

Business Architecture based on the integration of Communication, Actors and Production

Hans B.F. Mulder *Jan L.G. Dietz*
Delft University of Technology, *Delft University of Technology*,
Faculty of Mathematics and Informatics *Faculty of Mathematics and Informatics*
Patrijsweg 36 *P.O. Box 356*
2289 EX Rijswijk *2600 AJ Delft*
The Netherlands *The Netherlands*
hans.mulder@viagroep.nl *j.l.g.dietz@its.tudelft.nl*

Abstract

'Business Architecture' is a term referring to activities such as designing and defining business systems. Currently the dominant enabling technology in business architecture is communication and information technology. Before ICT, production technology and later the structure of organisations were dominant ways in shaping the business architecture. Of course before the 1990's business architecture was called by different names.

Current approaches regarding business architecture, originating from such areas as business administration, management science, informatics and logistics, fail to provide an integrated understanding of communication, actors, production and their realising technologies. A promising new kind of understanding is brought forward by the so-called language/action perspective. One of these approaches is known in the academic world, and for several years now in practice too, by the name DEMO.

This paper presents and elaborates on the theoretical foundations of the DEMO method. It is shown in detail that an integrated theory and modeling approach towards Communication, Actors and Production, is a necessary precondition for successfully carrying out business architecture projects.

1 Introduction and problem statement

The promise of the business architecture, as set forward e.g. in [2] and [4], is that the potential benefits of modern information and communication technology (IT) for organizations would really be exploited now, since it was fully understood then that IT was only a means to an end, an enabling technology, and that the real issue was the architecture of business systems¹. The term 'business architecture' became the appealing keyword to denote these issues.

Concurrently, it became evident, at least to a number of people, that the traditional knowledge regarding organizations or business systems, was not appropriate and sufficient to go about this new issue. At several places in the world, research groups started to investigate the possible practical contributions of the theoretical achievements of language philosophy, inspired by the pioneering work reported in [12]. The particular character of this research is commonly referred to as the language/action perspective [36], [37]. Several research projects and products fall in the L/A perspective. Among them are Action Workflow (cf. [25],[26]), Sampo [1], BAT [24] and DEMO (cf. [8], [9], [41], [42], [11]).

¹ With the term 'business system' we refer to a coherent part of an organization that brings about a (primary or secondary) business process. In this paper we do not draw however a strict distinction between the notion of organization and the notion of business system.

The purpose of this paper is to highlight the way of thinking of the CAP theory, an integrated approach towards Communication, Actors and Production that has proven to be a crucial success factor in business architecture projects. It will be introduced hereafter and elaborated in the subsequent sections.

In order to design a business architecture, appropriate knowledge of organizations is required. Many conceptual representations of organizations have been described in the literature like those identified by Morgan [1986] and Mintzberg [27]. A popular perspective is to regard an organization as a system of regulated flows of documents and goods, [34]. Business processes are considered to be managed and controlled by organizational structure and coordination mechanisms [13], [28], [29]. Many business scientist, such as Chandler [5], Porter (cf. [31],[32], [33], [34]), Hamel and Prahalad [14], [15], [16], [17], have suggested strategy-making and restructuring the organizational structure to achieve competitive advantage.

Since the publications of McFarlan [38], Cash and Konsynski [4], Porter and Millar [35] and notably Hammer [18], the awareness has grown that information technology may be a very powerful means to achieve higher performances of an organization and other desirable things, like flexibility. At the same time it has also become clear that in order to achieve this, one needs a thorough and appropriate understanding of the organization itself. The business architecture approach demands a different way of thinking about organizations, production and communication and their realising technologies. This line of thought is developed by Medina-Mora, Flores [26], Keen [23] and Dietz [8]. The first methodologies for designing organizations with information technology were introduced by IT-people, such as Chen [6] or Yourdon and Constatine [44]. In these early ISD methodologies a computer processor was roughly considered to be equal to a human processor. Organizations were (just like software) perceived as a limited set of procedures in which events trigger processes to transform data [20], [22].

At the same time, the professionals on the organization side, whom we will call from now on the O-people, have been equipped with organisational and production theories. The O-people tended to ignore the information and communication technology when designing a

business architecture. Moreover, they assumed that the organisation structure and production technologies were leading and ICT would follow their strategy. The application of organisational and production models have a long-standing tradition, e.g. in the fields of management science, of logistics, of economics and of business administration. These models are very appropriate and sufficient for dealing with management issues, for controlling the human behavior and production processes of a business system [11]. But are these models, such as the Porter's value chain [34], also appropriate and sufficient for developing an architecture for the communication and information of the business system?

