (e.g. write *a letter*)
- resources, i.e., the object(s) used to perform the action (e.g. write a letter with *a blue pen*)

and leads to a classification of actions which is organized in a hierarchy. The first level contains the classes of actions, which share the way in which they affect the ontological level of the input and the output objects. For example:

- The class *creation* collects the actions whose execution changes the ontological level of the output from E2 (existence in the future) to E3 (existence in the real world)

- The class *destruction* collects the actions whose input passes from E3 to E4 (existence in the past)
- Another class (called *usage*) collects the actions whose input is in E3 both before and after the action execution
- The class *modification* contains actions that 'destroy' the object which they are performed on to reproduce a new version of it. They can be defined as actions having the input which passes from E3 to E4 (as in the destruction class) and the output from E2 to E3 (as in the creation one).
- The class *production* contains actions whose input is *not* destroyed: it is at the E3 level both before and after the action execution. As above, the output passes from E2 to E3.

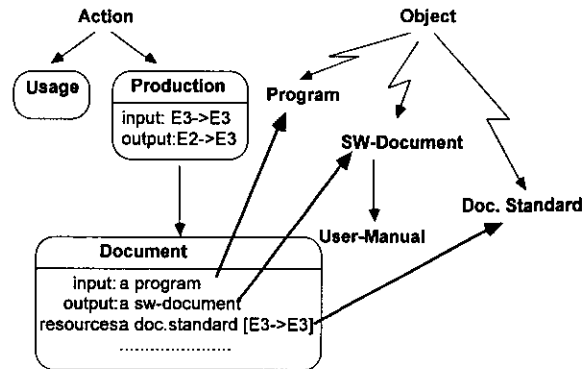


Figure 3 - Links between Action and Objects: a simplified example

At the second level of the hierarchy each action contains the full set of its characterizing attributes, as they can be referred to in the semistructure of the conversation propositional content. Moreover, the classes of objects related to input, output and resources are defined and an ontological transition is associated to each resource type. Resources must necessarily be at the E3 level before the action execution. Therefore the only acceptable transitions are E3->E3 (reusable) and E3->E4 (consumable). Changes in the ontological levels of resources are only a part of the information necessary for the resources handling or monitoring. In fact, the behaviors of a resource can be fully characterized by taking into account properties intrinsic to the particular resource in combination with the action type. However, a complete description of resources behavior is beyond the scope of the present paper.

To conclude let's consider the example of an action called 'document', defined as the activity of preparing the program documentation according to a documentation standard. Using the model, it can be specified as follows (see Figure 3). *Document* is an action which belongs to the *production* class and has a *program* as input, a *software document* as output and a *documentation standard* as a resource; all the entities named in the action specification refer to classes defined in the object hierarchy. Moreover the transition E3->E3 is associated to the specified resource: this means that resources of that class are not affected (from the ontological point of view) by the action execution.

The mechanisms for recording the dynamics of objects are based on the above classification of the actions. In fact, when the system recognizes that the execution of a particular action has been completed, the ontological level of the involved objects can be updated according to the information specified by the class containing the action. Action execution can be recognized as a specific point in the life-cycle of the commitment which the action belongs to (see section 5).

4. User Models For Representing Knowledge Sharing

In order to organize the knowledge that each user acquires in performing communication and actions, we use the concept of User Model (UM) (Divitini and Simone, 1994a). Recently, user modeling has become a central issue in the development of different kind of applications, mainly with the aim of improving the interaction between human and computer (Kobsa and Wahlster, 1989). As already mentioned, the HCI approach is not fully satisfactory when shifting from the single user to a group of people communicating among them, because of the dynamicity of the reference domain. What makes the difference is what characterizes a group as such and how the knowledge owned by the people is affected by their mutual interactions through a machine.

First of all, in our framework, and in general in cooperative systems, it is not possible to classify users into stereotypes (Rich, 1989). In fact, what characterizes a user is not strictly in relation to his/her experience levels (as for example, a novice, an expert...) or to taxonomies that are definable *a priori*, rather it is influenced by the conversations each individual has been or is currently involved in (inside and outside the organization), and by the

evolution of the related commitments. Secondly, and in consequence of the previous point, one of the key elements in defining the context in which the current communication occurs is the knowledge the users acquired during their past interactions and share with the other group members. Since communication does not involve all the members of the group at the same time, the knowledge of each user is necessarily partial. For a system supporting human to human communication, taking into account possible contradictions is essential to provide the kind of support we intend to provide.

Bearing in mind the above requirements, in our framework a User Model is defined as a partial view of the linguistic domain: this view contains the knowledge each user acquires in the communication with other users. A UM contains the following types of knowledge:

- *Consciously Shared Knowledge* (CSK_{ij}), i.e., the knowledge users agree upon during commitment handling or they become aware of via notification mechanisms. For example, if Ann (A) tells Bob (B) the location of a particular document, then this information enters in the CSK_{AB} . The symmetry of CSK_{ij} with respect to users i and j can be broken when they acquire (within conversations between one or both of them and different persons) a piece of knowledge X that is inconsistent with some knowledge X belonging to CSK_{ij} . In this case the system marks X in the CSK_{ij} to denote that i and j can use X in an asymmetric way. Referring to the previous example, if the location of the object has been changed and Ann acquires this information conversing with Carl, Ann will share with Bob and with Carl two different values for an attribute of the same object. The system marks the information about the location in the CSK_{AB} reflecting that it will probably be considered false by Ann from now on, while it is still true for Bob. The not marked knowledge is supposed to be the current knowledge of the involved users, though in the group more updated knowledge might exist.
- *Shared Knowledge* (SK_{ij}), i.e., the knowledge a user i shares with a user j without being aware of this sharing. For example, in a conversation with Bob, Ann can acquire the same knowledge K that Carl (C) acquired by conversing with Bob. K is in the CSK_{AB} and CSK_{CB} but not in CSK_{AC} , though they both possess the same knowledge. As a user i may share with different individuals j different, possibly contradictory views of the same object. Then, the more recent view of i and j is considered when the SK_{ij} is computed, since this view is supposed to be the more reliable one.
- *Private Knowledge* (PK_i), i.e., the knowledge a user i acquires by acting within the group without any communication with other members. For example, let us suppose that Ann took on the responsibility of writing a report on a project and that she did it. As long as she does not converse about this fact with someone else, she will be the only person aware of the report's physical existence and final characteristics. By the way, users' PK , when suitably initialized and maintained, serves to introduce in the organization the knowledge the users acquire outside the group.

As pointed out by many authors different kinds of knowledge coexist in a group of people and all of them are relevant to understand the process of knowledge creation and diffusion within the groups and sub-groups. For example, Nonaka and Takeuchi (Nonaka and Takeuchi, 1995) distinguish between explicit and tacit knowledge, Habermas (Habermas, 1991) explicitly refers to a common background ('life world') making communication possible and finally, Winograd and Flores (Winograd and Flores, 1986) emphasize the role of the social context in interpretation. The types of knowledge we are using are not meant to contain all the knowledge a user possesses and uses to manage commitments. They are just classifying the knowledge (i.e., the sets of references) explicitly mentioned in the conversations the system is supporting. This is per se a strong limitation. However, our every day experience tells us that linguistic opacity arises even in relation of this circumscribed portion of knowledge. On the other hand, as anticipated, we do not believe in the capability of the technology to make any sort of reliable inference about what is behind what is explicitly written. Thus, the only role the technology can play in this game is the role of memory of the different contexts in which single conversations or conversation networks happen. This memory is not just a flat container: rather, its structure tries to organize the explicit knowledge by taking into account when the communication happens in order to identify and notify possible misunderstanding when users have different background knowledge, to make explicit the knowledge they share without being conscious (at least from the system point of view), and last but not least, to reconstruct the context of conversations at the time they are suspended when they are resumed, possibly after a significant amount of time, and to reconstruct how individual knowledge has been changed in-between.

5. Supporting the evolution of knowledge sharing

UMs are automatically updated thanks to mechanisms that are triggered in a user transparent way by communicative events: on the basis of the contents and evolution of a conversation, these mechanisms allow the system to acquire

pieces of knowledge that users exchange during communication. Details about these mechanisms can be found in (Divitini et al., 1993). Figure 4 sketches the commitment life cycle, through a transition diagram representing the various states the commitment goes through during its negotiation⁴.

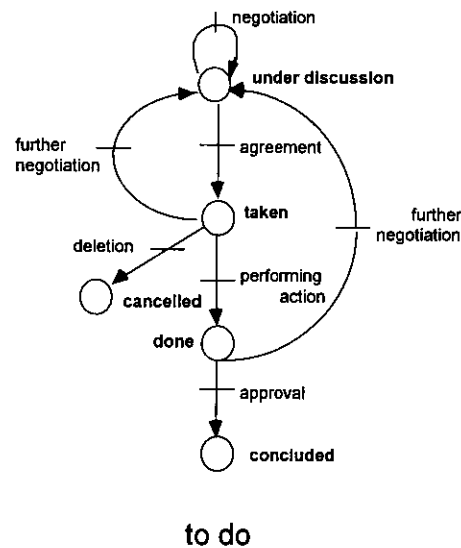


Figure 4 - Commitment life cycle

By considering the evolution of the commitment and the class of the related action it is possible to define mechanisms that allow the system to maintain an updated representation of the objects of the domain and of the possible inconsistencies among the knowledge of the members of the group. In short, the system recognizes the various state a commitment goes through (see Figure 4) and updates the User Models of the interlocutors and the representation of the objects involved in the related action according to the class the action belongs to.

When a commitment is *under discussion* it becomes a shared entity between the asker and the doer. The mentioned objects are linked to the knowledge contained in the individual knowledge of their UMs. In particular, each object has a specific ontological level that can be different in the two UMs. During the discussion, the different standpoints can be clarified and the sharing of knowledge can be increased. For example, if the action characterizing the commitment under discussion presupposes an input and the 'hearer' does not know about its existence, he can become aware of it, possibly after an exchange of utterances in the communication. At this stage, objects at the ontological level E1 still stick at this level, as nothing new is actually created, not even at the linguistic level. The knowledge handled within a commitment under discussion is linked to the communication supporting the discussion (e.g., to conversations for action): this is analogous to the classical approach of keeping not consolidated information in a temporary storage.

When a commitment passes to the state *taken*, the information that users have talked about are entered in the UMs of the asker A and in the one of the doer D as a knowledge that they consciously share (CSK_{AD}). The changes the objects can pass through are determined both by the dynamics of the commitment and by the kind of action it is about. Referring to the classes of actions mentioned in section 3, if the commitment is about the creation of an object being at level E1, when the commitment is taken the object reaches level E2. The actions belonging to the classes 'usage' and 'destruction' do not modify the ontological levels of the objects on which they have to be performed, while for actions belonging to the classes 'modification' and 'production' it is necessary to record in their CSK a new (output) object in state E2. In case of 'modification' the new object reflects the changes that will occur in the input, while in case of 'production' it represents the object resulting from the action execution.

When the commitment is *canceled*, the objects that have been taken to the level E2 go back to E1. If the action to perform was a modification or a production, the object that has been recorded as 'appearing in the future (E2)' is canceled. Obviously, canceling the commitment does not destroy the objects that have possibly been produced in the

⁴ CHAOS implements two kind of conversations: Conversation for Action (CfA) and Conversation for Possibility (CfP). These two types of conversations negotiate commitments that contribute to the definition of the work arrangements in relation to actions to be performed (commitments to do), and roles to be played in the organization (commitments to be), respectively. Commitments to be will not be described in this paper, though mechanisms analogous to the ones described for commitments to do have been realized.

meanwhile, and the sharing of information concerning its conditions of satisfaction (e.g., about the resources, as mentioned above).

When the commitment reaches the state *done* the ontological level transformations characterizing its action are applied and recorded in the private knowledge of the doer. These pieces of information stay there until the doer decides to use them in communicating with someone else. The typical case is when the doer asks for the approval of the 'asker': if the asker approves (the commitment reaches the state *concluded*), this knowledge enters in their CSKAD together with a link to the commitment from which it has arisen. If the asker does not approve, the commitment is rediscussed and the knowledge referred to it is the one acquired through the foregoing phases.

Moreover, we want to underline that CHAOS provides its users with information on contexts other than the linguistic one, as mentioned in the introduction. In particular, CHAOS helps its users to keep track of the organizational context in which they act, in term of distribution of responsibilities and expertise. This distribution is the result of previous conversations and can be (re)negotiated at any moment. This provides an essential help in the process of giving a "meaning" to the conversation.

This section concludes the description of the mechanisms for modeling the dynamics and partiality of knowledge sharing of the members of the group. The next section describes how it is possible to exploit the mechanisms for improving communication.

6. Functionalities

We are going to illustrate the type of support the system is able to provide through some exemplification.

6.1 A semantic view of the conversation history

It has been recognized (Bullen and Bennett, 1990) that it is important to group messages into conversations. However, in a highly dynamic environment the chronological collection of messages within the conversation is not enough to reconstruct the evolution of the commitment and the different phases it passed through. For this reason, the concept of Discourse Structure has been exploited (Grosz and Sidner, 1986) in order to capture both the linguistic structure and the attentional state. The attentional state is modeled through a list of foci, one for each different segment of the discourse, which record the objects that have been mentioned in the discourse and how they have been modified by the communication. In the considered framework, the segments of the discourse into which messages naturally aggregate are determined by the commitment that the segment is about.

