Inscribing behaviour in information infrastructure standards

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Abstract

We focus on the processes producing the standards which make up the technical back-bone of an information infrastructure (II). These standards are neither ready-made nor neutral. They are currently being developed, and they "inscribe" behaviour in complex and non-transparent ways. Behaviour at individual, organisational and inter-organisational level is inscribed. We explore how this takes place, identifying by whom, where and how inscriptions are made. Our principal aim is to uncover the socio-technical complexity of establishing an II, a complexity which so far has been severely underestimated by those involved. By studying the process of aligning and linking one inscription to other inscriptions, we also hope to learn more about the strength of inscriptions, that is, the degree to which an inscription actually succeeds in enforcing a desired behaviour. The empirical basis of our analysis is a case-study of two standardisation processes of II from the Norwegian health care sector.

Keywords: information infrastructure, inscriptions, standardisation process, social construction of technology, health care sector.

1 Introduction

The technical basis for an information infrastructure (II) is the standards which regulate the communicative patterns. These standards are commonly held to be neutral (Ciborra 1992; David 1987; OECD 1991, 1992; Webster 1995). Far from being neutral, totally flexible or ready-made, these standards are currently negotiated, developed and shaped through complex social processes. They embody inter-organisational changes in the concrete way they regulate the communicative patterns. This implies that the organisation of the standardisation activities, usually through a variety of formal standardisation bodies, deserves closer scrutiny because it is an important — but neglected — element of the social process through which organisational networks are transformed.

Establishing a working II is a highly complex socio-technical task which at least includes: designing a large collection of communication standards, testing and adapting these to a wide range of different use situations and ensuring that the standards are run through the bureacratic procedures of international standardisation bodies. It is fair to say that these problems have so far been significantly underestimated and benefits exaggerated generating a considerable level of frustration (Graham et al. 1996; UN 1996).

Our principal aim is to uncover more of the socio-technical problems of establishing an II. We are particularly concerned with how any given element of an II constrains others, that is, how it "inscribes" a certain pattern use. Some of these inscriptions are in technical components, notably the different kinds and levels of communication standards. Such inscriptions (attempt to) predetermine the pattern of use of the standards within the II. Other inscriptions are of a highly non-technical nature, for instance, the bureacratic organisation and procedures for working out international standards. The different bureacratic arrangements inscribe, for instance, distinct opportunities and mechanisms for user input. Both the technical and the non-technical inscriptions need to be considered together when establishing an II. By studying the process of aligning and linking one inscription to other inscriptions, we also hope to learn more about the strength of inscriptions, the degree to which an inscription actually succeeds in enforcing a desired behaviour.

The remainder of the paper is organised as follows. As a vehicle in our study, we employ a framework called actor-network theory (ANT) borrowed from the field of science and technology studies. It is outlined in section 2. As ANT cannot be said to be a well-defined, stable framework — it is a study in itself keeping up with the latest reworkings — we elaborate a version of ANT suited our purposes.[1] Section 3 deals with the development of general purpose IIs. It delineates the notion of II, sketches the organisation of the international standardisation processes

and briefly reviews relevant research on standardisation of II. Section 4 considers methodological issues relevant to our study. Given the fact that the object of our study, establishing IIs, is so big (it is likely to be global) and currently in-the-making, our study has made a number of pragmatically motivated approximations we discuss. Section 5 addresses II for health care. A definition is offered. Brief accounts of the history of health II, both internationally and in Norway, are presented before the organisation of the standardisation process is described. Section 6 presents two cases of standardisation of health II. One evolves at an international level, the other largely on a national one. Section 7 contains a discussion and section 8 offers a few concluding remarks.

2 Inscribing organisational behaviour in technology

The relationship between technology and society may be conceptualised in many ways. Two extreme end points of a continuum of alternatives are, on the one hand, technological determinism holding that the development of technology follows its own logic and that the technology determine its use (Winner 1977) and, on the other hand, social reductionism or constructionism (Woolgar 1991), (which comes close to technological somnabulism (Pfaffenberger 1988; Winner 1977)) holding that society and its actors develop the technology it "wants" and use it as they want, implying that technology in itself plays no role. A series of Braverman inspired studies appeared in the late 70s and early 80s biased towards a technological determinist position arguing that the use of IT was but the latest way of promoting management's interests regarding deskilling and control of labour (Phil Kraft, Åke Sandberg,...). Later, a number of studies belonging close to the social constructivist end of the continuum were produced which focused on diversity of use among a group of users and displaying unintended use (Kari & Tamar: Har systemer bruksegenskaper? Henderson and Kyng 1991 MIKAEL: woolgar i mosters!!!!).