Of course, there are several factors that determine the success or failure of a business architecture project, and the way one understands business systems is only one of them. Still, this is a crucial factor, and it happens to be badly recognized, often even seemingly denied.

The prevailing models among IT-people, as defined above, are the data model and the information process model. Since these types of model appears to be the ones needed for automating a business, it is tempting to let them do the job of developing an architecture for business systems. Actually they did and still do this job, all over the world, but unfortunately, they often don't do a good job. The cause of this is, that although they do possess the right type of knowledge, they do not recognize that business systems and information systems belong to different system categories.

Information systems belong to the category of conceptual or rational systems. The components of a rational system collect, distribute, contain and derive knowledge of facts about some world. They act upon each other by emitting commands to each other to perform these rational operations. The components operate in a rather mechanical way, i.e. a command is a cause for some effect, a stimulus to which there is a particular well-defined response. This mechanical understanding of how a system works fits perfectly well for rational systems, thus for information systems. The mistake many IT-people make is that they consider a business system as a kind of information system, and consequently apply the (rational) data model and information process model to understand business systems. They fail to recognize and appreciate then that organizations are

essentially social systems, not rational ones.

The foregoing sets the problem to be discussed and resolved in this paper. In the next section the notions of system and model are elaborated as well as the needed category of knowledge. The conceptual framework thus established is applied and further developed, in section 3, with regard to systems of the category on which this paper is focused: social systems, in particular business systems. Section 4 illustrates what the outcomes of the foregoing sections do mean for being practically occupied with business architecture. Section 5 completes the paper with a few conclusions that do have an impact on current practice.

2 System models and types of knowledge

Before discussing distinct types of system models, notably the communication model, the actor model and the production model, it seems worthwhile to spend some words on the notion of system itself. All the more so since there exists a variety of system definitions, and since the notion of system and the notion of model of a system often appear to be mixed up.

A scan of text books on systems from any category (so, biological or chemical or social) reveals that there are roughly two general kinds of system definitions: ontological definitions and teleological ones. Ontological definitions are based on empirical observation of what a system is, distinct from other observable things. Teleological definitions are based on the interpretation of observed behavior of a system. An example of a teleological definition is, that the heart is an organ that provides the vessels of a body with oxygenate blood. Another example is that an inventory control system controls the inventory of a company. Obviously, teleological definitions do not have an objective empirical basis, they are to be understood only by way of a metaphor, often of an anthropomorphic nature.

The system definition provided hereafter is derived from the very general and very exact ontological definition of the notion of system as provided by Mario Bunge [3]. It defines the class of discrete dynamic systems.

Something is a (discrete dynamic) system if and only if it has all of the next properties:

- It has composition, i.e. there is a set of constituent elements. The nature of these

elements determine the category to which the system belongs.

- It has structure, i.e. the elements influence each other's behavior, such that every element influences or is influenced by at least one other element, and such that there are no 'isolated parts'.
- It has boundary, i.e. the composition is divided in two subsets: the kernel and the environment. Every element in the environment only influences or is influenced by one or more elements in the kernel of the system.
- It has activity, i.e. the elements cause changes in the state of some world. The number of changes in any finite interval of time is finite.

The notion of subsystem is very exactly defined as follows. A system A is a subsystem of a system B if and only if the kernel of A is a subset of the kernel of B, the environment of A is a subset of the composition of B, and the structure of A is a subset of the structure of B.

By way of teleological additions, one could say that the purpose of a system, as defined above, is to expose the activity, and that the distinct activities of the elements are coordinated by the structural relationships (the influencing of each other's behavior). However, these additions do not have any empirical foundation.

For the purpose of studying systems, e.g. for analyzing their external behavior or their internal processes, we need to model them, i.e. to conceptualize the properties in which one is interested (while abstracting from all other ones), and preferably to formalize the conceived model.

For the purpose of integrated business architectures we are interested in the domains of ICT, organisation and production. Figure 1 shows the realising technologies of a business architecture.



Figure 1 The realising technology of a business architecture

3 Business Systems

As was discussed in section 1, the current ways of thinking concerning business systems of both the IT-people and the O-people, are both not appropriate. An appropriate way of thinking must encompass an

integrated model that applies to the category of social systems and which is comprehensive and compact to understand an entire organisation. To develop such a model is the subject of this section.

