The aspect-phase model from the viewpoint of LAP and OS

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Abstract
Cognitive science (CS), the language action perspective (LAP) and organizational semiotics (OS) can be seen as complementary perspectives. Several authors have successfully combined elements from these three perspectives. The aspect-phase model is an abstract model of financial control in government organizations. For an analysis of this model we select appropriate instruments from OS and LAP that are also useful in multi-actor simulations. After an explanation of the aspect-phase model, this is subjected to a first analysis. We learn from this analysis that distinguishing ontological knowledge, process knowledge and interaction knowledge is fruitful. A first analysis based on DEMO shows that aspect processes may run parallel while language actions cross over from one aspect to another and are connected sequentially. Furthermore, we see that the DEMO framework can bring structure in our analysis, and has the potential to reveal gaps in conversations. A first analysis in the field of organizational semiotics shows work unit states and work unit state transitions that are at the process level, and detail accounts (and aggregate accounts) that are at the ontological level. The existence of parallel processes might indicate entities at the ontological level.

1 Introduction

The economic transaction has been extensively studied by organizational semiotics and the language action school in several examples and cases. What would be interesting is to look at patterns not in the private sector, but in the public sector. The main activities in the public sector are the making and executing plans and rule systems. A budget is a kind of plan for expenditure/ expenses. The aspect-phase model is a rather abstract model of a government budget used for registering transactions and calculating the resulting positions of rights and obligations. The aspect-phase model has been the basis of a number of functioning information systems. This paper selects appropriate instruments from organizational semiotics (OS) and the language action perspective (LAP) for the analysis of the aspect-phase model and makes a start with the analysis of this model. The ultimate aim of this project could be to develop an OS and LAP alternative for the analysis patterns in chapters 6 and 7 of Fowler (1997), or to construct a financial control agent.

We explain why cognitive science, organizational semiotics and the language action perspective are complementary perspectives and discuss some earlier work combining CS, OS and LAP (section 2). Some characteristics of organizational semiotics and the language action perspective as we see it, including some specific modelling elements we use in our work, are explained (sections 3 and 4). The aspect-phase model is explained (section 5) and subjected to a first analysis (section 6). Finally, we wrap up what we have learnt from this exercise (section 7).

2 The combination of cognitive science, OS and LAP

2.1 Cognitive science, organizational semiotics and the language action perspective

One can see cognitive processing (studied by cognitive science), language actions (studied by the language action perspective) ands social constructs (studied by organizational semiotics) as three complementary perspectives. They are complementary if one looks at the time bands they have to do with: cognitive processing is at the cognitive band (100 ms to 10 seconds),

language action is mainly at the rational band (1 minute to 3 hours), while social constructs have an existence at the social and historical band (1 day to 300 years or more) (see table 1).

Scale (sec)	*Time units*	*Time band*	*Cognitive system*	*Language interaction*	*Social environment*
10^{10}	317 years	Historical			Institution (e.g., Parliament, University)
10^{9}	32 years	Historical			Human generation and time-dependent habits; Marriage
10^{8}	3 years	Historical			Government; Cooperation between organizations
10^{7}	116 days	Social			Making of laws; Project teams
10^{6}	12 days	Social			Internet auction
10^{5}	1 day 4 h	Social	Daily rhythm		Economic transaction
10^{4}	2 h 47 min	Rational	Organizational Task; Change of social context	Conversation	Typical appointment; Economic transaction
10^{3}	17 min	Rational	Organizational Task	Conversation	Economic transaction (e.g., buying a book)
10^{2}	1 min 40 s	Rational	Task	Speech act; Conversation;	
10^{1}	10 s	Cognitive	Unit task	Speech act	
10^{0}	1 s	Cognitive	Operations		
10^{-1}	100 ms	Cognitive	Deliberate act		
10^{-2}	10 ms	Biological	Neural circuit		
10^{-3}	1 ms	Biological	Neuron		
10^{-4}	100 μs	Biological	Organelle		

Table 1. Time scales of human action (partly based on Newell, 1990, p. 122)

They are also complementary in their subject: cognitive processing science studies the working of the human cognitive system, the language action perspective studies communication processes between humans (possibly aided by information systems), while organizational semiotics describes the elements of the invisible web of agreements, habits, norms, organizations, institutions, laws, plans, and so on that together form the social context in which people live. The human cognitive system enables speech acts, while conversations consisting of speech acts construct new elements in the fabric of social constructs. The other way round, social constructs form the social context in which conversations take place. The human cognitive system has to monitor social constructs in order to behave appropriately. Speech acts are important instruments to convey intention and knowledge decisive for the development of the human cognitive system.