The system exploits the discourse structure to give users a semantic view of the conversation history in which messages are grouped according to the commitment they are about. In this way the user can reconstruct how the same commitment has been handled independently of the time attributes. Moreover, each message is related by the system to the description of the involved commitment (action and temporal attributes) and through the latter to the involved objects. Finally, the system can provide the user with the view of all the objects referred to in all messages grouped in the conversation.

The history is the place where the system records the information exchanged in a conversation before an agreement is reached. In fact, as long as the interlocutors are negotiating a commitment, the pertinent information is kept local to the conversation. It is copied in the UMs of the interlocutors only when they agree upon it, since the agreement makes the information of public interest.

The semantic view of the history allows the user to confront the knowledge possessed and mentioned at the time the conversation was suspended with the knowledge held at the time of a new access: in fact, the knowledge of the user can evolve as a result of events outside the specific conversation. Furthermore, what has been said in a particular moment is kept as an image of his/her cognitive status. This can be very useful such as when the user wants to reconstruct the rationale of the decisions characterizing the negotiation of a commitment. This is an elementary (even not so usual in communication systems) support the system is providing to argumentation.

6.2 Answering queries about the work arrangement

Stressing partiality and contradiction of the knowledge represented in the UMs is fully in accordance with the basic principle that omniscient people do not exist and that people have individual experiences. According to that, one functionality that can be provided on the basis of the various contexts maintained by the system (see Figure 1) is to answer user queries about aspects of the organization they are not informed about. In this case, what can be defined

as 'true' at a given moment in time? The notion of UM combined with the information about roles and expertise maintained by the GSM can be used to define a description of the domain that can act as the organization reference context. We can say that in the consensual domain of the organization only what has been declared/agreed upon by people who have the authority to do so may be considered as the most reliable information. Therefore, the answer to a query is sought in the individual knowledge of the user 'privileged' with respect to the matter of the query under concern. In other words, *truth*, i.e., what ties the behaviors of the organization, is always relative to a pair <object, privileged user>. This implies that if a user needs information on a specific object or an action, the system will return the information owned by the user that is responsible for it (possibly through a delegation) according to his/her UM.

6.3 Looking for the Most Appropriate Reference Context

In every moment of his/her working activity, a user is embedded in a network of commitments, either as doer or as asker. Each commitment has its own state and a context where it is defined and fulfilled. Moreover, the life-cycle of a commitment can last over time. This has at least two consequences: first of all, it can be difficult to reconstruct such contexts and secondly, it is likely that these contexts are no longer aligned with the present status of the organization. The mechanisms implemented in CHAOS can serve to make the contextualization easier, and more than that, to find the most appropriate context depending on the user's needs.

Let us consider the following scenario. A user realizes that s/he has a pending commitment and that it is time to handle it in some way. A first necessity is to reconstruct the genesis of the commitment with the information sensible at the time of its definition. By accessing this knowledge, the user gets the impression that some condition of satisfaction is no longer met: before starting a new stage of negotiation s/he wants to be aware of the present situation. To do this, the user can decide to look in his/her 'memory' if s/he has the feeling that it is enough, or to look at a more official situation since, for example, some aspects are not fully under his/her control and visibility.

What the previous example points out is that in every state of a commitment, a user may require a check on the objects that it involves, following their evolution in the dynamics of the organization. The proposed mechanisms support users with the possibility of accessing objects at different levels of presentation, in accordance with users' varying needs. These levels are based respectively on:

- the knowledge consciously shared with the specific user that one wants to interact with: this level is useful if the user wants to have a view on what s/he shares with his/her interlocutors (e.g., during the definition of a commitment).
- the individual knowledge of each user: in this way the user can have a view on her/his cognitive state and how it has evolved through communicative processes and working activities.
- the reference *truth*: as illustrated in the previous point.

The foregoing levels can be made richer and more flexible, if users agree upon some access rights to their individual knowledge when they cooperate. Traditional mechanisms based on the notions of user group and capability can be applied: what we want to stress is that they are not defined once and for all by some external authority, but are the outcome of negotiations (typically, managed by the GSM) and can be recorded according to the same mechanisms we have presented for the negotiation of commitments.

6.4 Identifying Contradictory or 'Illegal' References

In handling commitments users use references to objects. As mentioned before, it is not likely that at any moment all members of a group share the same knowledge about an object: on the contrary, several views can coexist and can be mutually inconsistent, reflecting the different subgroups' experience. This can be a source of misunderstanding in people's communication as they can use different references to define the same object (or vice versa). Moreover, misunderstandings are not always easily recognized as different factors (like hurry, inattention, wrong presumptions) prevent them from clarifying all aspects in all details. These aspects incorporate part of what is called 'success of speech-acts and negotiating commitments' in (Auramaki and Lyytinen, 1996). CHAOS incorporates mechanisms to reduce ambiguities arising in the definition of the commitment by exploiting the various levels of knowledge sharing contained in the UMs of the interlocutors. A sensible strategy is to solve the reference, i.e., to associate to a reference x the referred object $K(x)$, in the CSK of the interlocutors A and B, and in case of failure in their whole user models. Several situations can arise.

If $K(x)$ belongs to CSK_{AB} and the user models of A and B do not contain knowledge contrasting $K(x)$, or if $K(x)$ does not belong to CSK_{AB} and $K(x)$ belongs to SK_{AB} , then $K(x)$ can be considered the appropriate solution.

In all the other situations the reference could be 'interpreted' differently by A and B. Then the system warns the user naming x about this possibility, asks for the appropriate reference knowledge, and whether this latter has to be transmitted to his/her interlocutor as part of the context of the commitment description.

Another service that can be easily provided to the communicating people is to warn them when they define conditions of satisfaction of the commitments under negotiation that are not possible in the current situation, (e.g., a person left the organization, a computer is out-of-use, an environment has been upgraded, etc.). To do this it is sufficient to compare the references used by the interlocutors (that is, their Personal Knowledge) with what we have called 'official knowledge', (that is, the Personal Knowledge of the user privileged with respect to the referenced object).

6.5 Enhancing Consciously Sharing of Knowledge

When people take a commitment (when it passes from the state *under discussion* to the state *taken*) the information about objects, and about their attributes are entered in the CSK of the doer and asker. Other organization members will share the same knowledge only through future communication. It is well known that this can be unsatisfactory, especially when the propagation of knowledge sharing is too slow with respect to the relevance of the knowledge itself. The same situation arises when the commitment is concluded or canceled. To overcome this problem CHAOS provides some 'notification' mechanisms. Their definition however has to satisfy two conflicting requirements: reaching the widest set of interested people and avoiding to overwhelm them with an unacceptable overhead of communication.

Again, the different levels of knowledge sharing represented in the UMs can be of some help to solve the above conflict. In other words, this particular forms of awareness is governed and is adapted to the knowledge owned by the two interlocutors.

A typical situation can be described as follows. The user A acquires some consciously shared knowledge K with B in conversing about a specific commitment. At the same time, A has a set of conversations open with other interlocutors, where K can be of some interest (e.g., K plays an active role in the conditions of satisfaction of the related commitments). Then A is interested in broadcasting K to all these interested people, and eventually to someone else, to speed up the sharing of K . The system supporting the communication can identify the list of interested people according to the above criterion and propose it to A. Let us suppose that A selects some of these persons, neglecting some of them for unspecified reasons. Then the system can reduce the overhead of communication in notifying K , as follows. Let X be a member of the selection:

- a) If K belongs to CSK_{AX} , then nothing is notified.
- b) If K belongs to SK_{AX} , then K is put in the CSK_{AX} . Next time, when X communicates with A about something involving K , this new degree of sharing is presented to X (by some feature in the interface). Then a quite unobtrusive notification is made, just when needed.
- c) If K does not belong to the user model of X , then an explicit notification is activated: the acknowledgement that this notification has been read by X puts K in CSK_{AX} .

In the above process, if A makes the selection visible to all the selection members, then a further propagation of consciously shared knowledge can be activated among them. In fact, being aware of who has been notified determines a conscious sharing of the notified knowledge, that can be realized by means of the same strategy adopted previously between A and X. Obviously, the same can be activated from B's side. CHAOS provides additional help to the performing of the explicit notification by supporting the construction of the notification form: in this case the notified person receives additional information about the context in which the changes under concern have occurred.

The proposed mechanisms can be viewed as an additional, almost silent trigger of the 'physiological' processes improving knowledge sharing mentioned in the introductory section. The relevant thing is that both mechanisms are controlled by users A and B who can possibly adopt different strategies.

6. Conclusions

The basic feature of CHAOS, that is, the capability of 'creating and maintaining contexts' from ongoing conversations, is demonstrated just in the case of the management of written communication. As explicitly admitted in (Simone and Divitini, 1996), CHAOS was a feasibility study: in our opinion it shows that this is a valuable view

on how technology can support cooperation. The same idea can be extended to other forms of interaction among people in an integrated way, for example, to document exchange and workflow management. These extensions require the identification of events that trigger information recording in these forms of cooperation, once the appropriate work flow model is selected. The quite natural option of adapting the structure of a conversation to this new scope failed, as an approach that seems so powerful from the conceptual point of view shows itself as not equally natural in the modeling of real processes. In short, structuring the conversation is appropriate in some points of the workflow while in others is definitely too demanding. So we came at the opinion that a conversation-based approach is very fruitful in the analysis of the flow of work, especially because it focuses on aspects not explicitly considered by other approaches: in short, the network of responsibility. This intuition was corroborated by many experiences (e.g., (Schael and Zeller, 1993)) that adopted the workflow model rooted in the Coordinator (Medina-Mora et al., 1992). We defined another framework (Divitini and Simone, 1996; Schmidt and Simone, 1996) which is flexible in the description of processes as it incorporates both conversations and flow of work representations. If interpreted as clusters of simplified forms of negotiation, these representations can be handled by using the approach described here as the triggering events are almost the same. However, this extension is not yet incorporated in the implementation of this framework (Divitini et al., 1996).

The contexts maintained by CHAOS can be used in the specific case of electronic commerce when the interaction between the client and the services/products provider involves also the communication between people playing different roles (vendors, experts, administrative roles, etc.). In fact, the physiological alternation of actors playing the different roles as well as the possibly lasting interactions between clients and providers are justifying the need of maintaining contexts and improving the knowledge sharing of the involved roles. For example, this could allow for a more aware and personalized interaction with the client, independently of whom, and in which order, was interacting with the client. Moreover, the contexts can be used by the system component managing the dialogue with the users as a basis for adapting the presentation of the information about services/products, without relying just on static stereotypes. Here in particular, the information collected in the UM in the course of the dialog should take into account also user's preferences as an input for an additional personalization. So, the taxonomy of actions and the ontological levels of the objects should be refined to take into account the characteristics of the new application domain. These goals are part of a three year project on "Adaptive Telematic Services" that is going to start with the financial support of Italian Telecom.

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Habermas and Searle in Hospital: A Description Language for Cooperative Documentation Systems in Healthcare

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Abstract

Different healthcare professionals share the task of caring for a patient. This task can only be achieved through smooth and effective cooperation. Communication problems make cooperation difficult. If there is written communication via a documentation system instead of face-to-face communication, these problems can become serious and cause breakdowns in cooperation. We will argue that the integration of Habermas' Theory of Communicative Action and Searle's Theory of Speech Acts provides a framework for analysing and classifying communication and cooperation problems in a cooperative healthcare environment. However, this framework is not sufficient and, thus, we will introduce refinements and additional features. Furthermore, we will argue that the formalisation of this framework, i.e. the development of a formal description language, will provide the means for the design of effective documentation systems that avoid many communication and cooperation breakdowns.

1 Introduction

Documentation as an important and necessary part of healthcare serves different purposes, e.g. as memory aid, to ensure continuity of care, for medico-legal reasons, for data analysis purposes, and, most of all, as a medium of communication. The aim shared by different healthcare professional groups such as nurses and doctors is to maintain and improve the patient's health. Each professional group produces patient-related documents specific to that group's requirements. The documents are useful for the particular group that produces them but not necessarily for other healthcare professionals. This has led to the practice of keeping separate documents for each professional group which means that a large amount of redundant data is collected. A serious problem is that this practice can cause many breakdowns in cooperation because there is no central medium for written communication and information exchange.

Healthcare is beginning to use shared documents more and more often because it has been recognized that this practice helps to avoid cooperation breakdowns since there are central reference points for disciplines to focus on a collaborative plan of care. Cooperative documentation systems are information systems using documents shared by different healthcare professional groups. We understand information systems as socio-technical systems containing information, users, machines etc. In a cooperative documentation system, all healthcare professionals involved in the shared task of caring for a patient are responsible for reading and maintaining multidisciplinary documents. These documents act as a medium of communication between the different professional groups.

The description of a cooperative documentation systems must take into account potential breakdowns in communication. The most obvious communication problem is misunderstanding what the communication partner means because of different terminologies or misinterpretations. There are also more subtle problems such as questioning whether statements made are really true, whether the speaker's intentions can be trusted, whether a statement is appropriate in the particular context, or who is the target for a request. Good communication leads to good cooperation and this will ultimately improve patient care.

