

Data Structuring, Standards and Knowledge Work

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Abstract. This paper discusses the possibility and consequences of using data structuring standards for knowledge work settings. The discussion is based on an analysis of the e-mail standard and a case study done in an IT development project. The case study focuses on the use of artefacts for communication and shows how they engage in different genres of communication. Genres of communication are suggested as the analytical basis for designing data structuring standards for knowledge work settings.

1 Introduction

Data structuring is a tricky aspect of IT systems design and use. It is considered an important discipline in Systems development mostly under the term data modelling. The data model of an IT system is very consequential for what kind of functionality can be built into the system. The data model defines what is visible and what is invisible to an IT system. In businesses where the IT system is central to the workings of the company, this has the consequence of defining also what is visible and invisible to the whole business. As an example the banks traditionally had shared bank accounts for married couples represented by the male. When the bank sent a letter regarding the

shared account, they would always address it to the male. This has provoked not so few women, including my girlfriend in the early 90's. You can speculate into the reasons for the bank acting like this, but the primary practical reason for their resistance to change it has been their data model. Each account is modelled to have one owner to whom the letters regarding the account is sent.

Data structuring is also recognised as a practical issue in the use situation. Anybody who has worked in an organisation using shared LAN drives is familiar with files called "myfile.doc" inside a folder called "project" in a folder called "my stuff". Marshall & Shipman (1999) has pointed out some of the practical difficulties with getting users to structure information for the computer. One thing is creating a good data model, another is to get users to use it. It is often considered to be overhead and waste of time.

An interesting place to look for data structuring with big implications is the development of standards. One example is the Dublin Core project (www.dublincore.org). Dublin Core is an initiative with participants from many different organisations working on standards for metadata¹. Their purpose is stated in the following way:

The Dublin Core Metadata Initiative (DCMI) is an organization dedicated to promoting the widespread adoption of interoperable metadata standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems.

In initiatives like Dublin Core, the focus is on easing information retrieval and the approach is that of the librarian.

Bowker & Leigh-Star (2000) have studied several standard classifications including ICD (International Classification of Diseases) and NIC (Nursing Interventions Classifications). Their studies have shown the profound consequences of producing classifications (or data models) and implementing them in IT systems. They on the one hand act as enablers for communication between otherwise incompatible work situations and makes possible co-ordination of activities². On the other hand they have scary consequences because they are ubiquitous and persistent. The classifications become invisible and the rationale for details in the design are forgotten as the standards/classifications are used.

The work of standards can be observed on the Internet. The Internet or WWW is a example of something deeply dependent on standard interfaces between different layers, creating unique economic possibilities for the development of new services. See e.g. Abbate & Kahin (1995) for a description of the cascade of standards working together on the Internet or Hanseth et. Al. (forthcoming) for an analysis of the

¹ Applying Metadata to data is another expression for data structuring.

² This is captured in their notion of classifications acting as „Boundary Objects“ Bowker & Leigh-Star (2000) p. 16

necessary conflict between standardisation and flexibility in infrastructures like the Internet.

An interesting aspect of the Internet is the development of standard data structures. The basis for this is the XML (Extensible Markup Language) standard recommended by W3. The XML standard has been called „the next big thing“ on the Internet. It has gained a lot of commercial attention and is being used broadly in very different settings for very different purposes. The XML standards is now forming a part of the basis for a group of activities under W3 called „The semantic web“. As a result of the release of XML 1.0 a lot of initiatives have started to produce standard data models for specific purposes. These standard data covers such diverse areas as Teaching tutorials (TML: Tutorial Markup Language), Workflow (WfIML: Workflow Modelling Language) and Financial data (OFX: Open Financial Exchange). A list of initiatives can be found at www.xml.org.

The development and use of standard data structures based on XML creates the tensions described by Bowker & Leigh-Star (2000). On the one hand they work as enablers for communication. On the other, they produce blindness and reproduce obsolete decisions like the example with the bank accounts.