Communicative interaction focuses at elementary speech acts (about 10 seconds, higher cognitive band) and conversations (1 minute to 1 hour, rational band). This means that speech acts and conversations generally take place within a social context that is relatively stable regarding the time scale of speech acts and conversations. The environment of a cognitive actor in terms of the active communities changes every 1 hour to 4 hours leading to the selection of the appropriate social constructs (higher rational band and lower social band). The social constructs themselves change at a much slower rate ranging from days to centuries (social band and historical band).

Noticing the complementary nature of cognitive science, organizational semiotics and the language action perspective, several authors have worked on methods and designs combining elements from these three perspectives.

2.2 Barjis, Dietz and Liu

Barjis, Dietz and Liu (2001) offer a combination of DEMO with the norm specification of organizational semiotics. The conditional links between transaction phases in the DEMO business process diagram can be specified by norms that result from a semantic analysis and norm analysis based on the MEASUR method. The semantic analysis is needed to identify the correct roles, objects, operations and other affordances that are needed in the norm specification. A similar analysis by Shiskov, Xie, Liu and Dietz (2003) identifies interaction patterns in terms of uses cases based on semantic analysis and norm analysis.

2.3 De Moor

De Moor (2002) combines elements of DEMO with the MEASUR norm specification. De Moor uses the terms ‘conversation acts’ for DEMO communicative actions, objective acts for DEMO essential actions, and conversation states for DEMO transaction states. Conversation acts aim at changing knowledge definitions. Conversations are influenced by their context. De Moor distinguishes internal and external (institutional) contexts. The internal context consists of the knowledge definitions semantically related to the knowledge definition being changed in the conversation. The external context consists of the knowledge definitions needed to select the users who can legitimately be involved in a particular conversation. Four types of knowledge definitions are distinguished:

1. type definitions that determine the ontological meaning of concepts (definitions of the properties of actor, object, and process entities, including the events that automatically trigger actions in workflows; this in a type hierarchy);
2. state definitions that capture states-of-affairs;
3. action norms that specify acceptable operational behaviour;
4. composition norms that specify acceptable change behaviour.

De Moor explains an application in which norms are used by the workflow/ specification system for selecting the appropriate participants in a conversation. Norms are selected based on the type of knowledge definition to work on and the type of definition process to be performed, thus creating a so-called external context for the conversation. Using these norms, participants are selected, assigned a role (initiator, executor, or evaluator), and informed about the actions they are expected to do based on a distinction between obligatory, allowed and forbidden actions. Norm components used in RENISYS are the deontic effect, the actor, the control process type (action or composition), and the target process type (workflow or specification process).

2.4 Gazendam, Helmhout and Jorna

Our contribution in this paper differs from the contributions of Barjis, Dietz and Liu, and of De Moor in two respects. Firstly, we base ourselves on the development of a multi-actor simulation model in which the actors have the capabilities of a cognitive architecture and use awareness of their social context to determine their actions. Secondly we use a more fine-grained model of social constructs including social construct states and several other enhancements of MEASUR semantic modelling to be able to monitor a changing social context. To explain our approach, we give a short overview of some earlier work.

In an earlier publication, we have explained a pattern for economic transactions (Gazendam, 2001). Categories that proved helpful for identifying object types were actor, transaction, subject of transaction (good or service), type, space and time. Semiotic operators (abstraction, combination and application) were used for finding derived object types like a collection of goods or a packaging structure. Economic transactions were seen to be composed of (sequentially) coupled DEMO transactions.

The process of construction of a social construct like a plan or design can be described as a multi-actor process (Charrel, 2003; Gazendam, 2006). This interaction pattern shows several stages of the work process on a plan (Gazendam, 2006). These stages are ordered sequentially in the sense that a subsequent work stage follows from a previous work stage. The stages are also connected by feedback loops because when a problem arises in a subsequent work stage, the work process may go back to a previous stage to find a more optimal solution.

Helmhout, Gazendam and Jorna (Gazendam, 2005; Gazendam, Helmhout & Jorna, 2006) use organizational semiotics as a source of inspiration for the modelling and specification of social constructs and social norms (see further sections 4.2 to 4.6). Social constructs and the related social norms are used in a computer simulation of a cognitive actor that is aware of its social context. The simulated actor is based on the ACT-R theory (Anderson & Lebiere, 1998), but has been improved in order to allow for distributed multi-actor simulations and the easy addition of new cognitive architecture components. The simulation model offers a simple but innovative connection between the action to be performed, the behaviour rules leading to that action, the norms influencing the behaviour rules, and the awareness of the social context in terms of affordances. The perceived physical and social context is the basis for the selection of the active norms. The actor adapts to changes in the physical and social context. Norms act as metarules, influencing the preferences for selecting a goal or behaviour rule, but not deterministically requiring it. The simulated actors can interact forming a multi-actor community, and are able to develop and follow social norms. From the sphere of the language action world, the illocution primitives of FIPA are taken as well as XML formats for messages between actors.