In this paper, Habermas' Theory of Communicative Action and Searle's Theory of Speech Acts are discussed and used for analysing and classifying communication and cooperation problems in a cooperative healthcare environment. Scenarios experienced during ethnographic investigations on a geriatric ward will serve as examples. The Theory of Communicative Action and the Theory of Speech Acts will be integrated to provide a powerful framework for analysis and classification of communication problems. However, this framework

cannot be used to describe all communication and cooperation problems and, therefore, refinements and necessary additional features are discussed. The development of a description language that will formalise the framework is proposed. Finally, concluding remarks and an outlook to future work are given.

2 Theories for Analysing and Describing Communication and Cooperation Problems

Habermas' Theory of Communicative Action [5, 13] and Searle's Theory of Speech Acts [17, 18] will be used in the next chapter for analysing and classifying communication and cooperation problems in healthcare. The relevant components of both theories are introduced in this chapter.

2.1 The Theory of Communicative Action

Habermas [5] argues that the competence of an ideal speaker is not only the ability to produce and understand grammatically correct sentences but also to utter them in the appropriate way and thus to be able to interact with the external world. Therefore, communicative competence is as important as linguistic competence.

A speaker who utters a sentence makes four implicit **validity claims**:

- The utterance is **comprehensible** so that the hearer can understand the speaker.
- The statement is **true** so that the hearer can share the speaker's knowledge, i.e. the statement represents an experience or a fact.
- The expression of intentions is **truthful** so that the hearer can trust the speaker.
- The utterance is **appropriate** in relation to a normative context so that the hearer can agree with the speaker in these values.

Only the claim of comprehensibility is language-dependent whereas all other claims are on a metalinguistic level. The four validity claims can be seen as four dimensions where communication problems can occur and communication can break down.

If the comprehensibility of utterances is doubtful, then the misunderstanding has to be resolved, e.g. by translating, rephrasing, explaining. If the truth of statements is challenged, then communication can only continue if the speaker gives reasons or explanations for his statements, e.g. by citing references, pointing to experiences, adding more information etc. However, if the truth is questioned in a fundamental way, then communication either breaks off completely or is continued at a different level (that of theoretical discourse). If the hearer questions the speaker's intentions, i.e. the hearer challenges the speaker's truthfulness, then the speaker must try to solve the problem by restoring the trust e.g. through accepting responsibilities, acting consistently, assuring the hearer of one's truthfulness. The hearer can challenge the appropriateness of the utterances by questioning the speaker's right to perform the speech act. The speaker has not the right to perform a speech act if his status or role does not entitle him to do so or if the speaker violates recognized values or norms. Here, not the statement itself but the related norms, standards, or values are challenged. Consensus can be restored by pointing to recognized norms, accepted values, established authorities etc. However, there might be situations where the appropriateness is challenged in such a fundamental way that communication either breaks off completely or is continued at a different level (that of practical discourse). Thus, the claims of truth and appropriateness can result in stepping out of a given action context and into discursive action.

Habermas distinguishes two forms of communication:

- **Interaction** (Communicative Action)
- **Discourse**

Interaction is the form of normal communication that takes place on a prediscursive level. Communication partners enter a discourse when they cannot agree on problematic truth or appropriateness claims. In discourse, these problematic claims are taken as hypotheses and the aim is to find a rational grounded consensus. All constraints, power relations, and barriers are left behind and the only force is that of the better argument. All participants must have the same chance to speak, to ask, to challenge, to suggest, to accept, to reject, to consider etc. According to Habermas' terminology, theoretical discourse deals with truth claims whereas practical discourse tries to achieve a consensus about norms or standards. In other words, entering a theoretical discourse means there is something wrong with the actual utterances in the interactions whereas entering a practical

discourse means there is something wrong with the outer world and its norms according to which the utterance was made.

2.2 The Theory of Speech Acts

The idea that each utterance is a **speech act** is introduced in the Theory of Speech Acts by Searle [18]. Communication is viewed as an exchange of speech acts. Each speech act consists of an **illocutionary force** and a **propositional content**. Both components have to be known in order to understand the meaning of a speech act. Speech act theory distinguishes five categories of illocutionary forces:

- **assertives** representing states of affairs in the real world
- **commissives** committing the speaker to carrying out the action represented by the propositional content
- **directives** trying to get the hearer to carry out the action represented by the propositional content
- **declaratives** changing the world by saying so
- **expressives** expressing feelings or attitudes about affairs represented by the propositional content

Furthermore, the concept of a commitment is introduced. Some forms of communication produce commitments for the communication partners. Every utterance of a commissive or a directive speech act issues a commitment for the speaker or the hearer to carry out certain actions implied by the propositional content.

The Theory of Speech Acts has a formal semantics defined by Illocutionary Logic [17] and is therefore not only a philosophical framework like Habermas' theory. Illocutionary logic allows the illocutionary force to be further analysed into seven detailed components, i.e. the illocutionary point, its degree of strength, the mode of achievement, propositional content conditions, preparatory conditions, sincerity conditions, and the degree of strength of the sincerity conditions. The propositional content is not analysed any further in the Theory of Speech Acts.

3 Scenarios of Communication and Cooperation Problems Between Different Healthcare Professionals

The research is based on a concrete domain of healthcare in order to find out the types of communication and cooperation problems in such cooperative environments. Geriatrics was chosen as the domain because the shared care of the elderly is a highly cooperative area. Many different healthcare professionals contribute to the diagnostic, therapeutic, and care process. Ethnographic methods such as participant observation, structured and unstructured interviews, and document analysis were used because they are unobtrusive and they allow the researcher to see the situations from the participants' point of view [3, 4, 6]. The research setting is a geriatric ward with twenty-six beds. One consultant is responsible for the ward which has a senior house officer, a registrar, junior and senior nurses, sisters, physiotherapists, one occupational therapist, and one social worker attached to it.

We will now discuss five scenarios (shown in *italics*) that were recorded during the ethnographic investigations. Four scenarios deal with problems in face-to-face communication, the fifth scenario is an example for problems in written communication. Both types of communication need to be observed to provide us with the necessary knowledge about different types and causes of communication and cooperation problems. Habermas' Theory of Communicative Action and Searle's Theory of Speech Acts will be used for analysing and classifying these problems.

3.1 Scenario 1: Challenges of Appropriateness and Comprehensibility

The ward doctors want precise and concise answers from the nurses. They think that nurses use too many words and give a large amount of irrelevant information. This issue was raised during a wardround in a discussion about a form for incontinence assessment. The consultant demanded that nurses had to know important things about incontinence and should fill in a certain (medical) form for incontinence assessment. The nurse did not agree and replied that they did indeed know the important things and did their own assessment. She¹ argued that the nurses could not fill in

¹Male and female healthcare professionals work on the ward. We will use "he" and "she" according to the participant's sex.

that particular form because it was a medical assessment and they could not understand most of the terms.

Appropriateness is the validity claim that is challenged in this situation in a fundamental way. The doctors state that the detailed utterances of the nurses are inappropriate. The nurses do not agree with this; in fact they claim that every detail of their answers is relevant for them and thus they assume the same for the doctors. However, a different granularity of detail is necessary to achieve nurses' and doctors' tasks and this is what the two professional groups view as appropriate. The consultant demands knowledge ("important things about incontinence") that the nurse thinks she has. Again, the different notions of appropriateness are obvious. The nurse has the relevant knowledge about incontinence according to her professional concerns. This knowledge is different from the doctor's medical one that is necessary and relevant for his work.

There is also a comprehensibility problem because the nurse cannot understand the medical terms on the incontinence assessment form. The different terminologies are implicitly related to this situation since the nurses often cannot understand the doctors' concise answers because of unknown terms and this results in the doctors having to rephrase or explain their statements. Nurses' terminology is different from doctors' terminology but both overlap. Doctors' terminology consists of short, formal and precise terms and sentences whereas nurses use simpler whole sentences. The terminology of nurses is closely related to that of patients. Nurses have the most intensive contact with patients and; therefore, it is a practical requirement that patients can understand them.

3.2 Scenario 2: Challenges of Truth and Appropriateness

During a wardround the consultant asked whether one patient was incontinent. The nurse replied that the doctors would call it incontinence. The consultant stated that there was a clear definition of incontinence: Everybody who wets himself or herself is incontinent. The nurse replied that she was aware of the doctors' definition but said that the patient knew when to go to the toilet but couldn't hold the urine very long.

On the surface, there is a challenge of truth. The nurse challenges the truth of the doctor's implicit statement that all patients who wet themselves are always (without any doubt) incontinent. She would not call the patient incontinent whereas the doctor would do so.

Underneath lies the problem of different values and standards and thus the appropriateness is questioned. The nurse knows the doctor's definition of incontinence but finds it inappropriate. It is obvious that her definition of incontinence is different (although she doesn't give it here). Definitions are related to the relevant perceptions of situations, i.e. the appropriate definitions are developed in connection to the person's (professional) standards and values. The nurse can tell the difference between an incontinent patient and one who cannot hold the urine very long and might therefore become wet because she observes the patient during the day and knows about the patient's problems with passing urine. The doctor examines the patient and observes signs of incontinence, e.g. wet underwear, and does not know the specific circumstances and thus diagnoses the patient to be incontinent. For him, the definition is sufficient and thus he judges the nurse's criticism as being inappropriate.

3.3 Scenario 3: Theoretical Discourse

Case conferences are being held once a week on the geriatric ward. All healthcare professionals involved in the diagnostic-therapeutic and care process participate, i.e. consultant, senior and junior doctors, sisters, senior and junior nurses, district nurse, physiotherapists, occupational therapist, and social worker. Each patient is discussed during the conference with the aim to settle an agreement about the best care for them. These case conferences are the medium for institutionalized theoretical discourse, i.e. they deal with problematic truth claims on a discursive level. Every action or decision that is critical or has to be approved of by others is discussed here. Every participant has the same right and chance to speak, to agree, to disagree, to question, to suggest, to refuse, to approve, and the existing power structures are somewhat non-existing here since, for example, the junior physiotherapist's word counts as much as the consultant's word. Thus, this is a kind of an ideal speech situation. The participants try to lay aside all constraints and concentrate only on rational arguments. An agreement is always found even though it might be a compromise for some of the participants (but this is exactly the outcome of any theoretical discourse - a rationally grounded consensus). Within these case conferences as the medium for theoretical discourse, there are also episodes of practical discourse and of discussions on a prediscursive level.

Thus, scenarios 3 and 4 are not only (but mainly) accounts of theoretical discourse and practical discourse respectively.

The following is an example showing the "theoretical discourse" character of dialogues typical of case conferences.

Nurse: I feel that patient Y needs more home help.

OT (Occupational Therapist): No, she is functionally capable of doing house work.

Nurse: But she won't do it without prompting. It's just that when sending her home with the same package as before, her husband will do everything for her and won't let her do anything.

Registrar: She came to hospital because her husband came to hospital and she couldn't cope alone. This was the only reason.

OT: So was there nothing wrong with her medically?

Registrar: No. Since things are deteriorating in her social environment, she'll become a regular attender in hospital since her husband is one as well.

Consultant: So can we try to get home help twice a day instead of only once?

Nurse: Yes, initially.

Senior House Officer: So can we discharge her on Tuesday with this new package?

OT: OK.

The initial discussion took place between the nurse and the OT. The OT challenged the nurse's statement that the patient needed more help. The nurse gave the reasons for her statement (won't do housework without prompting and her husband won't prompt her) and the registrar joined the discussion to supply more relevant information (medically nothing wrong with her). The consultant suggested more social input and this new package as well as a discharge date was agreed on by all of the participants.

3.4 Scenario 4: Practical Discourse

Although much of the dialogues in case conferences is theoretical discourse, there are also many episodes dealing with issues of appropriateness, i.e. episodes of practical discourse. Here is an example.

During a case conference a discussion about the responsibilities of district nurses came up in the context of discussing a patient's package of nursing input and home help.

Social Worker: District Nurses have to go into this patient's home for care but they don't do it.

District Nurse: The arrangement is for the patient to have home help five times a day.

Consultant: The problem here is how we define nursing care.

Social Worker: I have the relevant guidelines which explicitly state that district nurses are responsible for palliative care. This means that they have to act according to this guidelines.

Nurse: But the patient is not terminal ill.

Social Worker: I thought he had cancer.

Registrar: No, he doesn't.

Social Worker: Anyway, I need to have a word with the district nurse in charge.

District Nurse: This is a good idea. The conflict has to be sorted out as soon as possible so that we all know our obligations.

Consultant: OK, then let's move on to the next patient.

The professional standards according to which district nurses act were challenged by the social worker by stating that certain actions had to be added to their responsibility. A discussion about this professional standard took place and the outcome was that the social worker was going to tell the district nurses (or their representative) about these responsibilities and that the district nurses would then act according to that (new) professional norm. Within this practical discourse, the truth of statements was challenged (the patient is not terminal ill, the patient has cancer, the patient has not cancer) and the level of discussion was changed (from practical discourse to a prediscursive level concerning the validity claim "truth").

3.5 Scenario 5: Challenges of Comprehensibility and Appropriateness and Non-Fulfilled Commitments

The following is an example of a serious breakdown in cooperation. Communication took place via the shared documentation system and thus some problems could not be solved by asking for clarification.