By way of a small exercise, start to think of an organization with which you are well acquainted. Think of it in an operation-oriented way, such that you see the activities, the work flows, the people that perform actions, the equipment they use, as well as the machines they operate. Now leave out all organizational structures, like the grouping of employees into departments and business units (or however these groups are called in your organization), and like hierarchical relationships. Having done this, you only see persons, the equipment they use and the machines they operate.

Next leave out all means for communication, information storage and information processing, like computers and networks, pencils, paper and filing cabinets. Having done that, you see a collection of persons that talk to each other and that do things, with or without machines. The picture of your organization you have created now, is called its OER-shape, its primal shape or archetype ('oer' is the Dutch word for primal; the reason for using the Dutch word will become clear later) [10]. Notice that in this OER-shape many employees do not figure anymore, e.g. the employees that operated and managed the computer applications and the computer equipment, as well as all office clerks.

Let us focus now on the communication between the persons, and ask ourselves the question: What do people do when they talk to each other? Because we dropped all technology, it has become rather easy to discover that the basic meaning of the word 'communication' is the sharing of thoughts between human beings. Because we are interested in business processes, we pay no attention to (private) communication that is not directly relevant for performing the business activities. This sharpens the picture of the organization further: we only see persons that communicate about some common world and that execute actions of which the effects are changes in that world. This world is called the object world. Likewise we call the collection of communicating persons the subject system. The word 'subject' emphasizes the important distinction between the talking persons and the things they talk about; it also stresses that these persons are human individuals, no artifacts.

In addition, it appears to be very convenient to abstract from the individual subjects and instead concentrate on the kind of things they do and communicate about. Such an abstracted role of a subject is called an actor. Every distinct actor role can be performed by one or more subjects, and every subject can perform one or more actor roles.

The communication that is left can be divided in two kinds: informative communication and performative communication. By informative communication is meant the dissemination of knowledge about the object world. It does not change the object world. *Performative* communication consists of requests and promises, of statement and acceptances, but also e.g. of declinations (of requests) and rejections (of stated results). The distinguishing property of performative communication is that it aims at bringing about changes in the object world [8],[9].

In both informative and performative communication, but most significantly in performative communication, the subjects are engaged in mutual commitments. With the notion of commitment we are at the heart of the category of social systems, of which organisations are a special kind. A social system is a system of which the elements are social individuals (human beings) who enter into and comply with commitments. This is the working principle of social systems, thus also of organisations. The entering into and complying with commitments takes place at the background of shared norms and values, and is directly related to the notions of authority and responsibility: every subject is allowed only to enter into (and consequently comply with) commitments for which it is authorized, and it can only be held responsible for those commitments.

The levels of abstraction

Among the IT-people it is very common to consider information systems at distinct levels of abstraction. A very wide-spread distinction is the one between the content and the form of information; in the terminology of semiotics [21]: between semantics and syntactics. This distinction is best known as the logical-physical or the functional-technical distinction among IT-people. Less common is the distinction of a level of abstraction at which one investigates the purpose and the effect of communication; in the terminology of semiotics: pragmatics and the social world [40]. These

distinctions are of great help, provided they are drawn clearly and consistently.

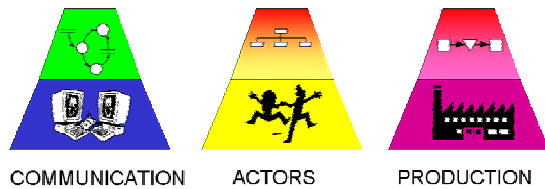


Figure 2 The first abstraction (rational, semantics)

Unfortunately, this is a weak point in many current methodologies. Hereafter three levels of abstraction are distinguished, all of them clearly defined and clearly distinct from each other. To explain them, think again of your organization, and leave out again all organizational structures. Then look successively at the three levels of abstraction. Figure 2 and 3 shows the first and second abstraction from the business.

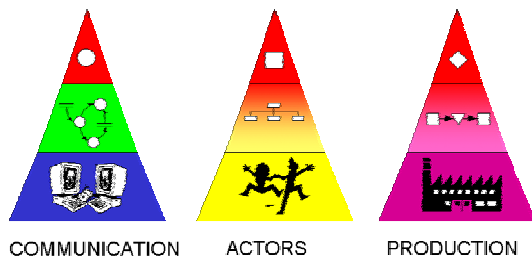


Figure 3 The second abstraction (social; pragmatics)

When looking at figure 3 you see what we had found in the first exercise already as the object system of the organization, as well as the corresponding intersubject world. The actors you see (actors are represented by boxes) carry through transactions (which are represented by disks) of which the results are produced (diamonds) in the object world. These transactions, as we have found, constitute the business systems.