This shows that the concepts of organizational semiotics can be developed further and consequently used for the specification of a dynamic social context and of social behaviour that follows that state of that social context. Concepts taken from the language-action world and from multi-actor simulation turn out to be practically useful for the specification of messages between actors.

3 The language-action perspective

3.1 Interaction scenarios in the language action perspective

The language-action perspective[1] focuses on communicative actions and the actors performing these actions. Communicative actions produce messages with a proposition part and an illocution part. So communication, because of the illocution, triggers action of the addressee. Communicative actions enable coordination and create the organizational world we live in. Humans are actors. Human actors can act on behalf of an organization; in this case the human actor is an agent of the organization, and the organization can be seen as an actor. An *organization* is seen as (1) an agreement (a communicative fact) between the principals and other parts of the society, and (2) a pattern of everyday actions that is continuously reproduced through communicative acts of its agents. Organizations are constituted and maintained through communication. *Information systems* are organizational sign artefacts with action capabilities. This view on information system transcends a purely representational view of information systems. Information systems can also act as agents of an organization. Information systems are established through design actions. These design actions have a communicative character and also have a regulative force. Actions can be part of a *structured interaction* between actors, for instance a business interaction. Such an interaction has a default structure consisting of generic phases based on social convention. In the language-action perspective, the analysis of organizations and the related design of information systems typically focus on the charting of actions and language actions between actors within organizations, and between organizations conceived as actors. This charting of actions generally leads to interaction diagrams. Frameworks that offer basic concepts and typical patterns of interaction are used to sharpen observation and to standardize modelling. In our work we use the DEMO framework (section 3.2) and interaction levels (section 3.3).

3.2 DEMO

The DEMO theory (Dietz, 1996; Barjis, Dietz & Liu, 2001) is based on language actions. DEMO distinguishes performative conversations from informative conversations. In *performative conversations*, the effect is a change of the current positions of rights and obligations, while informative conversations only reproduce existing information. Furthermore, communicative actions are distinguished from essential actions. *Essential actions* are the actions that are the subject of performative conversations. There are two types of performative conversations: *actagenetic conversations* create an obligation for one of the actors to do some essential action, while *factagenetic conversations* create an agreement between the actors that the action agreed on has been performed. An actagenetic conversation, and essential action, and a factagenetic conversation together form a DEMO transaction, which is a kind of atomic communication and action pattern. A *DEMO transaction* consists of five (communicative) actions:

1. request for achievement (communicative action by the requestor of the achievement) by actor A;
2. promise to achieve (communicative action by the executor of the achievement) by actor B;
3. achievement (essential action by the executor) by actor B;
4. statement of achievement (communicative action by the executor) by actor B;
5. acceptation of achievement (communicative action by the requestor) by actor A.

[1] See for a more extensive explanation for instance Goldkuhl & Röstlinger (2003).

The actagenetic conversation consists of actions 1 and 2, the factagenetic conversation consists of actions 4 and 5. The DEMO transaction can have six transaction states, namely before its beginning and after each action.

3.3 Interaction levels

Interactions can be defined using three perspectives: the cognitive view, the economic view, and the language action view (Gazendam, 2001). Language action occurs at a time scale of 5 to 30 seconds (the cognitive band), and corresponds to the *unit tasks* of the cognitive view. In the *DEMO transaction*, there may be long periods between the relevant actions. It is a *non-dense description*, while the cognitive time band description is a *dense description*, a description without time gaps in it. A *conversation* is a dense network of language actions and essential actions. In its simplest form, a conversation consists of a message and a message in reply, e.g., a question and an answer. The conversation and its preparation can be seen as an organizational action. The economic transaction view is even less dense than the DEMO transaction. An *economic transaction* is defined based on the concept of achievement. An achievement is change of the legal positions of the participants based on, for instance, the transfer of property rights with respect to an object, the transfer of other rights, the transfer of property of money, and the rendering of a service. In most cases, an economic transaction consists of an achievement and achievement in return. Each economic transaction will consist of a network of DEMO-transactions. The DEMO-transactions that make up an economic transaction may be connected sequentially, or sequentially with feedback, or may occur in parallel.

We conclude that it is useful to distinguish several levels of interaction, namely:

	Interaction level	Studied by
1.	economic transaction (non-dense).	OS, LAP
2.	DEMO transaction/ organizational use case (non-dense);	LAP
3.	conversation/ organizational task/ information system use case (dense);	LAP
4.	language action/ unit task (dense);	LAP, CS

4 Organizational semiotics

4.1 Organization, information field and social norms

Information field based organizational semiotics (the Stamper[2] school of organizational semiotics) is based on the idea of an information field (Stamper, 2001; Liu, 2000). An *information field* is a set of shared social norms that express knowledge about desirable, acceptable and exemplary behaviour in a community. This shared knowledge generally has been accumulated during many generations. An *organization* is such a community in which the information field enables people to behave in an organised fashion. The shared social norms in an information field can be seen as generating forces that make the members of a community tend to behave or think in a certain way. Organizations, especially bureaucratic organizations, can be described in terms of cultural and legal norms that regulate people's behaviour. For instance, a shelf of legislation defines everything the social security bureaucracy should do. Social norms are dependent on the consensus formed in a community.