It is Friday afternoon. During a wardround, the consultant writes in the shared document for a patient with a TIA (Transient Ischaemia Attack):

'Blood sample to lab: test prothrombin time (anticoagulant)'

The nurse does not understand this statement and asks the consultant for clarification. The consultant explains that a blood sample has to be taken and examined in order to decide whether a drug like Warfarin preventing blood clotting should be administered.

The nurse then writes in the shared document:

'To take blood / Doctors'

'To send sample to lab re Warfarin / Nurses'

The ward doctor, i.e. the Senior House Officer (SHO), looks in the shared document and reads the entry later that day. Afterwards he forgets the entry and the outcome is that no blood has been taken over the weekend. The patient is about to be discharged (the planned date was Monday) but the situation results in a failed discharge due to a breakdown in cooperation.

When challenged, the SHO states that he did not understand the second entry as a commitment for him to take the blood because this is usually done by phlebotomists. The nurse replies that they don't work over the weekend and that he wrote 'Doctors' which indicated that the action should be carried out by the doctors. The SHO answers that he thought it meant that this action was ordered by the doctors:

There are challenges to the claims of comprehensibility and appropriateness. The other problem is that of non-fulfilled commitments.

Obviously, the consultant's documentation is not comprehensible for the nurse because the nurse does not know the terms the doctor is using. This communication problem is solved because both doctor and nurse are present and the consultant rephrases his original utterance. If, however, there is written communication via a shared document instead of face-to-face communication, this problem can become a serious obstacle for smooth interaction. The different main tasks play a role here, too. The doctor is concerned with the patient's diagnosis - in this case TIA - and knows that anticoagulants are administered for prophylaxis and treatment of thromboembolic disorders. The prothrombin time must be determined before the initial dose is given; depending on the time, the daily dose is then prescribed. The nurse is concerned with caring for the patient. He knows that TIA patients usually recover completely within 24 hours but that they are initially unsafe to mobilise and have sometimes problems swallowing. Thus, 'nil by mouth' is the course of action to be taken until the doctors either confirm the initial diagnosis 'TIA' and order a change to soft diet or change their diagnosis to 'stroke' and the speech therapist has assessed the patient. The nurse is not concerned with the aspect of preventing the patient's blood from clotting. However, the nurse administers the daily drugs and therefore knows Warfarin.

In an interview about the incident, the nurse expressed his concern about this particular kind of interaction. Questioned about the reasons for this breakdown, the nurse gave the answer: "It is because we all have different viewpoints. The doctors think there are more important things to do than to take a patient's blood." The nurse raised the issue that if he were allowed to take blood, this situation would not have happened and it would be better for the patient. Here, he explicitly challenges the appropriateness of the existing norm that nurses are not allowed to take blood. The nurse suggests a solution to the problem by eliminating one interaction and thus one possible source of a breakdown in cooperation.

Another problem in this situation is that of non-fulfilled commitments caused by communication failures. To analyse this, we must use Searle's Theory of Speech Acts in addition to Habermas' framework. There are three speech acts in this example. The first is an order issued by the consultant for the nurse to sort out the whole process of taking a blood sample and sending it to the laboratory to get it analysed. The second speech act is a request issued by the nurse for the Senior House Officer to take the blood. The third speech act is a request issued by the nurse for a nurse to send the sample to the laboratory (it is not considered here that the nurse issues a commitment for the lab to examine the blood by sending the request for analysis together with the blood sample). The first speech act initiates the two others; the second speech act has to be completed (the commitment has to be fulfilled, i.e. the blood has to be taken) before the third speech act commences. Fulfilling the commitment issued through the utterance of the third speech act, i.e. sending the blood to the lab, means fulfilling the first commitment, i.e. the nurse has sorted out the process of the analysis of the blood. Thus, the first commitment could not be fulfilled because the second and therefore the third are not fulfilled. The SHO did not understand the second one as a commitment. Here, we have the problem of different pragmatics. This is not a terminological problem because the doctor understands what the nurse has written but the interpretations are

different. It is clear for the nurse that his written utterance means that the SHO is requested to take the blood whereas this was not the meaning for the SHO.

Figure 1 shows on the left side the temporal sequence of the three speech acts. The first speech act is issued before the other two. The second and the third speech act are shown as parallel because they are issued by the same person and there is no temporal dependence for the actual issuance of them. The second part of figure 1 shows the order of commitments. If the second commitment is fulfilled, then the third commitment can be fulfilled. The first commitment can only be fulfilled if the third is fulfilled.

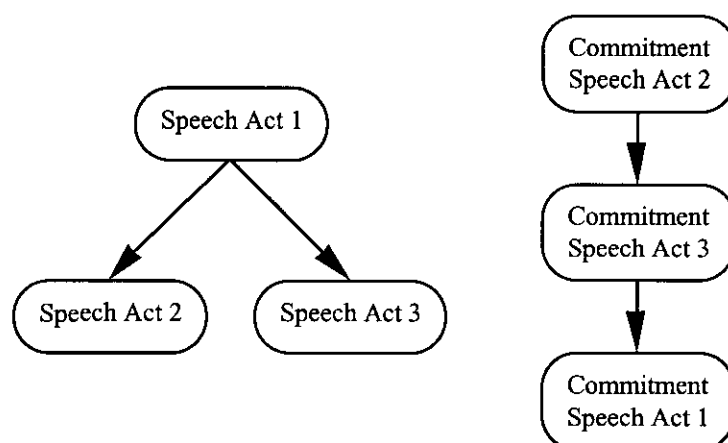


Figure 1: Interactions of Speech Acts (Temporal Sequence and Order of Commitments)

3.6 Summary

So far, we have discussed five scenarios, four of which dealt with problems in face-to-face communication. We want to develop a framework for cooperative documentation systems that will deal with written communication. However, analysing all communication problems of healthcare professionals in a cooperative environment is important for a classification of such problems. In general, we want to transfer the human solution mechanisms for problems in face-to-face communication to problems in written communication in order to avoid cooperation breakdowns. We have found out that comprehensibility problems are solved by rephrasing in face-to-face communication. This observation led to the idea of rephrasing a propositional content in order to avoid such problems (cf. 4.2.2). Analysing situations where the truth of statements was challenged helped to identify the necessary level of detail that data must have for each professional group in order to communicate and to fulfil the main task. The ethnographic studies showed that "appropriateness" is the most fundamental of all validity claims because it is the underlying cause of many communication breakdowns. It is important to understand what each group views as "appropriate" because this notion has to be considered for future systems to be accepted by and useful for all healthcare professionals. The only of the four validity claims that has never been explicitly challenged in the research setting is truthfulness. Questioning a person's truthfulness adds a very personal level to the whole process of communication and interaction. There are of course interpersonal problems on the ward like in any other setting where human beings interact. However, these problems never led to situations where they openly affected interaction and cooperation.

As discussed in this chapter, both Habermas' Theory of Communicative Action and Searle's Theory of Speech Acts can be used for analysing and classifying some communication and cooperation problems of healthcare professionals. However, neither of the theories alone is sufficient to explain all problems that were recorded during ethnographic investigations. Habermas' theory views communication breakdowns as validity challenges but does not consider a distinction between challenging a claim for the illocutionary force or for the propositional content. This theory does not contain the concept of a commitment and, therefore, breakdowns due to non-fulfilled commitments cannot be described using elements from Habermas' theory alone. Speech Act Theory does not include the problem of communication breakdowns which means that a communication problem due to a validity challenge cannot be described using elements from Searle's theory alone. Taken together, we can analyse communication and cooperation problems and breakdowns due to validity challenges or non-fulfilled commitments. However, a mere consideration of both theories is not sufficient for a deep analysis of communication and cooperation problems: We want to be able to state which validity claim is

challenged for which component of the speech act, e.g. a challenge of appropriateness for the illocutionary force or for the propositional content. Thus, we propose an integration of both theories which will be discussed in the next chapter.

4 A Framework for Cooperative Documentation Systems in Healthcare Based on the Theory of Communicative Action and the Theory of Speech Acts

4.1 Integrating the Theory of Communicative Action and the Theory of Speech Acts

Habermas views communication breakdowns as validity challenges and introduces the four validity claims comprehensibility, truth, truthfulness, and appropriateness. Furthermore, Habermas argues that linguistic competence is as important as communicative competence, i.e. the speaker must be able not only to utter a grammatically correct sentence but also to utter it in the appropriate way. Habermas introduces the argumentation that pragmatics is as important as syntax and semantics and that all three levels of language have to be taken into account for an analysis of communication [5].

The Theory of Speech Acts provides us with the idea to view communication as exchanges of speech acts. Each speech act has two components, i.e. an illocutionary force and a propositional content, that are necessary for understanding the meaning of the utterance. The concept of a commitment for either speaker or hearer is introduced [17, 18].

As we have discussed for the scenarios, elements from both theories are necessary for classifying and analysing communication and cooperation problems. The Theory of Speech Acts provides a taxonomy of utterances whereas the Theory of Communicative Action provides a taxonomy of communication breakdowns. Thus, both theories can be seen as orthogonal in that they consider different dimensions of speech.

We have two different theories that we want to integrate into one framework. How can we bring Habermas' theory and speech act theory together? We can analyse which validity claims belong to which component of a speech act. "Truth" is related to the propositional content whereas "truthfulness" concerns the illocutionary force. Both "comprehensibility" and "appropriateness" can be challenged for the illocutionary force as well as for the propositional content.

An utterance can be non-comprehensible because the propositional content is not understood by the speaker. This is a common communication problem. However, it is also possible to challenge the comprehensibility of the illocutionary force used in a speech act. Illocutionary forces are not always specified in communication which can lead to misunderstandings about which illocutionary force the speaker meant to use when uttering a sentence, e.g. the hearer understands a sentence as a statement whereas it was the speaker's intention to utter a directive. A concrete example could be the utterance of "The dosage of insulin has to be reviewed" by the consultant in a case conference. It is meant to be a directive for the ward doctor to review the dosage who understands it as a statement to all participants in the case conference.

Questioning the truth of a statement means questioning whether the statement really represents a fact, a relevant experience etc. Thus, "truth" is directly related to the propositional content. It is not possible to question the truth of an illocutionary force because doubting whether the speaker's intentions indicated by the illocutionary force are real is questioning the speaker's truthfulness.

The challenge of truthfulness is related to the illocutionary force since the hearer doubts whether the speaker is really committed to the illocutionary force used. Here, the ostensible nature of the speech act is questioned, e.g. what seems to be an assertive is really an attempt to deceive.

Both the illocutionary force and the propositional content can be inappropriate. However, a challenge of appropriateness occurs more often for the illocutionary force. The hearer challenges the appropriateness of the illocutionary force used by the speaker by doubting whether the speaker is entitled to use this force in this particular context. The speaker could have violated existing power relations, recognized norms, or work standards. A propositional content can also be inappropriate. Here, the hearer questions whether the sentence fits in a given normative context, i.e. whether it is legitimate to say so. Scenario 2 showed that the doctor judged the nurse's statement ("I wouldn't call the patient incontinent") inappropriate because for him it does not correspond to the common (medical) use of the term, i.e. the definition of incontinence.

Habermas' Theory	Speech Act Theory	
Validity Claim	Illocutionary Force	Propositional Content
Comprehensibility	+	++
Truth		+
Truthfulness	+	
Appropriateness	++	+

Table 1: Relations Between Validity Claims, Illocutionary Force, and Propositional Content

We have argued that three of the four validity claims are related to the propositional content. However, the relations are on different levels. An utterance can be non-comprehensible because the terms used are unknown (terminological level) or because the hearer's interpretation differs from the speaker's intended meaning (semantic/pragmatic level). The first problem is one of non-interpretative utterances whereas the second problem is one of misinterpreted utterances. The hearer has to understand the speaker's utterance in order to be able to decide whether it is true or whether it is appropriate, i.e. possible problems with unknown terms have to be resolved before the hearer can agree or challenge the truth or appropriateness. We argue that, therefore, it must be possible to distinguish between the different claims and, furthermore, there must be a distinction between a non-comprehensible illocutionary force and a non-comprehensible propositional content and an inappropriate illocutionary force and an inappropriate propositional content.

However, more refinements and additional features are needed for both theories. The scenarios showed that comprehensibility problems can only be solved if the original utterance can be rephrased. Speech act theory does not contain any further analysis of the propositional content. Thus, some possibility of rephrasing the representation of the propositional content has to be developed and integrated with speech act theory within the framework. Furthermore, we have to consider that the healthcare professional's main task and the required granularity of detail of data necessary to fulfil the task have to be known in the context of an utterance to understand it. In the next section, the necessary new features are discussed in detail.

4.2 Refinements of the Framework

So far, we have developed a framework to integrate relevant aspects of the Theory of Communicative Action and the Theory of Speech Acts and to introduce new components that go beyond both theories but that are essential for solving communication and cooperation problems. To formalise the framework, we will develop a description language for formally describing a cooperative documentation system that avoids communication breakdowns.

4.2.1. Refinements of the Theory of Communicative Action

Habermas' theory alone is not sufficient to analyse all communication problems. There might be utterances that are comprehensible, true, and appropriate for all communication partners but, nevertheless, there is a cooperation breakdown due to non-fulfilled commitments. Habermas' theory is a philosophical framework that can be used for an analysis of communication breakdowns but it cannot be taken directly for suggesting solutions of how to prevent these problems.