The actors observed are exclusively social actors (human beings who only exploit their social capabilities, who enter into and comply with commitments). You do see them perform intersubjective actions, like requesting, promising etc., but you do not see how these actions are performed. The only relevant point is that they do make requests, promises etc. Because what you see now constitutes the essence of the organization, this

level of abstraction is called the essential level.

Looking at figure 2, you don't see the social actors anymore. Instead you see new, other actors (recall that actor is a role concept; you might see the same persons, but now in a different role). What you see them do is exchanging messages. However you only see the contents of the messages, not their form, so you are not able to tell whether they are spoken or written, or in what language they are expressed. In other words, you are only aware of the meaning of these messages. You also notice that these actors memorize facts (both of the object world and of the intersubject world) and that they calculate or derive new facts from existing ones. This level of abstraction is called the rational or informational level. The actors you observe are exclusively rational actors. Some of them are human beings who exploit their rational capabilities, others are artifacts, e.g. computer applications. Apparently and contrary to the essential level, the actor roles at the rational level do not need to be performed exclusively by human beings. On closer look you see that these rational actors not only exchange messages among themselves but also with the social actors on the essential level. You observe that the social actors use the rational actors as information agents and as oracles.

Looking at figure 1, you see again new, other actors. Immediately you notice that there are far less human beings than artifacts that perform the actor roles at this level. What all of them do is handle physical things of various substances that carry information. Let us consequently call this level of abstraction the physical level. The actors thus are formal/physical actors, they only exploit formal and physical capabilities with regard to goods and documents. You see them transport goods and documents, store documents, retrieve documents, copy documents and even destroy documents. The actors do not seem to know what the contents of the documents they handle, is. Moreover, they also don't seem to care. On closer look you notice that they also receive documents from rational-actors (computers and information systems), and that they let these rational-actors acquire knowledge of the contents of documents. However not all information distributed on the physical level is a result of supporting the social level! Because of inefficient organisational structures and production systems the need for inspection of information arises.

Organisational grouping by place and time instead of communication

When designing organisational structures O-people traditionally grouped the physical persons into departments by place and/or time (Mintzberg, [27]). The technology used for the production of goods often determined this grouping, resulting in a functional structure. An example of functional structure build around the production process consists of a design, assemble and a logistics department. A product structure organises the work in and coordination between the departments by products, for instance an television broadcasting, radio and internet department. Geographical grouping is another way of structuring by national or regional places.

What happens when O-people design organisations by functions, product characteristics or geography? Implicitly the place and (production) time are separating an essential actor in two or more organisational units, which leads to the need to duplicate communication, between the units so that they can perform the responsibilities of the essential actor. Unfortunately the design of communication is not an integral design task of O-people, but is the responsibility of the IT-people, which often leads to disrupted or missing information and coordination. Galbraith [13] has pointed at the issue of coordination when designing complex organisations in the sense that the strategy, rules, information systems or buffers are ways to coordinate actions between departments.

In [18] Michael Hammer describes the Ford case as a best practice reengineering example. Actually a disintegrated business architecture was described. Missing information between the purchase and warehouse department led to a dysfunctional actor, causing extra work for the accounts payable department. This lack of information was restored by Hammer, but nothing new was engineered. A DEMO architecture shows this need for communication in relation to actors at the essential level and can therefore be of help for O-people.

To make business systems really operational, there need to be some 'realization' at the rational level as well as some 'realization' at the physical level. An example is provided in the case study of this article. In the next paragraph the transaction concept is explained.

The transaction concept

Changes in the object world are brought about by executing particular actions, called objective actions. It is useful to distinguish between two classes of objective actions: material actions and immaterial actions. Examples of material actions are the manufacturing and the transportation of goods. Examples of immaterial actions are making a decision, passing a judgment and determining a position. The problem with immaterial actions is that the results can not be observed, they can only be made manifest through communication. Let us therefore look more closely to the relationship between objective action and communication.

It appears that an objective action is always preceded by a conversation and that it is succeeded by a conversation. Both conversations are performative and are carried out by the same two actors. The aim of the first conversation is to reach agreement about a future objective action to be executed by one of the actors, the aim of the second conversation is to reach agreement about the result of that objective action. This pattern of a conversation before an action, the execution of the action, and a conversation after an action, is called a transaction. The three phases of a transaction have been named order phase, execution phase, and result phase (cf Figure 4).

The order phase, or O-phase for short, of a transaction starts with a request of one of the actors towards the other one. The requesting actor is called the initiator of the transaction, and the other one the executor. The order phase ends successfully with the promise of the executor. It may however also end unsuccessfully, and in either case there has been a lot of communication back and forth before it ends [43].