[2] See for an overview of Stamper's work Gazendam & Liu (2004).

Therefore, social norms are thus valid in this community only. The concept of information field expresses this community-dependent character of social norms.

Norms are socially constructed, and every socially constructed part of the world has a beginning and an end. The information field (based on social norms) is an alternative for the information systems concept (generally based on information flows). Although the concept of 'information field' was developed independently of the concept of 'semiotic Umwelt' (Von Uexküll & Kriszat, 1936/ 1970), you could say that an information field is the form that the semiotic Umwelt takes for a person living in a community. Because each person generally lives in several communities (family, work, religious community, club, country, and so on), the semiotic Umwelt for a person is composed of the information fields of the communities he or she participates in.

4.1.1 Social norms

Social norms can be described in a precise way so that they can be used in the development of (computer-based) information systems. For each norm, a condition, a triggering state, a responsible agent that has eventually to take (or avoid) action, a deontic operator, and the action to be taken (or avoided) can be specified. The deontic operator specifies whether the action MAY, MUST, or MAY NOT be taken. Norms can specify that if something X is the case, the actor with role R should interact with another actor with role Y according to interaction script Z. In this way, an interaction script can refer to many roles. Roles can be filled by specific people, animals, computer actors, or objects. Furthermore, for each norm the start time, the starting authority, the finish time, and the finishing authority can be specified. This focuses the attention on the fact that social norms are only valid during a limited period of time and in a specific community, and are created by the people that have the authority to do so.

4.1.2 Affordances

As an alternative to the basic notions of the mainstream in the FRISCO group, namely perceptions and conceptions, Ronald Stamper has posed affordances and signs[3]. Affordances stress the interaction between a human agent and its environment based on behaviour patterns that have evolved over time in a community. Signs stress the social construction of knowledge expressed in sign structures. Ronald Stamper sees *affordances* as repertoires of behaviour and distinguishes physical affordances and social affordances. *Physical affordances* are repertoires of behaviour attached to the recognition of properties of the physical environment that afford certain behaviour, while *social affordances* are repertoires of behaviour tuned to the social environment. Because a person's knowledge of physical affordances strongly depends on the knowledge that has been built up and has been handed down from generation to generation in a community, these physical affordances are social in nature as well. For instance, a car affords driving by humans and transportation of humans and other species from one place to another. Such a physical affordance often has norms attached to it based on an associated social affordance. For instance, a car generally will be associated with ownership, and ownership has norms attached to it regarding who is allowed to decide about the use of the car.

[3] We have distinguished the *Gibsonian affordance*, namely, a set of properties of the environment that is perceived as a Gestalt because of the actions it possibly allows (Gibson, 1979), from the *Stamperian affordance* (Stamper, 2001), namely, a repertoire of behaviour of a human or animal actor towards a Gibsonian affordance (Gazendam, Helmhout & Jorna, 2006).

4.1.3 The information field

The *information field* can now be seen as a set of physical and social affordances that are shared in a community. Social norms can be seen as specifications of normative patterns of behaviour attached to a social construct. Special norms are attached to each construct type governing the creation, annihilation, and use of particular affordances belonging to that type. Social affordances can be seen as *social constructs* existing as signs that can be created and annihilated by agents having the appropriate authority. Social affordances are socially constructed, and social constructs afford actions in a social context. Therefore, we see 'social construct' and 'social affordance' as the same.

4.2 Social constructs

A *social construct* is a socially shared, negotiated concept (for instance, 'property', or 'marriage') to which attributes like norms and default behaviour patterns are attached (Gazendam, 2003). An important characteristic of social constructs is that they exist over a period of time; their lifetime may vary from days to centuries, which means that they belong to the social and historical time bands (see table 1.). Sometimes, these social constructs have the character of contracts between agents. Once they exist, social constructs afford, that is, authorize and stimulate, certain behaviour patterns of the agents concerned. A social construct may be the prerequisite for another social construct.

There are numerous ways of describing behaviour patterns (habits of action) and most require the use of some form of socially shared conceptual entity that is not directly perceivable, like organization, task, plan, goal, problem, rule or norm. In other words, for effectively describing social behaviour, we need a social level of description and social constructs.

Social constructs have an existence as socially negotiated concepts expressed in publicly accessible sign structures and as knowledge and patterns of behaviour realized in persons. A social construct must be identified by the actor based on the remembrance of the authoritative act or ritual in which it was created (a physical situation), or of authoritative registrations of this act, or of authoritative documents stating the content of the social construct. In some cases, when no authoritative rituals, registrations, or documents can be accessed, a social construct can only be deducted by observing people's behaviour in certain roles in a community, or must be deducted by experimenting with behaviour patterns. This means that the perception of a social construct is always indirect and based on the perception of signs or the deduction from behaviour patterns.