There are two necessary refinements of Habermas' Theory of Communicative Action for the problems described above. Inappropriateness is the most fundamental cause of many communication problems in healthcare. As discussed for the scenarios, appropriateness is the underlying challenge of many terminological problems and arguments about the truth of statements. Thus, the validity claim "appropriateness" needs strengthening to reflect its central role in medical contexts. Furthermore, the relations between the validity claims and the components of speech acts, i.e. illocutionary force and propositional content, have to be considered for an analysis of communication breakdowns. Both refinements need to be discussed on a theoretical philosophical level in future work.

4.2.2. Refinements of the Theory of Speech Acts

We propose necessary additional features and distinguish between refining the concept of an illocutionary force, the concept of a propositional content, and the concept of commitments.

Different healthcare professionals have different main tasks (cf. scenario 5). A doctor is primarily interested in the patient's symptoms and the medical history in order to achieve the main task, i.e. the current diagnosis and therapy, whereas a nurse is primarily interested in caring for the patient's needs whilst on the ward [16]. The primary task must be considered because it is crucial for understanding utterances. Scenario 1 shows that the doctor thinks the nurses supply too much irrelevant detail which he considers inappropriate because it is not necessary for his main task. However, the nurse needs to know all the details for her task of caring for a patient. Thus, a certain granularity of detail is related to the main task and has to be considered in the propositional content as well. Different terminologies have been developed within different professional groups to accommodate the ability to communicate about all aspects related to the main task. Terms are knowledge-specific and context-specific, i.e. a person uses a certain term depending on the communication partner. A physician, for example, speaks with a patient about a broken thighbone while he transmits the diagnosis of a fracture of the femur to the surgeon. This aspect is a specification of the general aspect of comprehensibility. The main task, the related terminology, and the required granularity of detail of the data used to achieve the task are relevant for the illocutionary force, the propositional content, and the concept of commitments. The main task, the different pragmatics and existing power relations indicate which illocutionary forces can be used by different speakers for particular hearers. The propositional content can only be understood in relation to the main task, the related granularity of detail of data, and the pragmatic concerns. Communication problems on a terminological level indicate that unknown terms are used. The meaning of the propositional content can only be understood if the speaker supplies enough detail for the hearer to interpret the utterance in the intended way. The main task determines certain commitments that have to be fulfilled or issued by a member of a particular professional group. Doctors have other obligations than nurses but commitments for both groups need to be explicitly made in order to avoid misinterpretations.

Refinements of Illocutionary Force

We have chosen Searle's taxonomy of five different illocutionary forces as the basis for our classification of illocutionary forces used in healthcare although it is not unproblematic. However, unlike more detailed classifications such as [1] or [8], Searle's framework has a formal semantics defined by illocutionary logic. We propose to refine the seven components of illocutionary forces and to add further components but to use the five classes of illocutionary forces because they seem sufficient for our purposes. A medically oriented set of subcategories of the five categories of illocutionary forces is required in order to be able to classify forces and make general statements that are valid for all forces of a particular type.

The following list shows the most common illocutionary forces in healthcare according to our ethnographic studies.

- | | |
|------------------|------------|
| • admit | • query |
| • assess | • record |
| • diagnose | • refer |
| • discharge | • request |
| • evaluate | • review |
| • identify needs | • rule out |
| • inform | • set goal |
| • investigate | • suspect |
| • observe | • transfer |
| • order | |

We can classify the illocutionary forces according to Searle's framework in the following way.

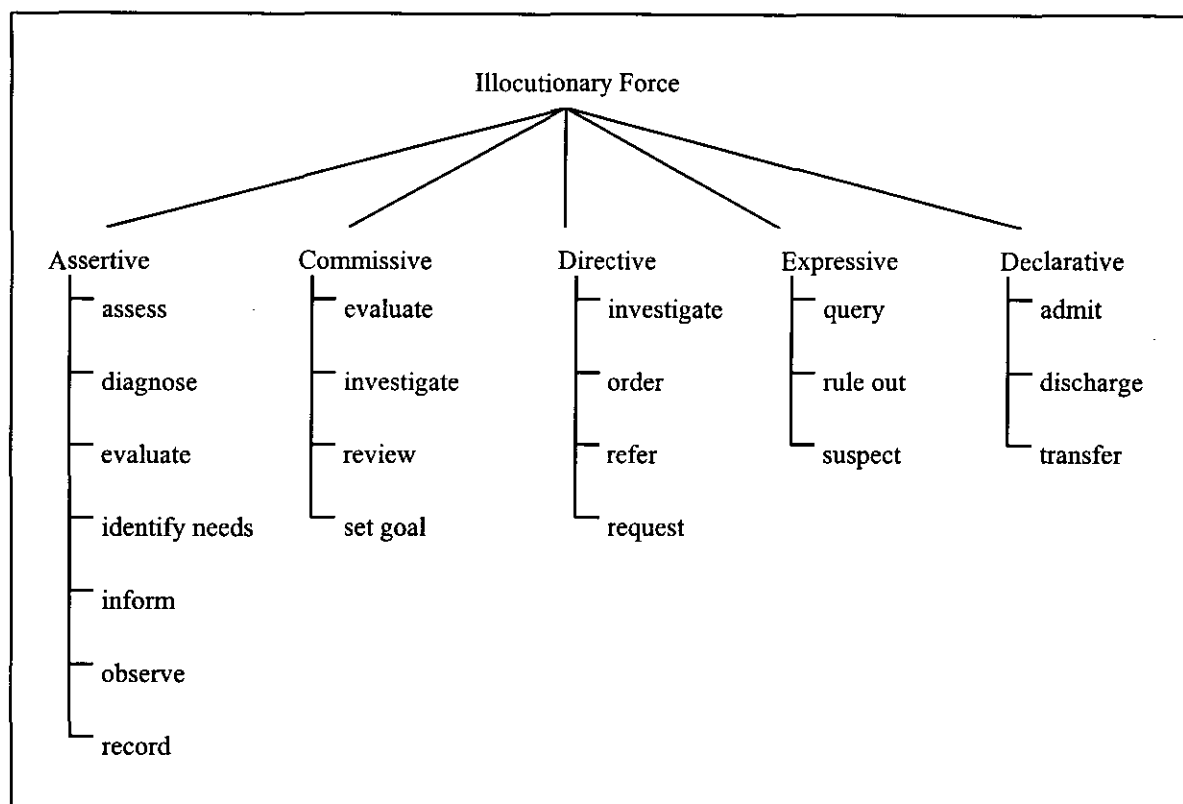


Figure 2: Classification of Medically Oriented Subcategories of Illocutionary Forces

The assertive illocutionary forces have the word-to-world fit, i.e. they try to represent states of affairs in the real world. An assessment describes the patient's normal and altered states. Issuing a diagnosis means classifying and labelling the patient's disease. A diagnosis is a statement made by a healthcare professional who believes that the disease he or she has given is actually the one the patient suffers from. However, a diagnosis does not change the patient's state of health and does not make the patient have the disease. Therefore, it is not a declarative speech act which has the double direction of fit ("changing the world by saying so"). Evaluating a patient's care and treatment implicitly includes two illocutionary forces, i.e. stating the patient's current state (assertive) and reviewing the planned interventions and goals and changing them if necessary (commissive). Nurses identify patients' needs during their assessment, i.e. they state the areas that are problematic and need to be considered in the daily care. Informing a communication partner about certain facts or recording these facts (indirect communication) is telling someone else how things are (word-to-world fit). Observing is looking at how things are in the real world and trying to represent them, e.g. through language, mental images etc.

In healthcare, "investigate" is always used as a commissive or a directive, depending on the hearer. Investigating for example the cause for a patient's fall or the home circumstances commits either the same or a different professional group to carry out the relevant actions. If a treatment or a prescription is reviewed, then a member of the same professional group than the speaker is committed to consider the patient's actual state in order to decide about any necessary changes in the plan of care and treatment and to give reasons for the decision. The process of reviewing is always carried out within one professional group; there are no requests to review a patient by members of different groups. Nurses assess the patient's normal and altered states, identify the needs and then set appropriate goals that they are committed to achieve while the patient is on the ward. Thus, setting a goal is committing nurses to ensure that the states described are achieved.

In addition to the general directive forces "order" and "request", there are two other specific directives for healthcare. As mentioned before, an investigation can be a directive force. Referring a patient to another specialty means issuing a commitment for a member of this specialty to assess the patient.

The process of classifying a patient's disease is an excluding one. Possible diseases are queried and ruled out and the most likely disease is taken as a preliminary diagnosis. This process is represented by the phrases

"We query disease x" or "Disease x is suspected". A suspicion in the medical sense is a speech act in which the professional expresses uncertainty about the state of affairs, i.e. making a preliminary diagnosis means implicitly making the speech act "I suspect this disease but I am not certain whether the diagnosis is true". Querying a disease expresses even less certainty. Here, the professional has thought of the possibility of this disease but does not necessarily suspect it. The phrase "cannot be ruled out" is often used in medical documents to indicate that, on the one hand, the professional is aware of the possibility that the patient might have a certain disease but, on the other hand, that the professional cannot decide yet whether this is really the case. Thus, using the phrase "ruling out" means implicitly making an expressive speech act "It has to be investigated whether the patient has the disease or not because I cannot decide yet". In all three cases the speaker does not believe in the truth of the statements, i.e. does not believe that this is the disease the patient is suffering from. Thus, these three illocutionary forces are not assertives.

Admission, discharge and transfer can be seen as declarative speech acts. By admitting a patient to a ward, the patient is taken under the responsibility of the ward solely through the speech act of admission. A patient can even be admitted to a ward before he or she physically arrives there. Discharging a patient means being no longer responsible for the patient. Transferring a patient to another ward or hospital means transferring the responsibility to someone else. These three acts are not mere statements or commissives but change the world (the patient is now one of ward X; the patient is no longer one of ward X; the patient is now one of a different ward Y) by saying so:

The different pragmatics and the different main tasks determine the illocutionary forces observed to be used in the different professional groups, e.g.

Illocutionary Force	Doctor	Nurse
admit	+	
assess	+	+
diagnose	+	
discharge	+	
evaluate	+	+
identify needs		+
inform	+	+
investigate	+	+
observe	+	+
order	+	
query	+	
record	+	+
refer	+	+
review	+	+
rule out	+	
set goal		+
suspect	+	
transfer	+	+

Table 2: Illocutionary Forces used by Doctors and Nurses

Furthermore, the professional role and the pragmatics indicate the speaker and hearer of speech acts with such forces, e.g.

Speaker	Illocutionary Force	Hearer
Senior Doctor	order	Junior Doctor
Doctor	order	Nurse
Doctor	request	Doctor
Doctor	request	Nurse
Doctor	refer	Doctor
Nurse	request	Nurse
Nurse	refer	Therapist

Table 3: Examples of Speakers and Hearers for Particular Illocutionary Forces

Refinements of Propositional Content

Speech act theory and illocutionary logic as its formalisation treat the propositional content as unproblematic whereas it is possible to break down the illocutionary force into seven detailed components. A further refinement of the propositional content is necessary in order to accommodate the relations between validity challenges and utterances as discussed before.

The propositional content must be further analysed into a terminological and a semantic/pragmatic level. As mentioned in the last chapter, comprehensibility is a major problem in a cooperative healthcare environment and should be considered according to Habermas' theory. Comprehensibility problems can occur on both levels. Terminology plays an important role for understanding. The usage of certain terms for a specific concept is crucial for the communication between different professional groups.

The idea of rephrasing is based on experiences made during the ethnographic work on a geriatric ward. In routine interaction, comprehensibility problems are usually solved by rephrasing or 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.

In our framework, the original speech act will remain unchanged and only the terminological level of the propositional content will be rephrased, i.e. not the meaning of the utterances but the words and wordings used will be adapted according to each group's requirements. The terminological aspect is not a part of the illocutionary logic which deals with meanings of sentences but for communication problems between different healthcare professionals we will combine illocutionary logic with a language for modelling terminology. We will concentrate on nurses' and doctors' terminology and here, rephrasing takes place in both directions since both terminologies overlap but none is a subset of the other.

Refinements of Commitment

Each utterance of a commissive or a directive speech act issues a commitment. The framework will consider the following additional features. In addition to the speaker, the hearer, and the actual utterance, it must be taken into account which competencies, responsibilities, duties and procedures there are for the different professional groups. We can for example state that a particular healthcare professional is only allowed to issue certain illocutionary forces for interactions with particular professionals, e.g. the nurse can issue a request but not an order to a doctor, but it is also relevant that the professionals have to issue certain commitments when particular situations arise, e.g. a nurse must refer a stroke patient to a speech therapist. The time aspect ("The speaker issued the utterance/commitment at 4.30pm") and the interactions with other speech acts (fulfilling the commitment means issuing another speech act; speech act 1 is dependent on speech act 2 in that the second has to be fulfilled for the first to be fulfilled) are also relevant.