The execution phase, or E-phase for short, consists of achieving the (material or immaterial) result the actors have agreed upon, by the executor. It may, and often does, involve the initiation of other transactions of which the results contribute to or collectively constitute the final result.

The result phase, or R-phase for short, starts with the statement by the executor that the agreed upon result has been established and ends successfully with the acceptance of the result by the initiator. Like the order conversation, this conversation may have an unsuccessful termination, and there may be a lot of communication back and forth before it terminates. (Note. The first letters of the phase names constitute

the word 'OER' which has in the Dutch language, as was mentioned in section 1, the meaning of primal and original.)

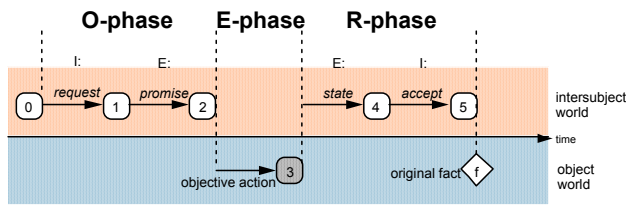


Figure 4 The transaction model

It is important to notice, as figure 4 demonstrates also, that the result of a transaction is not achieved after the objective action has been executed, but only when the result has been accepted by the initiator. This necessarily holds for immaterial actions, but it appears also to hold actually for material actions (one may easily find examples in many organizations that indeed not the physical establishment of a change counts as a new fact, but the authorized statement of it followed by the corresponding acceptance). Once more this illustrates that an organization is essentially a collection of social individuals, of human beings that enter into and comply with commitments towards each other. What these subjects constitute in their communication is what really counts.

In figure 4 the term 'intersubject world' is used to emphasize its intersubjective nature. The state of the intersubject world at some point in time is constituted by the collective statuses of all current transactions. The progression of these transactions is a very appropriate meaning for the term 'work flow'. Monitoring work flows then comes down to monitoring the succession of transaction statuses.

A state transition in the intersubject world is said to be the effect of an intersubjective action, analogous to object world and objective action. An intersubjective act thus is identical to an act of performative communication. The transaction concept as defined, is the universal building block of every business system. Conversely, a business system is a coherent structure of transactions, and a business process is the succession of statuses of these transactions. The most important thing to keep in mind about business processes is that they are sequences of commitments between authorized and responsible social individuals.

4 Casestudy of a framework architecture

In this section, the modeling framework as presented in section 3 will be elaborated. In particular it will be shown how a DEMO architecture looks like, and how this can serve businesses, taking the VISE case study for illustration (see www.visi.nl)

VISI [19] is the acronym of 'Voorwaarden scheppen voor invoeren standaardisatie ICT in de GWW-sector' ('Creating conditions for introducing standardisation of information & communication technology in civil engineering' in English). Its objective is to develop a framework architecture, which will enable partners in large-scale and complex infrastructural development schemes to organise communication and co-operation flexibly. This, in turn, will significantly reduce costs and runtime of development schemes. Representatives of all parties in civil engineering are participating in the project: local and national government, engineering firms, contractors, associations, research – institutes and Information Technology companies are all working together to improve the communication within civil engineering. There are many reasons to carry out VISI and standardise Information & Communication Technology in civil engineering. Society demands that development schemes be executed quicker, while schemes are becoming more and more complex: multiple use of space, large quantities of engineering information and many partners involved in one development scheme. The need for an integral approach is urgent. Problems with the exchange of information obstruct effective communication and at the same time competition forces the parties involved to work together more flexible and effectively.

Therefore VISI has developed a framework architecture based on the CAP theory, which describes the production and communication process on the boundaries of identified actors. The responsibilities of each actor are specified including the required communication. The information exchange is defined by messages. The contents of all messages are reflected in a common data model.

The framework (figure 5) integrates three systems, namely the actors (boxes), the communication (disks) and the production (diamonds).

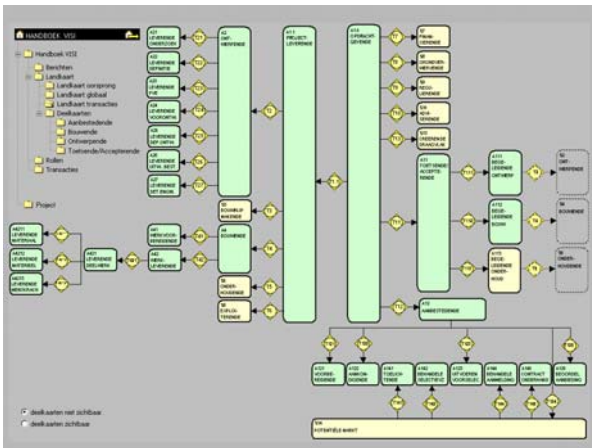


Figure 5 VISI architectural framework for Civil Engineering

The VISI architectural framework for Civil Engineering projects is the abstract specification of the composition and the environment (identified actors). The structure consists of interaction and interstriction of the identified actors involved in communication and production.