Power and economy are central issues in the discussion of standards. Bowker & Leigh-Star notes that when you are looking for political power in today's society, look for the people producing the classifications, standards, and infrastructures.

Also Clark (2001) points to the political aspect of creating standard data structures or schemas as they are often called:

Institutions and individuals create schemas in working group of programmers, analysts, domain specialists and others.... Some schemas become de facto or de jure standards. The widespread use of a standard empowers those who control it; the more it is used, the less reason to develop or to use an alternative. (Clark 2001 p.1)

The politics of schema is also the economics of schema. Underlying Clarks description is the mechanisms of the information economy (Shapiro & Varian 1999). Lock-in and network effects are central and what Clark describes is similar to what Shapiro & Varian coins

Waging a Standards War (Shapiro & Varian 1999 p. 261)

The political and economical aspects of standard data structures such as XML schemas are very interesting topics for sociological and economical macro analysis.

In the present paper, I shall take another part and look in detail on use of data structuring standards for a specific domain. The domain is communication in knowledge work settings. A knowledge work setting is e.g. a research project, a business development project, or an IT development project as is our case. One of the characteristics is that what is mostly produced in projects like this is communication both as means for meeting the ends and as deliverables of the project. This could be in the form of scientific papers, reports, system descriptions etc. Another characteristic is

the very few pre-defined processes. It is a highly unstructured environment compared to an assembly line or a call-centre in a bank. The objects of study are thus the artefacts used for communication like e.g. documents, drawings, e-mails etc.

The purpose of the paper is to study some of the problems of creating data structuring standards for this setting and give some characteristics of possible standards.

The case study reported here analyses the role of artefacts in the internal communication of an IT development project. It analyses the role of artefacts over time, and how different means for structuring the artefacts are used. The focus is on the role of Use Cases³ in the project. The case study shows a way of analysing artefacts in terms of the potential genres of communications they will take part in. The hypothesis is that this analysis could be a fruitful input to the formulation of data structuring standards.

Before reporting back from the case study, we need to take a closer look at how data structuring standards actually are related to the use of the IT systems they are built into. We also need an argument for engaging in the project of discussing standards for data structuring in such “ill-structured” environments. Since there is no XML standards working in this area, we shall need to look at another standard (or set of standards), that has been working in knowledge work settings very successfully for quite some time. Standards based e-mail has been around for quite some time and is heavily used in most organisations doing knowledge work (as well as in a lot of other places). E-mail thus forms an example of a very successful standard for structuring data in a knowledge work setting and a good place to watch the role of the standard in the use situations.

1.1 Method

The present paper is based on a case study in a big Nordic financial company. The case study combined interviews, document analysis and observation of project meetings and work. I had access to documents on the two platforms used for document sharing: LAN-drive and a Lotus Notes database. The interviews were semi-structured and used interview guides. They were partly used for factual questions and belief questions, partly to confirm and discuss findings from the document analysis and the observation of project meetings. The document analysis was done on-site, which gave opportunities for overhearing face to face communication, telephone conversations and for discussions with the project members.

The use case process was mapped based on interviews with the project manager and one of the use case authors and participation in three project meetings.

³ Use Cases is a method for modelling the interaction between user and system used in the design proces. See Jacobsen et. al. (1992)

The analysis of the technology used for communication and tools used to program was done based on analysis of the documents on the LAN-drive and the Notes database as well as interviews with the project manager.

The analysis of XML and other standards was partly performed based on on the W3 and IETF⁴ standard specification documents and W3 tutorials, partly on experiments with different tools for creating and analysing XML as well as implementations of the e-mail standards⁵.

2 Data structuring in knowledge work

Before we proceed to the analyses some conceptual clarifications are needed. When we discuss standards for structuring data in knowledge work settings, we assume some object for structuring, and we need some means for identifying relevant from less relevant properties as well as stable or essential properties from unstable or incidental properties.

The concept suggested here is: *artefacts used in communication*. We are not including artefacts like hammers but artefacts like documents, pictures, e-mails, models etc. whose prime purpose is to be used for communication.