The *identity of a social construct* is derived from the authoritative sign expressing the affordance. This sign often has an authority, name, time and place attached to it. For instance, a law is signed by the queen at a certain date at a certain place, given a specific name, and is published in the Statute Book (in Dutch: "Staatsblad"). In case of a verbal agreement, the social construct refers to the situation (including actors participating in the agreement, authorities and witnesses present, time and place) where the agreement was made. Once the identity of the social construct is established, the content of the social construct in terms of the actions it allows must be detected by manipulation, experimentation, or consumption (Morris, 1938, p. 121). This means, for instance, reading the authoritative documents for detecting the usual procedure for establishing an instance of a social construct (for instance a marriage), the defined roles, and the norms for each role.

A social construct defines roles and tasks, refers to an authoritative document, and defines behaviour patterns in the form of for instance norms and interaction scripts.

In our work, we distinguish social constructs at the type level and at the instance level (section 4.3), see social construct as parts of the state of the social context (section 4.4), see ongoing processes also as social constructs and distinguish substates of social constructs (section 4.5), and finally distinguish five levels of knowledge about social constructs (section 4.6).

4.3 Social constructs at type level and at instance level

A social construct can exist at the type (universal) level or at the instance (particular) level (Salter, 2003). A social construct at the type level is, for instance 'property'. This social construct is described in several laws that also state appropriate behaviour based on property rights, and is recognized as such in common knowledge and behaviour patterns. The laws and other sign structures at the type level contain patterns that contain variables (like a person, a citizen, a legal person, and so on).

A social construct at instance level regarding 'property' is 'the yellow recumbent bicycle of brand Sinner with serial number 00637 is the property of person Martin. At the type level, a social construct generally has other dynamics than at the instance level. For instance, the mechanisms to change the responsibilities of the pope are quite different from the dynamics of the start, existence, and finish of the appointment of a person in the role of pope. There are several types of ontological dependencies. An instance level property social construct will be dependent on the appropriate (community-dependent) type level social construct. Type level social constructs can have an ontological dependency relationship. Instance level social constructs can also have an ontological dependency relationship. A social construct with the roles filled is at the instance level; a social construct at the type level generally does not have its roles filled.

4.4 Social constructs as parts of the state of the social context

If a social construct is the basic part of the social context an actor wants to monitor in order to determine appropriate actions, a social construct should correspond to a *state* that has a beginning and an end (Cordeiro & Filipe, 2005, Gazendam, Helmhout & Jorna, 2006). Social constructs should be able to describe the social context together, so they should allow composition. Thus the *state of a social context* is a composition of the states of all participating social constructs. The composition of social constructs knows restrictions because of ontological dependency (some social construct A is ontologically dependent on social construct B if B must be present during the existence of A). If an action allowed by an affordance is performed, this does not change the state of the social system in terms of affordances, unless the action explicitly creates a new affordance. In this respect, the affordance model differs from the usual UML state diagrams. To create a new affordance the actor performing the action must have the appropriate authority.

4.5 Social constructs as process and social construct substates

The problem is that many social constructs correspond more to a *process* than to a state that has no ongoing activities. A process is characterized by doing a sequence of actions (instantaneous) or activities (requiring time) according to some pattern repeatedly while some condition is true. It corresponds to a special type of state in which the process is running. For instance, a shop employee must perform the activity of selling during working hours. Processes as well as other social constructs may be *complex* because they have substates or stages. The social construct of marriage (at the instance level), for example, is a relationship with the possible substates of, amongst others, to be unmarried, married, and divorced. It might be best to conclude that a social construct may correspond to a process (in the sense of the state that the process is running), and that social constructs may be complex in the sense that they have several substates (Gazendam, Helmhout & Jorna, 2006). A process is a special

social construct that can have phases as substates. In general, a social construct will have substates. In the simplest case, a social construct will have the substates start (means before the social construct is active), active, and end (after the social construct has been active).

The identification of the substates of a social construct allows a more *fine-grained understanding* of the behaviour attached to social constructs. Once these substates are identified, afforded behaviour patterns can be attached to substates and to state changes of the social construct. The behaviour of actors can be described in several ways. For instance, it can be described in the form of a script, with actors filling roles. Another way to describe behaviour is based on a checklist, which is an unordered pattern of actions that have to be completed. An example is the interaction between user and information system based on filling in fields in a window, ticking checkboxes, and so on. The activation of the window corresponds to an affordance that allows for all action possibilities on the window, in a sequence that is not determined beforehand. Only when a button OK is clicked, the affordance state is changed, and other actions may be allowed. With the usual state chart model, the model would be more complicated.