Commitments could be used for several purposes, e.g. reminder (The patient has yet to be referred to the speech therapist), control (Which commitments are not fulfilled yet?), discourse (Where does the cooperation

between nurses and speech therapists break down, what could be changed?), and for coordination of cooperation (Referral to speech therapist means that the therapist has to examine the patient in the next three days). Marking commitments as "non-fulfilled", "rejected", or "not yet dealt with" is possible within the framework. According to Habermas' theory, these three possibilities allow a certain kind of emancipation for the hearer in that the hearer can reject certain commitments and then enter into a discourse why these commitments are not appropriate. The ethnographic investigations have shown that this is a useful feature. Different healthcare professionals want to cooperate but this does not mean that they want to carry out all actions requested or ordered by other professionals. A nurse may want to explain why a certain order issued by a doctor cannot be carried out. In this case, the nurse rejects the commitment and enters a discourse about the reasons. Furthermore, it is possible to describe that a commitment is rejected because the propositional content is non-comprehensible, false, or inappropriate, or because the illocutionary force is non-comprehensible or inappropriate. Questioning a speaker's intentions, i.e. challenging the speaker's truthfulness, is not considered here.

5 Conclusion and Future Work

Different healthcare professionals have to cooperate in order to fulfil the shared task of caring for a patient. However, their communication problems make cooperation more difficult. Examples of communication and cooperation problems from ethnographic investigations carried out in a geriatric ward were analysed and classified using Habermas' Theory of Communicative Action as well as Searle's Theory of Speech Acts.

Both theories need to be refined for a sufficient description of communication and cooperation problems in a cooperative documentation system. We discussed a framework that integrates and refines both theories. Future work will formalize the framework resulting in a formal description language. The formalization gives the opportunity to deal with the framework through scientific methods from mathematics and computer science. The description language can be used as a foundation of cooperative documentation systems avoiding most communication and cooperation problems between the different healthcare professionals.

New documentation systems based on the description language will have many features that make them powerful and useful. Documentation can be enhanced by giving professionals the possibility to use their own terminology and thus to be able to express themselves in the best way. Understanding the communication partner will be made easier as well by specifying the main task, responsibilities, duties, and competencies of all professionals involved. Thus, the context of utterance is extended in order to reach a better understanding of utterances.

A cooperative documentation system based on the description language includes more possibilities for information access, e.g. to

- particular illocutionary forces
- particular propositional contents
- particular speakers/hearers
- *commitments fulfilled so far*
- commitments rejected because of false propositional contents
- commitments rejected because of inappropriate illocutionary forces
- commitments rejected because of inappropriate propositional contents
- commitments not yet fulfilled

Explicit commitments allow a better coordination of interactions and the possibility of rejecting commitments can lead to more discourses. Furthermore, the detection of non-fulfilled commitments provides an argumentative basis for entering discourses about questions of changing norms that govern cooperation. This can enhance emancipatory tendencies and will ultimately lead to better cooperation structures and procedures.

The aspect of rephrasing non-comprehensible propositional contents allows a certain kind of emancipation [10]: Each professional group's terminological requirements will be considered and thus the group members have the power to express what they really want to say instead of being forced to use and understand different professional terminologies that are useful for different tasks. It would be unrealistic to try to dissolve existing power structures but emancipation is possible even though they still exist. Using Habermas' terminology, we can state that cooperative documentation systems based on our description language will consider technical as well as practical and emancipatory knowledge interests [10, 11].

Future work on the project will include further ethnographic work in order to observe more scenarios of communication and cooperation problems and to specify competencies, duties, and responsibilities on a more detailed level. Foremost, the description language will become more concrete.

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Structure and Coherence in Business Conversations

A Hierarchical model

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Abstract

Business Conversations play an important role in the performance of the activities of the actors participating in an organization. In this paper the attention is focused on the structure and coherence in business conversations. Starting point of the discussion is the transaction concept which is the core notion of a communication centered business analysis method, called DEMO (Dynamic Essential Modelling of Organizations). We propose a hierarchical model of business conversations to describe the structure of this particular kind of conversations. This model will be helpful for the analyst who wants to draw up a Communication Model of an organization.

1 Introduction

In performing tasks in an organization communication plays a dominant role. Participants in an organization coordinate their activities by means of communication. This idea is the basic principle of the action workflow approach (Medina-Mora et.al, 1992; Denning&Medina-Mora, 1995) and finds a response in other office communication analysis methods like SAMPO (Auramäki, et al., 1988) and organizational theory (Taylor, 1993).

The action workflow approach is a design methodology and associated computer software for the support of work in organizations, developed by Flores and associates based on previous theoretical work (Flores& Ludlow, 1980; Winograd & Flores,1986). Theoretical foundation of this approach is the language/action perspective in which language is a form of human social action. Following Austin (1962) and Searle (1969,1979) the language/action perspective emphasizes the *act* of language. By the expression of speech acts and listening to these acts people create commitments that will regulate and coordinate their actions.

The basic sequence of actions in the action workflow loop consists of four phases (Medina-Mora et. al, 1992):

- Proposal
- Agreement
- Performance
- Satisfaction

In proposal the customer requests for the completion of a particular action or alternatively, the performer offers a work to be done to the customer. In Agreement the two parties come to mutual agreement about the work (or action) to be performed. In performance, the performer declares to the customer that the action is complete, so the execution of the action just has happened. In satisfaction the customer declares to the performer that the completion is satisfactory. The phases should come up in succession but at any phase

there may be additional actions like: clarifications and negotiations about conditions. There is always an identified customer and a performer and these words apply to people within a single organization as well as across boundaries.

This pattern of communication and action as is also dominant in DEMO (Dietz, 1990, 1994a, 1994b, 1996b), a communication centered business analysis method. Just as action workflow DEMO (Dynamic Essential Modelling of Organizations) is developed within the language/action perspective. According to DEMO the elementary units of activity in an organization are essential transactions. Essential transactions are theoretical concepts defined as a pattern of communication and action by which new facts are created that directly relate to the primary process of the business.

In the transaction concept, compared to the action workflow loop, there is more attention to the so-called execution phase in which a material or immaterial action is performed. According to Goldkuhl (1996) in the action workflow there is an overemphasis on communication, for example in the description of the performance phase. Next to that, according to us the transaction concept is more abstract because there is no reference to a customer and a performer. In the transaction concept, the participating actors are called initiator and executor in order to concentrate on the functions performed by the subjects while abstracting from the particular subjects that performs a function (Dietz, 1994a).

Both approaches, DEMO and the action workflow do not deal with the actual realization of conversations for action, extensively. Conversations for action can be defined as a network of speech acts directed toward explicit cooperative action. In Winograd & Flores (1986, p.65) a picture of the basic conversation for action is presented. In this picture the basic course of a conversation is represented and at each point in the conversation, there is a small set of possible actions determined by the previous history. When participants in the conversation move from state 1 to state 5 without any detour the conversation reaches a successful completion.

In this paper we will focus on real life business conversations in more detail. Especially we point at those conversations that directly serve the performance of business activities. If we want to understand the linguistic coordination of business activities, the unambiguous interpretation of speech acts is of extreme importance (Steuten, Van Reijswoud, 1996). In order to handle the interpretation of speech acts that mark specific phases in business activities and to establish the coherence in business conversations, we propose a hierarchical model of business conversations. We assume that coherence or order in a business conversation is not to be found at the level of linguistic expressions. Coherence is to be found at the level of speech acts or interactional moves that are made by the utterance of linguistic expressions. The analysis of separate linguistic expressions is not adequate to consider the coherence in a business conversation. Therefore the hierarchical model of business conversations can be conceived as a syntax of language acts in terms of hierarchically organized sets of interactional acts and exchanges.

By means of this hierarchical model we are able to determine the pattern and coherence in real life business conversations. It enables the analyst to mark specific phases in such a real life business conversation and uncover the pattern of communication and action. This will be useful in determining the type of transaction in question and its result(s). So, this model is helpful in drawing up a Communication Model (CM) of an organization. A CM of an organization is the central model in DEMO. It is the specification of the interaction and interstriction structure between actors. The interaction structure is the mutual influencing of actors by being initiator or executor of transactions. The interstriction structure is the mutual influencing by means of already created facts in the object world or statutes of current transactions. These facts or statutes are taken into account in carrying out a transaction, they restrict the 'playing field' of the actors.

We assume that this hierarchical model of business conversations is combinable with the Functional Grammar utterance model. Functional Grammar provides a theory concerning the grammatical organization of natural languages (Dik, 1989). It offers a coherent and explicit model which aims to provide a complete account of sentence structure from the underlying semantic representation to the surface phonetic form (Siewierska, 1991). Each clause can be described in a so-called underlying clause structure in which several 'layers' of formal and semantic organization are distinguished. In Steuten and Van Reijswoud (1996) we used Functional Grammar to provide for information about the internal structure of individual utterances. According to us the hierarchical conversation model can be integrated with the layered FG utterance model in order to build up a discourse grammar. A discourse grammar should have a

grammatical base supplemented by a syntax for the interactional level. For an integration of both models the reader is referred to Steuten (1996).

To illustrate the hierarchical model and its application we use a recorded conversation taken from a large corpus. This corpus is obtained in a Dutch hotel and the recordings are examples of the actual realization of business conversations involving a hotel reservation. They concern telephone calls between an employee of the reservation department and a client. Before we turn to our example conversation in section 3 we discuss some aspects of DEMO in section 2. We focus on the core concept, the transaction, on the structure of communicative acts in DEMO, and give the graphically representation of a Communication Model by means of a Communication Diagram. In section 4 the hierarchical model of conversation in a transaction will be displayed. Section 5 consists the application of the hierarchical model to our example conversation and we give some conclusions in section 6.

2 Dynamic Essential Modelling of Organizations

DEMO is based on language-philosophical theories of information and communication. It draws on the Speech Act Theory (Austin, 1962; Searle, 1969; 1979) and the Theory of Communicative Action (Habermas, 1981). It is a theory describing and explaining the communicational dynamics of organizations, as well as an analysis method based on that theory (Van Reijswoud, 1996).

According to DEMO an organization can be conceived as a subject system together with its corresponding intersubject world and object world (Dietz, 1995b). The object world is the part of the universe that is affected by, outwardly directed, actions. The subject system is a social system composed of a set of human beings in their quality of active social individuals. Subjects are able to act and to influence each other. With every subject system corresponds a particular intersubjective world which is the part of the universe that is effected by the so-called performative communicative acts of the subjects (for a description of this notion see section 2.2). In the next section we describe the core concept within DEMO.

2.1 Transaction concept

The core concept within DEMO is the transaction. A transaction is a sequence of three phases: the inception, the action and the conclusion. The inception phase consists of an actagenic conversation. In this phase the actors try to reach agreement on the performance of an objective action in the future. The actagenic conversation is initiated by actor A (the initiator) and starts with a request at t1. At t2 the executor of the transaction, actor B, concludes the actagenic conversation with a promise to execute the requested action. The result of this actagenic conversation is an agendum: a thing-to-do. Somewhere between t2 and t3 the action agreed upon is executed by actor B. After the execution the last step of the transaction, the conclusion starts. This phase consists of a so-called factagenic conversation in which the actors try to reach agreement about the results of the action. The factagenic conversation is started by actor B at t3 with a statement that the action is executed. When the initiator accepts the results at t4, the transaction succeeds and a fact stating the completion of the transaction is created. This is the end of the factagenic conversation and only after the acceptance by actor A, a new fact in the object world is established. According to Dietz (1990; 1994a; 1994b) the essence of an organization consists of the continuous accomplishment of transactions between actors. Figure 1 is the general structure of a transaction.

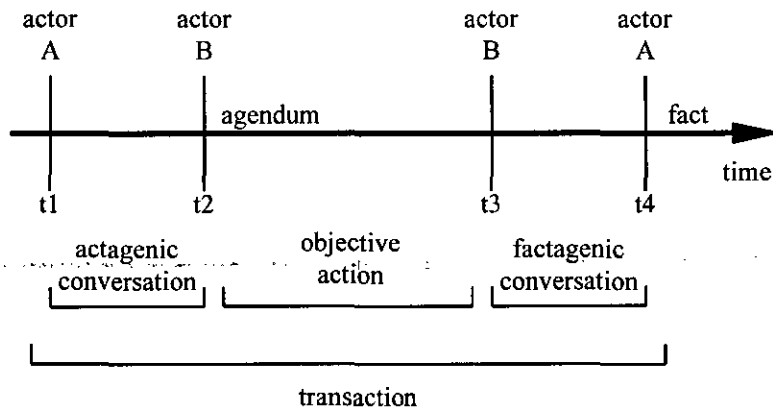


Figure 1. General structure of a transaction (Dietz, 1994b)

2.2 Structure of business conversations in DEMO

To focus on business conversations in DEMO we consider the communicative acts in a transaction. In DEMO communicative acts are represented in a so-called explicit notation (Dietz, 1996b) which is composed of four basic elements: locutor, addressee, the illocution and the proposition. The locutor is the speaker, the one who performs the communicative act. The addressee is the hearer, to which the communicative act is directed. The proposition represents a particular state of affairs (SoA) in some world. The illocution concerns what is expressed about the proposition. The actagenic conversation concerns some proposition *P*. The proposition concerns a fact and a time of completion or a specific period of time. We will represent the expressions of the communicative acts between the client (C) and the hotel (H) in the reservation transaction in the explicit notation and indicate them as CA1, CA2, CA3 and CA4:

C: Direct	: H:	a reservation is made for one double room for C for the second of September 1997. (CA1)
H: Commit	: C:	a reservation is made for one double room for C for the second of September 1997. (CA2)
H: State	: C:	a reservation is made for one double room for C for the second of September 1997. (CA3)
C: Accept	: H:	a reservation is made for one double room for C for the second of September 1997. (CA4)

Communicative Act 1 is called a directive act and Communicative Act 2 is called a commissive act. By means of a directive act the initiator (the client) expresses the wish that the proposition (a reservation is made for one double room for C for the second of September 1997) be made true. In the commissive act, the executor (the hotel, actually an employee of the hotel) expresses that it will see to it that the proposition becomes true. So, by CA2 the executor commits himself to perform some action such that the proposition will become true (Dietz, 1995a). According to Dietz CA1 and CA2 constitute the so-called actagenic conversation. Communicative Act 3 is called a statutive act and Communicative Act 4 is called an acceptive act. In the statutive act the executor declares that the proposition is made true. In the acceptive act the initiator expresses that he agrees with the established fact. According to Dietz CA3 and CA4 constitute the so-called factagenic conversation. The communicative acts appear to have the same propositional content, they are about the being reserved of one double room for a specific date, namely September the second, for the person that plays the role of the initiator, namely the client.