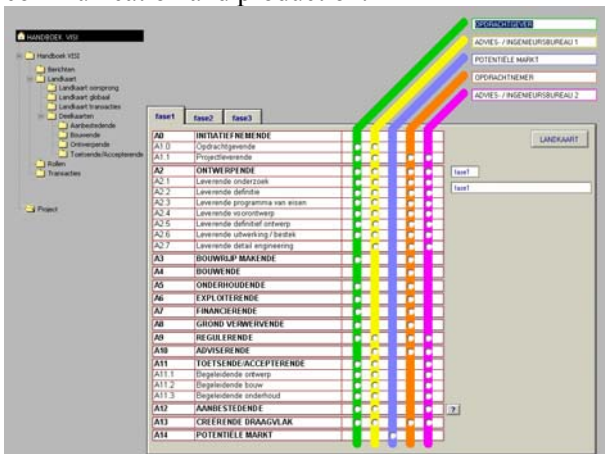


Figure 6 Mapping from second (actor) to first abstraction (organisations, business units or departments)

Figure 6 shows the mapping from actors to organisations, business units or departments. One actor role can be played by many organisations or units and one organisation can play more than one actor role. A specific division of labour in a civil engineering project between the organisational units is shown in figure 7.

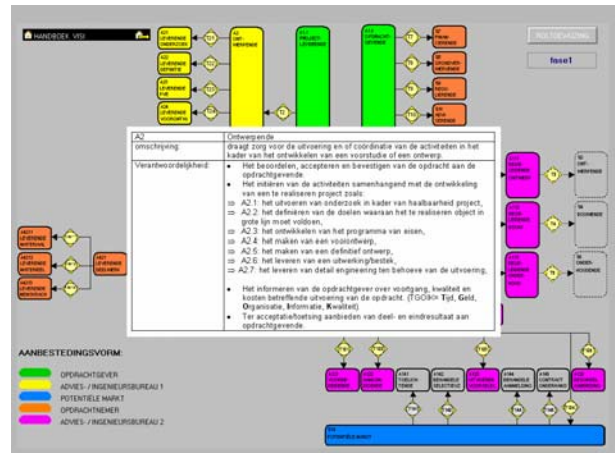


Figure 7 Mapping from first to second abstraction

The colors indicate which organisation is accountable for the results of an actor. 'Behind' each actor a description of the actor competence and responsibility is available. The example shown in figure 7 is A2 the engineering actor (color Yellow).

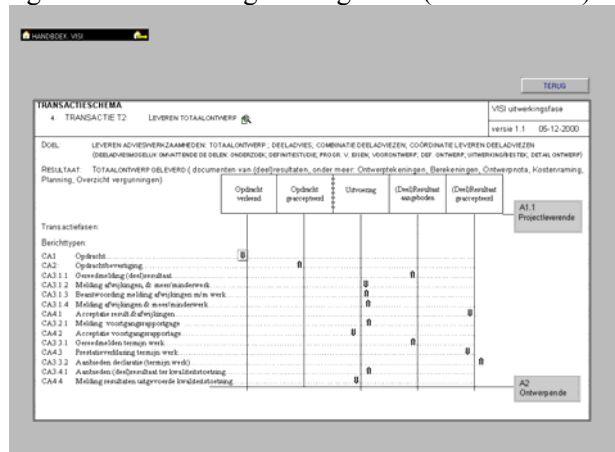


Figure 8 Mapping on transaction pattern of second to first abstraction (information flows and stores)

The communication and production results of a transaction are described by the transaction model. Figure 8 shows the communication and results of transaction T2 'delivering total civil design'. Each line represents an information flow and store.

The advantages of the VISI framework are:

- A clear defined communication reduces misunderstandings, building errors double work, and risks, and it saves time.
- Clear and complete exchange of information creates a better understanding of the design, the project and the process.
- A better definition of communication leads to a better agreement on activities.
- A greater uniformity in information leads to a better return on investment in ICT and other equipment.
- The framework enables the effective implementation of co-operation.
- The framework provides benefit as to quality, efficiency, duration costs and process control of projects in Civil Engineering.