One might argue that some artefacts like documents or pictures does not have as their sole purpose to be used in communications. Some documents are simply information stored for some future use that might be personal. My answer is: if the information will not at least potentially be part of a communication situation in the future, there is no reason to think of creating standard data structures for them. Neither is there a reason to think about building IT systems to support the handling of such artefacts.

As a means of reducing the very abstract notion of communication situation, I shall use the concept of „genres of organisational communication“ introduced by Yates & Orlikowski (1992). They define it in the following way:

“...a genre of organizational communication is a typified communicative act having a socially defined and recognised communicative purpose.” Yates & Orlikowski (1992) p. 3

A genre of organisational communication is thus a type of communicative act, e.g. a project meeting, a briefing or a paper review. Three different aspects define genres: the social rules, the form, and the content. A project meeting e.g. has some social rules. There is a project manager who invites for the meeting and decides who should

⁴ W3 and IETF (Internet Engineering Task Force) are the two important standards organisations for the Internet. W3 is hosting standard processes for e.g. XML, XHTML and XSL whilst IETF is hosting e.g. HTTP 1.1, WebDAV, and TCP/IP

⁵ XML manipulation tools: XML Spy v. 3.0, ZopeXML
E-mail implementations: Eudora, Lotus Notes, Outlook Express, Outlook, Hotmail, Yahoo mail

participate. It is also a rule that you have to cancel if you cannot participate in the meeting. The form of the project meeting concerns things like the typical presence of an agenda, that the meeting is held in a room, and that someone produces minutes from the meeting. The content of the project meeting concerns the common subjects dealt with in a project meeting. A project meeting typically discusses the project plan and whether the project is on target or delayed. The meeting minute from a project meeting is an example of an artefact involved in a genre of organisational communication.

The point of introducing genres of communication is thus to characterise the meeting minutes in terms of how they engage in the project meeting genre and not e.g. in terms of being a word document or being about the status of the project.

Now let's take a look at an existing data structuring standard used for various genres of organisational communication.

2.1 Standards for structuring data

The standards for e-mail is a very early example of a data structuring standard for a communicative artefact. Yates & Orlikowski (1992) showed how e-mail grew out of the organisational memo genre.

E-mail is actually covered in the IETF standards. Those are:

- RFC821 – Simple Mail Transport Protocol (SMTP)
- RFC822 - Standard for the format of ARPA Internet text messages
- RFC974 - Mail routing and the domain system
- RFC1725 - Post Office Protocol - Version 3 (POP3)
- RFC1521, RFC 1522 - MIME (Multipurpose Internet Mail Extensions) Part one & Two
- RFC2060 - Internet Message Access Protocol - Version 4rev1 (IMAP)

These standards specify different aspects of e-mail. SMTP is the basic standard for sending messages and routing them between computer hosts. POP3 and IMAP are two different standards for delivering mail to computers not always on-line and to keep a post office on a server. The MIME standard ensures the possibility of sending different data types with the messages. The RFC974 specifies how mail routing should use the DNS (Domain Name System). The last standard is the RFC822 for the format of text messages. If we look into this standard, we see how an early standard for an artefact for communication is structured.

The complete data model or „message specification“ can be found in RFC822. We will pick out some of the central elements of the standard. A message is defined as consisting of some header fields and a body, which is the text of the e-mail. The body is completely unstructured as far as the standard is concerned. The header fields concern different aspects of the mail e.g. the receiver, the sender, time of mail creation, mail path etc.

We shall look into two aspects of the mail. The one is the Receiver fields, and the other is the Optional fields which actually proposes some structure of the message content.

The Receiver fields.

We all know the To:, CC:, and BCC: fields of an e-mail. It enables you to specify three different types of recipients for your message. The primary receivers are specified in the To: field. The ones you would like to inform that you have sent a message to the primary receivers are put in the CC: field. Last in the BCC: field you specify the ones you want to inform that you have sent a message to the primary receivers without letting the primary receivers know.