The core conversations in a transaction: the actagenic and factagenic conversations, are both called performative conversations. We call these conversations performative because they create a change of state. An actagenic conversation results in a new agendum and a factagenic conversation creates a fact of having executed the action and a number of facts (possibly none) in the object world (Dietz, 1994a).

Opposed to performative conversations DEMO distinguishes informative conversations. In these conversations only already created information is reproduced or new information is deduced by mathematical or logical computation. The effect is that the knowledge of already existing facts (or a part of it) of one subject is shared by another subject. Informative conversations are not necessarily for carrying through a transaction successfully. Only when the executor needs some further information to execute the objective action adequately, an informative conversation will be performed. We consider an example of an informative conversation involved in the reservation transaction. We will represent the communicative acts in the explicit notation and indicate them as CA5 and CA6:

H: Ask : C: the type of room preference is..... (CA5)
 C: Assert : H: the type of room preference is suite. (CA6)

Both Communicative Acts, 5 and 6, have the same propositional content too. Both acts are about the type of room the client prefers. Communicative Act 5 is an interrogative expressed by the hotel addressed to the client about the proposition concerning client's room type preference. The hotel wants the client to specify his preference. Communicative Act 6 is the assertion of that preference. In the next section we represent the interaction and interstriction structure of the example mentioned above by focusing on the graphical representation of the Communication Model.

2.3 Communication Diagram

The graphical representation of a CM is a so-called Communication Diagram (CD). We will consider this CD and illustrate a part of it with the transaction of reserving a hotel room. In the CD an actor is represented by a box and identified by an actor number (A_i). A transaction type is represented by a disk and is identified by a transaction type number (T_n). This disk can be conceived as a store for the statuses through which the transaction of that type pass in the course of time. Therefore the disk symbol is called a transaction bank. The facts that are created as result of the successful completion of a transaction are stored in a fact bank, which is represented by a diamond. The diamond symbol is drawn behind the disk symbol to make clear that the facts are the result of the successful carrying through the transactions. External fact types are not created in or at the boundary of a system and we represent them by a diamond symbol only. External facts bank are identified by a number (E_k). They are created in external transactions and those transaction types fall outside the scope of interest. The actor who is the initiator of a transaction type is connected to the transaction bank by an initiator link. The link is represented by a plain line. The actor who is the executor of a transaction type is connected to the transaction bank by an executor link. This link is represented by a plain line with an arrow head at the side of the actor box, pointing to that box. Interstriction is represented by so-called data links between actors on the one side and facts bank and transaction bank on the other side. Data links are symbolized by dotted lines. The system boundary is represented by a gray-colored rectangle. Figure 2 are the graphical elements of the communication diagram. Figure 3 is the Communication diagram of the transaction type `reserving_room` (T_1). In this transaction two actors are involved: client (A_1) and tailor (A_2). For a successful completion of the transaction reserving a room the hotel needs client data (E_1), such as client's room type preference, period of reservation and possibly the name of the client. Next to that, the hotel needs information about the availability of the preferred room type in the period of reservation that is in request (E_2).

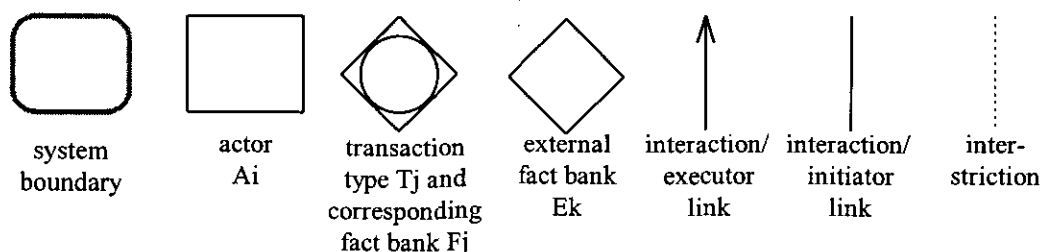


Figure 2. Graphical elements of the Communication Diagram

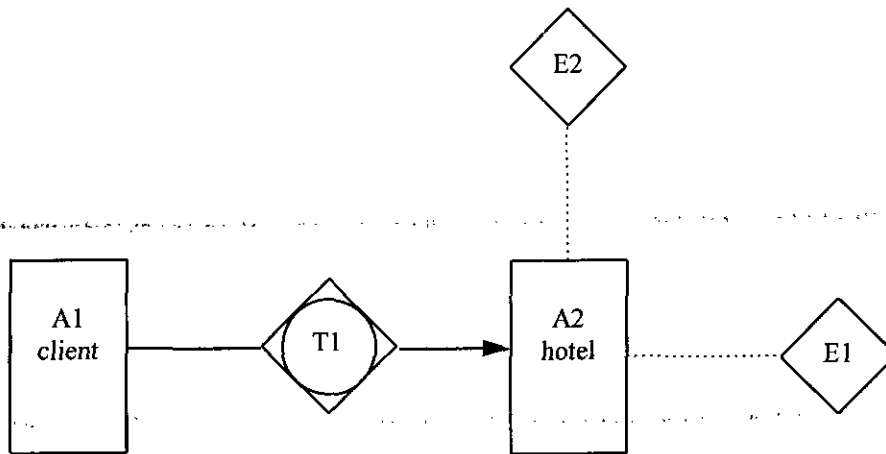


Figure 3. Communication Diagram of the transaction type reserving_room

3 Actual realization of a business conversation

In this paper we consider one example of a business conversation taken from a larger corpus obtained in a Dutch hotel. This hotel is attractive for both conference guests and tourists. It is situated on the edge of a famous Dutch city and it is directly connected to a conference centre which offers possibilities for organizing exhibitions and congresses. The hotel corpus consists of recordings of telephone calls concerning conversations between an employee at the reservation desk of the hotel (H) and a client (C). The conversations occur in the performance of a reservation transaction.

- 1 H: Good morning,
- 2 reservation desk, this is Ann speaking.
- 3 C: Good Morning.
- 4 H: Hello.
- 5 C: I would like a reservation for a single room for tonight.
- 6 H: Just for one night?
- 7 C: Yes, for one night.
- 8 H: Okay,
- 9 could you give me the name of the guest, please?
- 10 C: His name is Peterson.
- 11 H: Peterson, okay,
- 12 and the name of your company, please?
- 13 C: The M.K.C. Company.
- 14 H: M.C.K.,okay.
- 15 Could you give me the telephonenumber of the company?
- 16 C: That's.....
- 17 H: mmmmm
- 18 C: 2101
- 19 H: 2, yes
- 20 C: 10
- 21 H: Yes
- 22 C: 2101
- 23 H: and your name, please?
- 24 C: Carlington.
- 25 H: Carlington, okay.
- 26 I noted this
- 27 and do you expect the guest arrives before 6 o'clock p.m.?

- 28 C: No, I don't think so, probably he will arrive later on.
 29 H: Late arrival, okay that's no problem.
 30 C: Thank you very much.
 31 H: Thank you,
 32 good-bye.

In the next section we present the hierarchical model of business conversations.

4. A hierarchical model of business conversation

For a hierarchical model of business conversation we are inspired by Sinclair and Coulthard (1975). Sinclair and Coulthard belong to the so-called Birmingham discourse analysis group. According to the Birmingham approach coherent and meaningful discourse can be generated by a syntax of action just like well-formed sentences can be treated as the products of the rules of syntax. Sinclair and Coulthard established the Birmingham approach within the field of conversation analysis and their model is exclusively based on the study of classroom interaction. Despite the title of their study: 'Towards an analysis of discourse' their viewpoint is Conversation Analytically.

For their system of analysis Sinclair and Coulthard used Halliday's 'Categories of a Theory of Grammar' (1961). Following Halliday they use a rank scale. The basic assumption of a rank scale is that a unit of a given rank, for example 'word' is made up of one or more units of the rank below, 'morphemes' and combines with other units at the same rank to make one unit at the rank above 'group' (Halliday, 1961). The unit at the lowest rank has no structure. For example, morpheme is the smallest unit at the level of grammar and cannot be subdivided into smaller grammatical units. If we move from the level of grammar to the level of phonology we can perceive that morphemes are composed of a series of phonemes. Similarly, the smallest unit at the level of discourse will have no structure. This unit is composed of words, groups or clauses and these are at the level of grammar. Each rank above the lowest has a structure which can be expressed in terms of the units next below. Thus, for example the structure of the clause can be expressed in terms of nominal, verbal, adverbial and prepositional groups. The unit at the highest rank is one which has a structure that can be expressed in terms of lower units, but does not itself form part of the structure of any higher unit. Therefore, sentence is regarded as the highest unit of grammar. The link between one rank and the one next below is through classes. A class realizes an element of structure.

Our model of business conversation is a hierarchical model because we used a rank scale in describing such a conversation. The unit at the highest rank is built up by lower units and each rank above the lowest is built up by units next below. The highest unit of business communication (Rank or level 1) we call a **business transaction**. A business transaction is defined as the unit of activity of a subject system and as we described in the introduction it is a pattern of action and communication. We take a business transaction as the highest unit because it appears that it is not only linguistic activity by the interacting participants which is relevant to the structure of business communication. According to Edmondson there appears no essential difference between verbal and non-verbal acts in terms of the coherence of a conversational discourse. Any activity may form a structural element in an ongoing conversation. Linguistic (verbal) and non-linguistic (non-verbal) acts may be linked in a conversational sequence via the notion of performance or execution (Edmondson 1981). We will illustrate this with the following example in which a request is complied:

- S1: can you deliver the newspaper, please?
 S2: of course (delivering the newspaper)

The response here consists of the verbal act of saying 'of course' and the non-verbal act of 'delivering the newspaper'. But the non-verbal part is the element which is tied to the request. If S2 merely says 'of course' but makes no move within a roughly determinable time to deliver the newspaper he/she has 'responded' but his/her non-activity is signified as an act of non-compliance.

In a business transaction the non-verbal and verbal acts cohere because only after the performance of the non-verbal act (the execution of the objective action) the last phase of a transaction, the so-called factagenic part, can be started. This part after all concerns the results of the action. The linguistic (verbal) part is called a business conversation. By a business conversation is understood a conversation that directly

serves the performance of business activities. A business conversation is made up of a series of **exchanges** (Rank or level 2). An exchange consists ideally (but not necessarily) of an initiating move by speaker A and a reactive move by speaker B. In Conversation Analysis the term adjacency pair (Schegloff, 1972a; Schegloff & Sacks, 1973) is applied to such a pair. In a business conversation we recognize three exchanges. We distinguish two exchanges which are mandatory in a business transaction: *Actagenic* and *Factagenic*. In an actagenic exchange agreement is reached between actor A and actor B about the future execution of an action by actor B. In a factagenic exchange actor A and B reach agreement about the results of the execution by actor B. The third exchange in a business conversation is an *Informative* exchange. Informative exchanges are not necessarily mandatory. In such an exchange only knowledge of existing facts, necessary for the performance of the action agreed on in the actagenic exchange, is distributed. Only when the executor of the non-linguistic part of the transaction needs some further information an informative exchange will be performed. An informative exchange often appears after the first part of the actagenic exchange: after the request performed by the initiator of the transaction. In this case it can be conceived as an exchange embedded in an actagenic exchange. In Conversation Analysis such a question-answer pair is called an insertion sequence (Schegloff, 1972a). Next to that, a question-answer pair can be appeared before the actagenic exchange. In this case it is a so-called pre-sequence or more particular a pre-request (Merritt, 1976). Such a sequence is performed to check out the situation before performing some directive act.

Each exchange consists of **interactional acts** of several classes (Rank or level 3). We define an interactional act as the smallest significant element by means of which a conversation is developed. Interactional acts are made up of **illocutionary acts** (Rank or level 4). It is necessary to distinguish illocutionary and interactional acts. Here we define illocutionary acts in a restricted sense as linguistic acts because they are defined completely by lexical and grammatical properties of the utterance itself, whereas an interactional act is defined by its position within (an) other discourse unit(s) from a functional point of view. This definition of illocutionary acts differs from Searle's in which the communicative force is stressed. According to Searle (1969) a speaker is performing an illocutionary act by making a promise, asking a question, submitting a request, making a statement, etc. We suppose that illocutionary acts belong to the grammatical unit whereas level one, two and three belong to the communicative unit. There is no one-to-one mapping of illocutionary and interactional acts. Consider the following example in which an illocutionary act of a declarative form can be the interactional act of a request:

'I need a reservation for a double room for the second of may'

According to Searle (1979) this is an indirect speech act. In an indirect speech act one illocutionary act is performed by way of performing another. For the right interpretation of speech acts, we need to consider several syntactic and semantic properties like: mood, word order, intonation contour, tense, controllability of the state of affairs. Next to these grammatical elements we need to consider lexical elements like: 'please', 'if you want', 'if you care' (Risselada, 1990; Moutaouakil, 1991). However for the right interpretation of indirect speech acts the logical sense of the sentence and/or the situational context determine which category the utterance belongs to in the conversation. Interactional acts are realized or manifest in one or more illocutionary acts.