5 Conclusion

The notion of business architecture can and should be understood as something fundamentally different from information (systems) architecture. This is the major conclusion of the presented research work. The CAP theory provides an adequate conceptual framework for understanding business systems as social systems while at the same time integrating the aspects Communication, Actors and Production. Going back to the 'OER-shape' of an organization offers the essential model of an organization, from which one has the right design freedom for engineering it.

This has been demonstrated for the case study VISI. Only by abstracting from the form and the content of the information exchanges in Civil Engineering Projects, and by concentrating on the commitments that the different parties are engaged in, has it been possible to come to agreement between all the distinct parties about the mutual communication in a project. Two earlier, and costly, attempts that started from the content and the form of messages failed. The DEMO methodology appears to provide the right help in achieving this important separation of concerns: first the business architecture (as it is defined in the CAP theory), then the information systems architecture, and lastly the infrastructural architecture.

References

- [1] Auramäki, E., K.Lyytinen, On the Success of Speech Acts and Negotiating Commitments, in: [LAP96]
- [2] Zachman, J.A. 1996. Enterprise Architecture: The Issue of the Century. <http://www.zifa.com> (retrieved 3-9-1999)
- [3] Bunge, M.A., *Treatise on Basic Philosophy*, vol.4, D. Reidel Publishing, Dordrecht, Holland, 1979.
- [4] McDavid, D.W., 1999. A Standard for Business Architecture Description. IBM Systems Journal, Vol. 38, No. 1.
- [5] Chandler, A.D. jr., *Strategy and Structure*, MIT Press, Cambridge, 1962.
- [6] Chen, P.P.S., The Entity-Relationship Model toward a Unified View of Data. ACM Transactions on database Systems, vol. 1, no. 1, pp. 9-36, 1976.
- [7] Davenport, T.H., *Process Innovation*, Harvard Business School Press, Boston, 1993
- [8] Dietz, J.L.G., Business Modelling for Business Redesign, in: *Proceedings of HICSS-27*, IEEE Computer Society Press, Los Alamitos, CA, 1994
- [9] Dietz, J.L.G., Modelling Business Processes for the Purpose of Redesign, in: *Proc. IFIP TC8 Open Conference on BPR*, Holland, Amsterdam, 1994
- [10] Dietz, J.L.G., *Introduction to DEMO - from Information Technology to Organisation Technology*, Samsom Bedrijfsinformatie, The Netherlands, 1996 (in Dutch)
- [11] Dietz, J.L.G., J.B.F. Mulder, Realising Strategic Management Reengineering Objectives, in: [36]
- [12] Flores, F.M., J.J. Ludlow, Doing and Speaking in the Office, in: *Decision Support Systems: Issues and Challenges*, Pergamon, Oxford, 1980
- [13] Galbraith, J.R., *Organisation Design*. Addison Wesley, Reading Massachusetts, 1977.
- [14] Hamel, G., C.K. Prahalad, Strategic Intent. *Harvard Business Review*, May/June, pp. 63-76, 1989.
- [15] Hamel, G., C.K. Prahalad., The Core Competence of the Corporation. *Harvard Business Review*, May/June, pp. 79-91, 1990.
- [16] Hamel, G., C.K. Prahalad, 1993. Strategy as Stretch and Leverage. *Harvard Business Review*, March/April, pp. 75-84, 1993.
- [17] Hamel, G., C.K. Prahalad, *Competing for the future; Breakthrough strategies for seizing control of your industry and creating the markets of tomorrow*. Harvard Business School Press, Boston, Massachusetts, 1994.
- [18] Hammer, M, Reengineering Work: Don't Automate, Obliterate', *Harvard Business Review*, 1990.
- [19] [Http://www.visi.nl/pages/english/english_home.html](http://www.visi.nl/pages/english/english_home.html)
- [20] Hirschheim, R., H.K. Klein, K. Lyytinen, *Information Systems Development and Data Modelling: Conceptual and Philosophical Foundations*. Cambridge University Press,