The fields for addressing the message are now so common sense that it can be hard to come up with alternatives. There are lots of structures though that could have been part of the standard as well. Some proprietary mail systems have implemented priority ratings. Eudora 5.0 has five ratings: highest, high, normal, low, lowest, while Lotus Notes mail has High, normal, and low. Winograd & Flores (1986) even suggested that Searles taxonomy⁶ of basic illocutionary acts of speech act theory could be used as the basis for structuring messages.

The designers of the standard could easily have omitted the CC: and BCC: fields. Copying someone on a mail could have just been done as a manual forward. It is interesting to imagine what consequences it could have had on the patterns of use.

The optional fields

There are some optional fields that are part of the standard as well. Optional means that they are not necessary for messages to be sent and received. I have listed most of them here⁷.

- SUBJECT: Indicates the subject of the message body
- KEYWORDS: Keywords for the message
- COMMENTS: Comments to be separated from the actual body text
- IN-REPLY-TO: Previous correspondence
- REFERENCES: Other correspondence to which the message is related

The fields listed have had quite different destinies. The SUBJECT field is implemented in all e-mail systems (at least the ones I have seen). The KEYWORDS field is never used at all, nor is the COMMENTS field. IN-REPLY-TO is mostly not used. Instead the previous correspondence is referenced in the SUBJECT field with e.g.

⁶ Searles five illocutionary acts are: Assertives, Directives, Commissive, Expressives, Declarations (Searle 1969)

⁷ The remaining fields are MESSAGE-ID, ENCRYPTED, EXTENSION-FIELD, USER-DEFINED FIELD.

an „RE:“ put in front of the SUBJECT field of the message to which it replies. REFERENCES is not used either.⁸

This quick tour through the „Standard for ARPA Internet Text Messages“ or the IETF standard for e-mail message shows us some interesting properties of the relation between standard data structures and artefacts for communication.

The first finding is that this e-mail message standard is an example of a standardisation of an artefact for communication that is very successful. The three different types of recipients, and the distinction between Subject and Body are being used for lots of communications both professionally and for private purposes.⁹

The other interesting finding is that some of the fields are not used at all. The COMMENTS field is intended as a means for commenting the body of the message. With the knowledge we have today of how e-mail is being used, this field seems completely obsolete. The ability to comment on your self is a very natural part of oral communications and is also used in written paper-based communication. For some reason it was never a part of e-mail use. Also e-mails are commented, but it is done as forwarding, where the person forwarding adds some comments or additional information. KEYWORDS are another field never used. Typically email programs have implemented a folder structure to store emails instead of using keywords.

As to the *reasons* for why e.g. the SUBJECT field and not the COMMENTS field have been successful in use: there are many. Overall we can say, that there are two major kinds of agents responsible. The first are the software companies who have built the systems, the second are the users and organisations using the e-mail as an artefact for communication.

This quick analysis of the standard for e-mail messages shows how a data structuring standard for organisational communication can look like. We have a relatively long experience with e-mail use. This enables us to investigate the relation between the design of the standard and the use pattern that is not possible with e.g. XML based data structures because the use is not mature enough. SGML, the more complicated predecessor of XML has been an ISO standard¹⁰ since October 1986, but has not been widely adopted. Most of the standard data structures (DTD's) created in SGML have been for electronic books¹¹.

⁸ I have not been able to locate any surveys and investigations into the use of the e-mail standard. The claims here are based on my own experience with use and from observing different implementations

⁹ According to a study by Pitney Bowes, the average UK worker was in year 2000 sending and receiving 39 e-mails. (<http://www.pitneybowes.co.uk/news/article.asp?article=103>)

¹⁰ ISO standard nr. 8879 (Source www.iso.ch)

¹¹ See Robin Cover's extensive bibliography on SGML and XML and list of applications of SGML <http://xml.coverpages.org/gen-apps.html>

Unfortunately we don't have the same opportunity to study the role played by XML standards in corporate communication processes. This is simply too early. Most derived XML standards are still on the drawing board.