4.6 Levels of knowledge about social constructs

For monitoring the social context, social constructs can be modelled at several levels (Gazendam, Helmhout & Jorna, 2006):

	Modelling level	Studied by
1.	Communities, actors, social constructs, roles, and tasks (ontological knowledge);	OS
2.	States/ stages of social constructs and state/ stage transitions (process knowledge);	OS, LAP
3.	Interaction scripts (interaction knowledge) (De Moor's external conversation context);	LAP
4.	Norm specification (normative knowledge);	CS, OS
5.	Task specification (task knowledge and domain knowledge) (De Moor's internal conversation context).	CS

The top level social construct chart, *the ontology chart*, shows communities, actors, social constructs, roles, and tasks. Organizations and institutions can have a role as communities but also as actors, in which case they are represented by human agents. To understand the behaviour of human *actors*, we want to know what roles actors play and what tasks they have. A *role* can be interpreted as a position of authority, rights, responsibilities and obligations. A *task* is part of a role, often a responsibility to do something. The *social constructs* are for instance: organization, institution, authority, responsibility, property, transaction, object of property or transaction, contract, law, regulation, plan, budget, and model.

The *process chart* shows what happens inside a social construct. It shows the states of the social construct, connected by state transitions. For each state change there is an authority representing the community, and there may be additional roles as well. Each state change corresponds with an interaction pattern creating it.

The *interaction chart* shows an interaction pattern of roles of actors. This interaction pattern can be associated with (1) a task that has to be performed as a result of the authority and responsibility of actors within a social construct, (2) a task that effects a state transition of a social construct or (3) the task of enforcing a social construct. After making the interaction chart, we can go on by specifying norms and tasks.

5 The aspect-phase model

5.1 Types of budgeting systems

In the world of financial control in government, four types of budgeting systems can be distinguished (Mulder, 1995; Granof, 2005):
a. the encumbrance system;
b. the acquired rights system;
c. the cash system;
d. the system of assets and debts.

The first three systems are transaction-based and expenditure-oriented. The entries in the registration are based on the occurrence of transactions. As soon as a transaction occurs, the amount paid or received (or to be paid/ received) is registered. Expenditures have to be distinguished from expenses. *Expenditures* are decreases of the financial resources, whereas *expenses* are decreases of the value of the assets. A budget balance is decreased at the moment a transaction leading to expenditure is registered. The *encumbrance system* registers an expenditure as soon as an obligation is created for instance by placing an order, giving an assignment, or deciding about a request for funding. This obligation may be cancelled when the other party does not deliver the required achievement, for instance deliver the goods ordered. At the side of revenues, obligations are registered in the same way. In the *acquired rights system*, expenditure is registered when the other party acquires an unconditional right to be paid by delivering the required achievement (like delivering a good or service, or showing the qualifications for subsidy). Revenues are registered when unconditional rights on them are created. The acquired rights system is more or less the same as the modified accrual system that is widely used in the USA. In the *cash system*, the actual payment transaction is determining for registration. The *system of assets and liabilities* is expense or value-oriented rather than expenditure oriented. This system uses the traditional system of double bookkeeping to have a check on errors and to have an overview of the current value of assets and debts. For calculating the decrease of the value of assets, a system of depreciations is used. A budget balance is decreased as soon as there is an asset decrease. This system is oriented towards the creation of value. The system of assets and liabilities is also known as the full accrual system. In the Netherlands, the central government works with a combined encumbrance/ cash system, while the municipalities work with a system of assets and liabilities.

5.2 The aspect-phase model

At a somewhat higher level of abstraction, the four budgeting systems have many common characteristics. Each system knows *phases* like draft budget, approved budget, request (for government contribution, for performance acceptance, for payment), estimated expenditure/ expense, actual expenditure/ expense, and report. The systems differ because they want to control other moments in the financial process or *value cycle*[4]; these points of financial control we will call *aspects*. The aspect of encumbrances more or less corresponds to the activities of purchasing (and selling), the aspect of acquired rights more or less corresponds to creating debts (owing and outstanding), the aspect of cash corresponds to paying and cashing, and the aspect of value, adding value and making costs of the system of assets and liabilities

[4] The value cycle is the cycle of the different manifestations of value and the activities that transform value in an organization. For instance, the buying activity transforms value in the form of money into value in the form of acquired goods and services, the production activity transforms goods and services into value in the form of products, the selling activity transforms products into value in the form of money, closing the value cycle (Starreveld, de Mare& Joels, 1994, p.82).

can be recognized (with some effort) in the activity of producing. A model distinguishing aspects and phases as separate dimensions is an *aspect-phase model* (Wisse, 1991). If systems are combined, like in the integrated encumbrance/ cash system, one can make a two-dimensional aspect-phase model an action in phase p in aspect A has consequences for the action in phase q of aspect B.