- Cambridge 1995.
- [21] Holmqvist, B., P.B. Andersen, H. Klein, R. Posner (eds.), *Signs at Work*, De Gruyter, Berlin, 1996.
- [22] Iivari, J., R. Hirschheim, H.K. Klein, *Five Emerging Approaches to Information Systems Development: An Analysis of Paradigmatic Foundations*. Manuscript, 1996.
- [23] Keen, P.G.W., *Shaping the Future, Business Design through Information Technology*. Harvard Business School Press, Boston, 1992.
- [24] Lind, M., G. Goldkuhl, Reconstruction of Different Business Processes - A Theory and Method Driven Analysis, in: [37]
- [25] Medina-Mora, R., P.J. Denning, Completing the loops, Institute for Operations Research and the Management Sciences, may-june 1995, pp. 42-57.
- [26] Medina-Mora R., T. Winograd, R. Flores, F. Flores, The Action Workflow Approach to Workflow Management Technology. In: J. Turner, R. Kraut (eds.), *Proceedings of 4th Conference on Computer Supported Cooperative Work*. ACM, NY, 1992.
- [27] Mintzberg, H., *The structuring of organisations*, Prentice-hall, Englewood Cliffs, 1979.
- [28] Mintzberg, H., J.A. Waters, Of Strategies, Deliberate and Emergent. *Strategic Management Journal*, vol. 6, no. 3., pp. 4-19, 1985.
- [29] Mintzberg, H., The Design School: Reconsidering the Basic Premises of Strategic Management. *Strategic Management Journal*, vol. 11, 1990
- [30] Morgan, G., 1986. *Images of Organization*., Sage, Newbury Park, 1986
- [31] Porter, M.E., How Competitive Forces shape Strategy. *McKinsey Quarterly*, Spring,, 1980.
- [32] Porter, M.E., *Competitive Strategy, Techniques for analyzing industries and competitors*. The Free Press, New York, 1980.
- [33] Porter, M.E., The Contributions of Industrial Organisation to Strategic Management, *Academy of Management Review*, pp. 609-620, 1981.
- [34] Porter, M.E., *Competitive Advantage, Creating and sustaining superior performance*. The Free Press, New York, 1985.
- [35] Porter, M.E., V.E. Millar, How Information gives you competitive Advantage. *Harvard Business Review*, July/August 1985.
- [36] LAP96, Dignum, F, J. Dietz, E. Verharen, H. Weigand, *Communication Modeling - the Language / Action Perspective*, Electronic Workshops in Computing, Springer, 1996, <http://www.springer.co.nk/ewic/workshops/CM96/>
- [37] LAP96, Dietz, Mulder, , *Communication Modeling - the Language / Action Perspective*, Electronic Workshops in Computing, Springer, 1996, <http://www.springer.co.nk/ewic/workshops/CM96/>
- [38] McFarlan, W., Information Technology Changes the Way You Compete, *Harvard Business Review*, 1984.
- [39] Scott Morton, M. (ed.), *The Corporation of the 1990's; Information Technology and Organizational Transformation*, Oxford University Press, NY, 1991.
- [40] Stamper, R.K., Signs, Information, Norms and Systems, in: [21].
- [41] Van der Rijst, N.B.J., J.L.G. Dietz, Expressing Production Control Principles in the DEMO Communication Model, in: Verbraeck, A., H.G. Sol, P.W.G. Bots, *Proc. 4th Int. W.C. on Dynamic Modeling and Information Systems*, Delft University Press, 1994.
- [42] Van der Rijst, N.B.J., V.E. van Reijswoud, Comparing Speech Act Based Modeling Approaches for the Purpose of Information Systems Development, in: *Proc. of the Third European Conference on Information Systems*, Athens, 1995.
- [43] Van Reijswoud, V.E., *The Structure of Business Communication - Theory, Model and Application*, Doctoral Thesis, Delft University, 1996.
- [44] Yourdon E., L.L. Constantine, *Structured Design*. Prentice Hall, Englewood Cliffs, 1979.

Bibliographies

Hans B.F. Mulder is director of Venture Informatisering Adviesgroep n.v., a consortium of enterprises in the Dutch IT-industry. He has held several positions, which range from software analyst to project manager. During his career Hans Mulder received his Bachelors Degree in Informatics at the Polytechnics of The Hague and his Masters Degree in General Management at Nijenrode University in 1994. Since 1995 he has published several articles and case studies on the subject of information systems, business models, groupware and ICT-mediation and is working on his PhD thesis at the Delft University of Technology.

Jan L.G. Dietz started his scientific career in 1980 at the Faculty of Industrial Engineering of Eindhoven University of Technology, after having worked as practitioner since 1970. In 1987 he obtained his Doctoral Degree on the subject of modelling and specifying information systems. In January 1988 he was appointed Professor of Management Information Systems at the University of Maastricht in the Faculty of Economics and Business Administration. From September 1994 on he is Professor of Information Systems at Delft University of Technology in the Faculty of Information Technology and Systems.