The XML standard is a standard for structuring data hierarchically. It defines how specific data structures can be defined (e.g. TML, NewsML, MathML) via a DTD. It also defines how XML documents can be validated as XML documents based on a DTD. For example my file „traincrashinbelgium.xml“ can be validated as an XML document based on the NewsML.DTD.

As mentioned in the introduction, XML is being used to develop standard data structures for lots of different purposes both inside corporations, by working groups, by individual businesses hoping to create a de facto standard etc.

As we have shown with the e-mail standard, there is a potential for using standard data structures in communication and collaborations between people working. The following case study reports some aspects of how artefacts are used in communication and collaboration that can inform the construction of such standards.

3 The case study

The project studied was a system development project in a Nordic financial company. The goal was to build an “Internet bank” for retail banking customers. The company already had a popular PC bank in place based on traditional client server architecture. The PC Bank used the Internet for communication between client and server, so the “Internet bank” was a browser/Java-based version of the PC Bank.

The company manages all its change projects like e.g. system development projects in an organisation called “business-systems”. The projects all have a 6-month “produce value” life cycle. So the project should produce the Internet bank system in a period of 6 months, which they were able to.

The project had a core group of app.¹² 20 people. In addition to these people, a number of people from “business-systems” and IT operations, were attached to the project. These were primarily people responsible for related systems or processes. The core group had employees from the company as well as external people from a consultants company and a web bureau as members.

The core group was staffed with business people from the retail bank line of business. They were ensuring that the business requirements were actually implemented, that the business processes around the system were defined, and that the system and processes were implemented and marketed. The project manager, 3 – 4

¹² The number varied over the different project phases.

Host programmers, a security specialist and two architects came from the company's "business-systems" organisation. The Java developers, an architect, a test specialist and a technical project manager came from a consultants company and the user interface designers from a web bureau.

The core group was mostly situated in one big room with visual contact between all members. The business people in the core group were partly co-located with the rest of the group, partly in the corporate headquarters 30 min. away by car.

3.1 The use of artefacts

The purpose of the study was threefold:

- To investigate the role played by important artefacts in the project work.
- To analyse how the artefacts were handled and structured
- To analyse how technology was used in the communication of the project and thus also to handle the artefacts.

At first I will present how the project used different technologies (a.k.a. media) for different types of communication in the project. After that we shall dig deeper into the role of a specific type of artefact, that was central to the project.

Most of the communication in the project took place as face to face oral communication or as telephone conversations. As the project was located in one big room most of the time, with two meeting rooms next to it, a lot of communication took place orally across the desk. Meetings with the whole group or sub-groups were held daily.

Paper based communication was used in the project. Primarily as a medium for individual users for reading, but also discussions were often done with the use of some drawing or document that the participants could see and point to. For meetings a blackboard was occasionally used for drawings, to-do lists or agendas.

The following table lists the different media for communication in order of frequency and their importance for the project work.

Medium	Description of use
Face to face	Meetings, social conversations, co-ordination of activities, problem solving
Telephone	Communication between the two offices. Communication with project partners
E-mail:	Used extensively for the exchange of files, project meeting invitations. Used in the Use Case process between business and programmers to exchange comments and suggestions.
Notes database:	used for handling use cases, test scripts, and error reports/change requests

LAN drive:	Documents. Primarily used as personal drive
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The documents used in the project were either stored on personal drives, the shared LAN drive, or in the Lotus Notes database.

The written artefacts used in the project were mostly either e-mails or Microsoft Office files. The programmers used plain text files as well as development tools and the designers used Adobe Photoshop files and produced GIF or JPEG files as output.

The documents on the LAN drive were both created in the project and came from outside the project. After a quick analysis of all documents during the first three weeks of the project, it turned out, that by the end of week three, 50% of the documents were created outside the project. Partly created by the project members, partly by others.

The documents on the LAN were quite diverse. They were presentations of the project, an architecture, the final product or it was personal notes and working papers on diverse subjects. The documents from outside the project were typically presentations of related systems in the bank, specifications of systems, or presentations of e.g. the company's strategy and products evaluated for use in the project.