For instance, ordering a computer leads to an actual expenditure in the encumbrance aspect, which has to trigger one or more estimated expenditures (cash flows) in the cash aspect. Another example is that, if a payment is made, and no corresponding obligation can be found, the corresponding obligation could be automatically created and approved, or the payment might be rejected. The basic idea behind the aspect-phase model is that each aspect is ontologically dependent on what happens in predecessor aspects because a payment should not exist without an achievement, and before that, an order. Each aspect also has an independent life cycle in terms of phases. The financial control system has to maintain the consistence of the aforementioned ontological dependencies.

The relationships between the phases within an aspect of an account can be seen as *execution relationships*, while the relationships between different aspects of the same account can be seen as *conditional relationships* (the transactions within an aspect are restricted by the state of the previous aspect) or *estimation relationships* (a transaction in an aspect leads to the estimation of expenditure in a subsequent aspect). For instance, If there is a value aspect (corresponding to an assets and liabilities system), the computer order can also lead to an estimated decrease in value (expense) at several future moments based on depreciations and estimated costs. The aspect-phase model allows an easy insertion of new points of financial control by adding new aspects and/ or phases.

One can now imagine that the total bookkeeping system of a government agency is subdivided in accounts and aspects, where each account/aspect combination has a budget. For each account/ aspect combination there are a number of phases, minimally two, namely budget and expenditures/ revenues (expenditures are just negative revenues). For each account/ aspect/ phase/ institution combination there is a detail account and an associated register in which all transactions are recorded. The extent to which an approved budget account still has room for spending can be calculated by taking the approved budget account total and subtracting from it the connected actual expenditure account total (the computer can do this in milliseconds).

5.3 Extending financial control using the aspect-phase model

The financial control system based on budgets is based on the idea that each financial transaction should be approved only if there is no budget overrun. Alternative financial control systems are based on the idea that the available production capacity should be used optimally (process control) or that value creation should be maximized (output control) (Gazendam, 1999). *Process control* is appropriate for organizations with a large investment in a more or less fixed production capacity, like automobile factories or railway companies. The key decision is about the optimal production plan (or set of related production plans); activities and orders that do not fit in the optimal production plan have to be rejected. In such a process-oriented production systems, enterprise resource planning systems have boomed (Scheer, 1994). *Output control* is appropriate for organizations that have a flexible production capacity and/or sales capacity that can accommodate changes in demand for products. The key decision is about order acceptance, the order has to be produced cost-effective. These decisions are taken now-a-days supported by activity-based costing systems.

The aspect-phase model can be applied in a diversity of situations by selecting the events one wants to control and making aspects out of them. Events to be controlled could be (Gazendam, 1999):
In budget control (control aimed at restricting expenditure):
- accept request for expenditure (leads to estimated expenditure);
- commit expenditure under conditions of achievement (leads to encumbrance);
- accept achievement (leads to acquired rights);
- pay (leads to cash flow);

In process control (control aimed at optimization of processes):
- use of materials by organization units;
- use of personnel and other costs by organization units;
- depreciations to the account of organization units;
- program costs (contributions and subsidies to other organizations based on laws, regulations and contracts);
- use of means of production by activity;
- use of activities by product;

In output control (control aimed at value creation):
- request for delivery of product or service;
- promise to deliver product or service in return for payment (selling transaction);
- achievement (delivery of product or service);
- request for payment;
- payment for delivered product or service.

6 An analysis of the aspect-phase model

6.1 An analysis based on DEMO

In this analysis, the idea of DEMO is used that there is first an actagenetic conversation, then an essential action, and then a factagenetic conversation is used.
The aspects of the aspect-phase model are:
a. encumbrances,
b. acquired rights,
c. cash, and
d. value.

The *phases* of the aspect-phase model are
1. draft budget (MA and MF),
2. approved budget (MA and P),
3. request (for government contribution, for performance acceptance, for payment) (MA and I),
4. estimated expenditure (MA and MF),
5. actual expenditure (MA and I), and
6. report (MA and P).

The relevant actors are Minister A (MA), the Minister of Finance (MF), Parliament (P), and an Institution (I).

If we look at the actors that play a role in a phase, and look at the level of aggregation of the subjects of each phase, we see that the phases 2 and 6 belong together (actors: MA and P), and that the phases 3 and 5 belong together (actors MA and I). The two complexes phase 2+6

and phase 3+5 show a nested structure; phase 3+5 occurs within the context of 2+6. Phase 1 seems to follow a normal DEMO transaction pattern between MA and MF. Phase 4 has to do with the approval of the estimated expenditure of MA by MF. The two complexes phase 2+6 and phase 3+5 consist each of two DEMO transactions that are glued together in which the second DEMO transaction has no actagenetic phase. The essential action (2.3. or 3.3.) and factagenetic phase (2.4. and 2.5. or 3.4. and 3.5.) in the first DEMO transaction more or less act as an actagenetic phase for the second DEMO transaction. The first DEMO transaction can be seen as a 'request for requests'. As an example we give the communicative actions and essential actions in the complex 3+5:

3.1. MA announces that requests for government contributions from institutions can be sent in (A1);
3.2. missing (A2);
3.3. request of I for government contribution (E);
3.4. letter of I to MA concerning request for government contribution (F1);
3.5. MA notifies receipt of I's letter (F2);
5.1. missing (A1);
5.2. missing (A2);
5.3. decision to make expenditure regarding the request of I (E);
5.4. letter of MA to I stating the decision (F1);
5.5. missing (F2).