Table 1 is a picture of the hierarchical model of business conversations: an overview of the layers in a complete transaction. In brief, the highest unit of this model is a business transaction which consists of a linguistic and non-linguistic part. The linguistic part is business conversation which is made up of three exchanges: actagenic, factagenic and informative. In order to perform a transaction successfully the actagenic and the factagenic exchange are mandatory. An informative exchange is only performed when more information is needed for the accomplishment of a transaction. Each exchange consists of several classes of interactional acts. For an actagenic exchange to be complete there is a request performed by the initiator to get the executor to do something. After the request there is a promise by the executor to commit himself to do what is requested. For a factagenic exchange to be complete the executor firstly states the results of the execution. The initiator finishes this exchange by accepting the results. An informative exchange, consists of a question and answer. Both the initiator and the executor of a transaction can start an informative exchange. The lowest units of the hierarchical model are the illocutionary acts which realize the interactional acts.

COMMUNICATIVE UNIT						GRAMMATICAL UNIT	
Level 1		Level 2		Level 3		Level 4	
BUSINESS TRANSACTION ACTION	business conversation	EXCHANGE		INTENTIONAL		ILLUSTRATIONARY	
			informative	question answer			interrogative declarative
			actagenic	request promise			(mitigated) imperative declarative
			factagenic	state accept			declarative declarative
	non-linguistic part			ACT		ACT	

Table 1. The hierarchical business conversation model

5. Application of the hierarchical conversation model

Before we apply the hierarchical conversation model to the example conversation we first notice some general properties of the conversations in the corpus. These conversations concern telephone calls which are a class of verbal interchanges with specific features. They tend to have clear beginnings and carefully organized closings. We can recognize an opening section with identification and recognition (especially relevant in business calls) and the immediate relevance for calling (for an extended description see Schegloff, 1979a). Opening and Closing exchanges are not included in the hierarchical business conversation model because these exchanges are optional and actually do not contribute to the performance of a transaction.

Another noticeable property is that some kinds of telephone calls have an expectable overall organization that admits one topic. These, so-called monotopical calls, are typical for routine business calls or service inquiries (Levinson, 1993). These calls are not monotopical in the sense that no more than one topic is ever addressed within them. They are monotopical in the sense that the caller is oriented to the expectation of a single topic in the introduction of further topics. According to us the recorded telephone calls in the hotel corpus are monotopical because the caller (the client) is oriented to one single topic, namely the reservation of a hotel room for a specific period. Although, this does not mean that the caller has in fact no more than one thing to say, but he is at first oriented to a favour requested and done. Before he requests a favour (the reservation of a room) he may ask for example for the price of the room he preferred or for the location of the hotel in relation to the city centre.

To represent the structure and coherence of the presented example we apply the hierarchical Business Conversation model to the conversation presented in section 3. Line 1-4 in our example is a so-called opening exchange, meant as an introduction phase. In this phase the introduction of the participants of the transaction takes place: the client (C) is the initiator and the hotel (H) (in particular the employee which is authorized to grant reservations) is the executor. Line 5 can be interpreted as an announcement made by the caller, of the reason for calling. It is the first part of the actagenic exchange: a request for the reservation of a hotel room. This sentence is concerning C's wish or want to make a reservation for a single

room for tonight. In this sentence there is no explicit reference to the addressee, to the one that will make the reservation, however we assume that the sentence is concerning client's want that the hotel (in this case the addressee) will do the act of making the reservation for a single room.

After the request there are some informative exchanges. There are several question-answer pairs, some of them followed by feedback or stimulation. The question-answer pair in line 12 and 13 respectively is followed by feedback. In particular, the hotel repeats the answer of the client in line 14, and indicates that the provided information is sufficient. By stimulation the speaker expresses items like: 'mmm', 'yes' in order to encourage the other participant in the conversation to continue or to express a sign of attention. For example by the expression of 'mmm' in line 17 the hotel stimulates the client to continue in answering the question expressed in line 15.

Line 8: the expression of 'Okay' by the hotel, can be interpreted as the interactional act of promising and at this point the actagenic conversation of the transaction is finished. The client informed the hotel about the preferred period and date for reserving a room and about the preference with regard to the type of room. So, the information necessary for a successful execution of the action is known. Now the transaction moves on to the execution of the objective action. The actual execution of the objective action is not observed, but there might be an indication that the hotel is registering the reservation. The hotel puts the name of the guest on the list of rooms that are occupied in a specific period. In line 26 there is an indication of the statutive interactional act stating that the action is executed: 'I noted this.....' It is the first part of the factagenic conversation and the second part is expressed in line 30. The acceptive act is expressed by the client implicitly by the utterance: 'Thank you very much'. According to us the client agrees by means of this expression, with the result of the executed action.

From interviews we obtained the additional information that the client receives a fax or letter for confirmation. The hotel requests the client to check whether the reservation information in this confirmation letter is correct, if so, sign it and return it to the hotel. When the reservation information is not correct the client is expected to contact the hotel. If the client does not return the confirmation signed for agreement, nevertheless the room will be guaranteed until six o'clock in the afternoon on the day of arrival. So, when the client does not appear on the day of arrival, such as agreed upon telephonically, the client still is obliged to pay for the hotel residence.

The conversation ends with a so-called closing section. Line 30 and 31 can be conceived as pre-closing items. Although we interpreted line 30 already as an acceptive act, the expression of thanks is also a pre-closing item. This expression is oriented to the specific content of the first topic slot of the call, namely a request for the reservation of a hotel room. Line 32 is a final greeting.

Table 2 is the application of the hierarchical business conversation model to the example conversation. There are remarkable issues in the application:

- * we notice a lot more of interactional acts in the actual business conversation in comparison with the model. In the model we did not include the peripheral exchanges: opening and closing. These exchanges do not contribute to the performance of the transaction.
- * we notice more interactional acts in the informative exchange. These acts contribute to a natural course of the conversation and have to do with politeness, common use and conventionality in the context of hotel reservations. However they are of no real importance for the execution of a transaction
- * a lot of interactional acts are expressed by means of indirect illocutionary acts. For example the expression in line 8: 'Okay', can be analyzed as an exclamative. We stated before that the logical sense of the sentence and/or the situational context of the expression determine which category the utterance belongs to in the conversation. Therefore line 8 can be interpreted as a promise. According to us it is a response to C's wish or want to make a reservation for a single room for tonight.

In table 2 the application of the hierarchical conversation model to the actual business conversation is represented. In table 3 we describe the realization and definition of the interactional acts in the example conversation. With this we have tried to bridge the gap between the interactional and illocutionary acts. Table 3 presents the actual realization of interactional acts performed by illocutionary acts. An interactional act can be realized by merely expressing an item like: 'yes' (line 21). This expression has the (interactional) function of stimulation. An interactional act can also be an utterance in the interrogative form like line 9 or 15. So, an interactional act is perceived from its function within (an) other discourse unit(s) and an illocutionary act is the linguistic realization of it. Both, in table 2 and 3 the numbers in the last column correspond to the lines in the example conversation in section 3.

COMMUNICATIVE UNIT					GRAMMATICAL UNIT	
Level 1		Level 2		Level 3		Level 4
BUSINESS TRANSACTION ANALYSIS	business conversation	EXCHANGE	opening	INITIAL	greeting identification	INITIAL 1,3,4 2
			informative	INTERACTION	<i>question</i> <i>answer</i> feedback stimulation	OTHER 6, 9, 12, 15, 23, 27 7, 10, 13, 16, 18, 20, 22, 24, 28 11, 14, 25, 29 17, 19, 21
			actagenic	INITIAL	<i>request</i> <i>promise</i>	INITIAL 5 8
			factagenic	INITIAL	<i>state</i> <i>accept</i>	OTHER 26 30
			closing	ACT	thanksgiving 1 thanksgiving 2 final greeting	ACT 30 31 32
	non-linguistic part					

Table 2. The application of the hierarchical business conversation model

interactional acts	realization and definition	example conversation
Greeting	realized by items like: 'hello', 'hi', 'good morning'. Its function is greeting or introduction to the conversation.	1, 3, 4
Identification	realized by the class of proper names or by the expression of greetings merely. Station identification is a display for recognition and self-identification is a claim that caller recognized the recipient.	2
Question	realized by an interrogative. Its function is to request a linguistic response.	6, 9, 12, 15, 23, 27
Answer	realized by an assertive. Its function is to provide a linguistic response which is appropriate to the question and by which the speaker is committed to the truth of the expressed proposition.	7, 10, 13, 16, 18, 20, 22, 24, 28
Feedback	realized by items like 'okay', 'yes', 'good'. Its function is to indicate that speaker has heard and that the information suffices the speaker or realized by words or phrases which are a repetition, expressed in assertive form. Its function is a check of understanding and/or an acknowledgment of attention.	11, 14, 25, 29
Stimulation	realized by a class of items like: 'yes', 'mm'. Its function is to encourage the speaker to continue or to express a sign of attention.	17, 19, 21
Request	realized by a(n) (polite) imperative. Its function is to get a non-linguistic response, to get the hearer to do something. Or realized by a question for the availability of something. In this case the expression is in the form of an interrogative and is a request for a non linguistic response. Another possibility is an expression in a declarative form in which the speaker opts for something.	5
Promise	realized by an assertive. Its function is to commit the speaker to an action in the future. A positive reply to a question for the availability of something can also be interpreted as a commit to an action in the future. Or merely realized by an acknowledgment by items like: 'yes', 'okay', 'all right'.	8
State	realized by a declarative. Its function is to guarantee the correspondence between the proposition and the world. The state of affairs are brought into existence by merely declaring it to exist.	26
Accept	realized by items like: 'okay', 'yes', 'good'. Its function is to indicate that speaker is content or agree with the results of linguistic or non-linguistic action performed by the other participant in a conversation.	30
Thanks-giving	realized by a class of items like: 'thanks', 'thank you', 'thank you very much'. Its function is to express appreciation for the performance of an action or to express appreciation for confidence.	30, 31
Final Greeting	realized by a class of items like: 'bye-bye', 'so long'. Its function is to greet at the end of a conversation.	32

Table 3. Classes of interactional acts

6. Conclusions

In this paper we have presented a hierarchical model of business conversations in order to handle the structure and coherence in these kinds of conversations. Starting point for the sequences of communicative actions in business conversations is the transaction concept, the core notion in a communication centered business analysis method called DEMO. The transaction concept is a detailed pattern of action and communication by which business processes carry on. According to this pattern speech acts are the constituent parts of larger structures, namely actagenic, factagenic and informative conversations.

In DEMO the speech acts in the actagenic, factagenic and informative conversations are represented in an explicit notation which enables to separate the participating actors (speaker and addressee in their role of initiator or executor), the illocution and the proposition. The similarity in the propositional content of different acts indicates that they belong to the same transaction type. Just because of the clearness of the pattern of communicative acts in a transaction and their explicit notation, the transaction concept serves as a useful conceptualization of the communication along which people coordinate their efforts in an organization.

Nevertheless in the actual realization of business conversations the structure is hardly ever explicit. This observation is related to two issues:

- the pattern in real-life business conversations is not as straightforwardly as is supposed in the transaction pattern. In our example conversation we noticed that there is still an informative conversation about the name of the client after the commissive act performed by the hotel. In the perception of DEMO the propositional content of the transaction in question must be clear before the actagenic conversation is finished. Next to that, in real life business conversations we observe more 'encumbrance', a lot of expressions are contributed to a natural course of the conversation. They are conventional in the context of a hotel in which the intention is to be a friendly and helpfulness one.
- a lot of communicative acts are performed indirectly. The explicit notation of the speech acts in DEMO is a rather idealistic version. In order to interpret the speech acts in real life business conversation correctly, we have to consider the context of the actual realization of these acts. The explicit notation of speech acts in DEMO is a helpful aid in achieving such a correct interpretation. Next to that, the role of the participants in the conversation (especially relevant in task-oriented conversations) is important. The one who contacts the reservation desk is the initiator of the transaction reserving a room and the one who accepts the call is the executor of this transaction.

The hierarchical conversation model focuses on the constructing elements of a business transaction in detail and on the interactional function of individual expressions. By the application of the hierarchical business conversation model to real-life business conversations we are able to establish their structure and coherence. So, this hierarchical model provides for an improved understanding of the course of business conversations and their constituting expressions.

There is one bottle-neck in the analysis of real life business conversations: the relationship between interactional acts and illocutionary acts. As we stated before there is no one-to-one mapping of illocutionary and interactional acts. Interactional acts are realized or manifest in one or more illocutionary acts. In this paper we have described the realization and definition of interactional acts in table 3. With this we have tried to bridge the gap between the interactional and illocutionary acts but additional research on this topic is necessary

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