The LAN drive was typically used as a personal back-up drive and in a few cases as shared drive for two-three people. This is suggested by the fact that the folders often had names of the persons putting files into them, also there was a clear pattern that one persons documents were almost always placed in the same folder. The LAN drive was not used interactively. This is suggested by the finding, that of the documents produced in the project, 70% of them were not changed after creation after the third week of the project. These findings were verified in the interviews.

The Notes database was used primarily for handling Use Cases, test scripts and change request/error reports. The database was a template provided by the "Test" competency network.

According to the project manager, the Use Case documents were the most central documents in the project. Since the amount of documents were gradually increasing it was clear that analysing all of them would be unrealistic. The Use Case documents were chosen for detailed analysis for several reasons:

- They were limited in numbers. app. 50 Use Cases
- They were central to the project
- They were created collaboratively

3.2 Use Cases – artefacts engaged in genres of communication

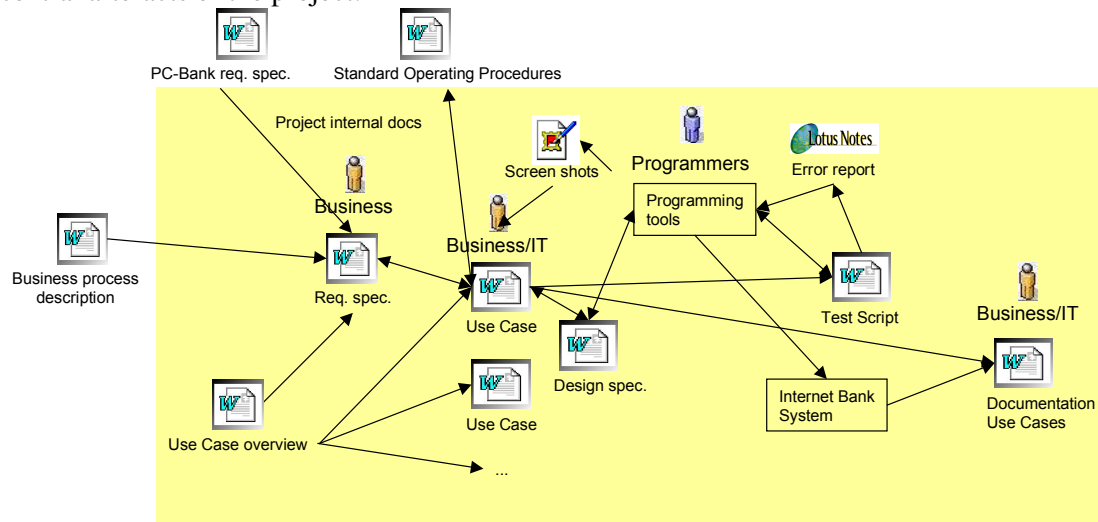
Use Cases is a concept invented by Jacobsen et. Al (1992) as a method for describing the aspects of an IT system involved in user interaction. In the case of the Internet bank system, an example of a Use Case is "create account transfer" or "send message to the bank". The Use Case describes the actions of the user and the

corresponding reactions in the IT system. The concept of Use Case used in the project did not include the method described by Jacobsen et. Al, but was rather elements taken from the method used as input for the process of creating Use Cases defined and used in the project.

According to all people interviewed the Use Case documents were considered central to the project. The Use Cases were the primary means of getting the business people to communicate with the programmers.

Most of the project members including the business people had no previous experience with Use Cases. As the work with the Use Cases began, the writing was mapped in a process and agreed upon in a workshop by the participants. The writers of the Use Case all used a common template. The template consisted of a PowerPoint slide, and a one or two page Word document.

The following figure gives an overview of how the Use Case was related to other central artefacts of the project:



The Use Case documents had different roles over the different phases of the project. We might say that the Use Case documents play a role in different genres of communication over time. I will shortly describe each of these roles.