Now we consider that these transaction complexes 1, 4, 2+6 and 3+5 are valid for all four aspects. Then we consider the dependencies between aspects. On the one hand, aspects can be characterized as parallel processes (at the process level). On the other hand, at the level of language actions and conversations, a language action in aspect p may trigger a language action in aspect q, indicating a sequential coupling of language actions. For instance, the completion of a DEMO transaction a3 may trigger DEMO transaction c5. We learn from this analysis that we need to consider the process knowledge level as well as the interaction knowledge level, and that the aspect processes may run parallel while language actions cross over from one aspect to another and are connected sequentially. Furthermore, we see that the DEMO framework can bring structure in our analysis, and has the potential to reveal (possible) gaps in conversations.

6.2 An analysis based on organizational semiotics

The analysis in terms of social constructs looks at the social context and will discover that there are social constructs outside the aspect-phase model itself, like society, Parliament, the Minister A, the Minister of Finance, a number of applicable laws, the institution as a corporate body, the institution as an acknowledged institution, and the institution as qualified for financial government contribution. Within the aspect-phase system itself the detail account consisting of a combination of account, aspect, phase and institution comes into the picture (a kind of point in the four-dimensional account/ aspect/ phase/ institution space). Norms may describe conditional relationships, for instance that expenditures regarding an institution are restricted by the room for spending (RS) in the budget as well as by existing commitments regarding that institution. Other norms might describe estimation relationships or execution relationships.

The states in the development of a work unit (for instance a request for funding from an institution and its follow-up) have to be distinguished from the state of a detail account (for most account/ aspect/ phase/ institution combinations there will be a detail account). The work unit states can be seen as connected more or less sequentially because they follow the

logic of the life cycle of the work unit. The work unit states generally are a subset of the possible aspect-phase combinations. Each state transition of a work unit is accomplished by an interaction between actors. Each detail account has a register of transactions attached to it (this register is at the interaction knowledge level). Each detail account has a state variable (determiner): the balance of the transactions (BT) in its register that can easily be calculated. The approved budget detail accounts also have a state variable reflecting the room for spending RS that can be calculated by taking its BT and subtracting the BT of the connected actual expenditure detail account from it. For instance, the RS of an approved encumbrance budget (a2) is the BT of a2 minus the BT of the connected actual encumbrance expenditure (a5). The BTs and RSs of an aggregated account are easily calculated based on the BTs and RSs of its composing detailed accounts. The detail accounts evolve in more or less parallel processes. Each detail account changes as a result of interactions between the budget holder and other actors.

This all leads to a picture in which three levels of knowledge emerge: the level of the detail accounts evolving in parallel processes, the level of the work units having states that are more or less sequentially connected, and the level of the interactions (parts of the DEMO transaction pattern) that cause state transitions of work units. Maybe this means that the interactions between actors and their registrations in the transaction registers are at the *interaction knowledge* level, the work unit states and state transitions are at the *process knowledge* level, and the detail accounts (and aggregate accounts) are at the *ontological knowledge* level. The existence of parallel processes might indicate social constructs at the ontological level.

7 Conclusion

We learn from the analysis thus far that distinguishing ontological knowledge, process knowledge and interaction knowledge is fruitful. A first analysis based on DEMO shows that aspect processes may run parallel while language actions cross over from one aspect to another and are connected sequentially. Furthermore, we see that the DEMO framework can bring structure in our analysis, and has the potential to reveal possible gaps in conversations. A first analysis in the field of organizational semiotics leads to a picture in which three levels of knowledge emerge: the level of the detail accounts evolving in parallel processes, the level of the work units having states that are more or less sequentially connected, and the level of the interactions (parts of the DEMO transaction pattern) that cause state transitions of work units. Maybe this means that the interactions between actors and their registrations in the transaction registers are at the interaction knowledge level, the work unit states and work unit state transitions are at the process knowledge level, and the detail accounts (and aggregate accounts) are at the ontological knowledge level. The existence of parallel processes might indicate social constructs at the ontological level. A further analysis is necessary to elicitate the details of the ontology, of the work unit life cycle, and of norms for execution relationships, conditional relationships and estimation relationships.

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