Writing of Use Case

The Use Cases were drafted by one person and was afterwards reviewed by at least two others. The Use Cases were all redone because they didn't turn out useful for the programmers the first time. This was due to the little experience with Use Cases in the project Team.

Design/Programming

Use Cases were secondary artefacts in this phase. The programmers used them as reference while doing the technical design and programming the modules. They also

worked as basis for continuous communication between the programmers and the business people. The design of the modules was changed through oral and e-mail based negotiations. The people responsible for the Use Cases updated them in two rounds but eventually gave up keeping them up to date with the actual design of the system.

Test

The Use Case documents were used as the basis for creating the test scripts in this phase. The Use Cases were the "requirements specification" and acted as the description of the desired system that they should measure up the actual system against. The fact that the Use Cases had not been updated as to reflect all design decisions was not a practical problem.

Documentation

The Use Cases became part of the documentation of the system. The decision to do this was not taken before the system was on-line with the first customers. The Use Cases were packed with the commented source code as the documentation. The Use Cases thus played a role that was not at all anticipated by any of the project members when the writing of the Use Cases started.

Knowledge transfer

The last use of the Use Cases is actually more a potential than an actual genre of communication. There has not been any actual nor planned process for using the Use Cases in other settings. We should include this genre, however because one of the ideas of standard data structures is to transfer them to other settings. The project has used the experiences gained in the work with version 2 of the Internet bank, which is currently being built.

The genres of communication

I have shown above, how the Use Case artefacts have played a role in quite diverse genres of communication over time. I have not described in detail the social rules, form, and content of the different genres but specified the role of the Use Cases, as these were our objects of interest.

The Use Cases had some interesting properties:

1. They are intertwined with other artefacts. Negotiations about the design of the system was partly done orally and via e-mail and although most decisions are reflected in the Use Cases, important details and rationales for decisions are either not documented or is placed in e-mails.
2. The Use Case changes its role over time in the different genres of communication

3. The processes around Use Cases were designed in the project. How to create and use the Use Cases was designed and agreed upon as the project moved forward. They were not working from a predefined process.
4. Uses of the Use Cases were invented along the way. The use of Use Cases for documentation was not thought until the system had gone live.

4 Conclusions

The case study has shown how the role of artefacts like Use Cases could be analysed through the engagement in different genres of communication.

In terms of standards for structuring data like Use Cases, the result of the analysis seems quite disappointing. All four properties of the Use Cases listed above means trouble in terms of defining a data structuring standard. No properties seems to be stable.

I have not at all discussed the internal form of the Use Cases, which at first sight would seem reasonable, since I'm discussing data structuring standards. The form of the Use Cases was decided on at the beginning of the project and was modified several times along the way. Also the individual Use Cases differed quite some. The point here has not been to analyse the potential for a data structuring standard for Use Cases. This is already taken on by OMG (Object Management Group) and in XMI (XML-based Metadata Interchange) where Use Cases are part of UML (Unified Modelling Language). The point was rather to analyse the Use Cases as general artefacts for communication in knowledge work settings.

On thing, it seems, is stable for the Use Cases as well as all other artefacts used in the project: they engage in different genres of communication.

We could say that the creator of a Use Case document or any other artefact for communication is engaging in a number of potential communications. As the analysis shows, these are unforeseeable at the point of creation. Formulating a standard for artefacts, as the ones studied here should depart from an analysis of the probable communications the artefact will engage in and derive the common and most important properties that pertain to the communications.

The invention and reinvention and change of Use Cases or other artefacts through different genres of communication are a general property of artefacts in knowledge work settings. The most stable property of the artefacts might be their engagement in specific genres of communication. Therefore genres of communication might be a good place to look for when designing standards for structuring knowledge work artefacts. As Yates & Orlikowski have shown, e-mail grew out of the organisational memo genre. E-mail has been very successful maybe just because of that.

5 Acknowledgements

I thank the DIWA project and especially the Ph.D. group for good discussions and collaboration on the empirical studies.

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