Today, the majority of scholars in the field adhere to an intermediate position somewhere between the two extreme positions mentioned above. The majority of accounts end up with the very important, but all too crude, insight that "information technology has both restricting and enabling implications" (Orlikowski and Robey 1991, p. 154). This insight — that IT enables and constrains — is reached using a rich variety of theoretical frameworks including structuration theory (Orlikowski and Robey 1991), phenomenology (Boland and Greenberg 1992), hermeneutics (Klein and Lyytinen 1992) or Habermas' theory of communicative action (Gustavsen and Engelstad 1990).

Hence, there can hardly be said to be a lack of suggestions for suitable theoretical frameworks (Kling 1991; Monteiro and Hanseth 1995). We will, however, introduce yet another one, ANT, one which we believe will bring us one step further towards a more detailed understanding of the relationships between information technology and its use (Akrich 1992; Akrich and Latour 1992; Callon 1991, 1994; Latour 1987). This choice is motivated by the way ANT[1], especially in the minimalistic variant we employ, offers a language for describing the many small, concrete technical and non-technical mechanisms which go into the social construction of standards. ANT accordingly goes a long way in describing which and how actions are enabled and constrained.

ANT views society as a completely interwoven socio-technical web. It consists of a highly heterogeneous network of actors, institutional arrangements, textual descriptions, work practices and technical artefacts. ANT has a so-called semiotic basis. This amounts to granting all entities of such a heterogeneous network the same explanatory status because "semiotics is the study of order building (...) and may be applied to settings, machines, bodies, and programming languages as well as text (...) [because] semiotics is not limited to signs" (Akrich and Latour 1992, p.259). It might perhaps seem a radical move to grant artefacts the same explanatory status as human actors: does not this reduce human actors to mere objects and social science to natural science? We intend to bracket this rather dogmatic issue. Interested readers should consult (Callon and Latour 1992; Collins and Yearley 1992). For our purposes, what is important is that this move has the potential for increasing the level of detail and precision. More specifically, allowing oneself not to distinguish a priori between social and technical elements of a socio-technical web,

1. ANT is constantly refined and elaborated (see Latour 1995). These modifications aim at making ANT still more refined in terms of capturing subtle details. These modifications are probably relevant to scholars in the field of science and technology studies concerned with ANT for its own sake, but are not, in our opinion, particularly relevant to an application of ANT within IS studies of the present kind.

or network, encourages a detailed description of the concrete mechanisms at work which glue the network together — without being distracted by the means, technical or non-technical, of achieving this.

Especially two concepts from ANT are relevant to our inquiry: *inscription* (Akrich 1992; Akrich and Latour 1992) and *translation* (Callon 1991, 1994; Latour 1987). The notion of inscription refers to the way technical artefacts embody patterns of use: "Technical objects thus simultaneously embody and measure a set of relations between heterogeneous elements" (Akrich 1992, p. 205). Balancing the tight-rope between, on the one hand, an objectivistic stance where artefacts determine the use and, on the other hand, a subjectivistic stance holding that an artefact is always interpreted and appropriated flexibly, the notion of inscription may be used to describe how concrete anticipations and restrictions of future patterns of use are involved in the development and use of a technology. Akrich (1992, p. 208, emphasis added) explains the notion of inscription in the following way:

> Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economcy will evolve in particular ways. *A large part of the work of innovators is that of "inscribing" this vision of (or prediction about) the world in the technical content of the new object*. (...) The technical realization of the innovator's beliefs about the relationship between an object and its surrounding actors is thus an attempt to predetermine the settings that users are asked to imagine (...).

Stability and social order, according to ANT, are continually negotiated as a social process of aligning interests. As actors have a diverse set of interests, stability rests crucially on the ability to translate, that is, re-present or appropriate, others' interests to one's own. A translation presupposes a medium or a "material into which it is inscribed", that is, translations are "embodied in texts, machines, bodily skills [which] become their support, their more or less faithful executive" (Callon 1991, p. 143).

The designer works out a "scenario" including the system under design, its users and the interaction between the users and the system. This scenario is inscribed into the system. The inscription includes programs of action for the users, and it delegates roles and competences to the users as well as the components of the system (Latour 1991). By inscribing programs of actions into a piece of technology, the technology becomes an actor[2] by imposing its inscribed program of action on its users.

The inscribed patterns of use may not succeed because the actual use deviates from it. Rather then following its assigned program of action, a user may use the system in an unanticipated way, she may follow an anti-program (Latour 1991). When studying the use of technical artefacts one necessarily shifts back and forth "between the designer's projected user and the real user" in order to describe this dynamic negotiation process (Akrich 1992, p. 209). Some technologies inscribe weak/flexible programs of action while others inscribe strong/inflexible programs. Examples of the former are what can be called "tools," the hammer being a classic example, and the assembly line of Chaplin's "Modern times" a standard illustration of the latter.

Inscriptions are given a concrete content because they represent interests inscribed into a material. The flexibility of inscriptions vary, that is, some structure the pattern of use strongly, others quite weakly. The strength of inscriptions, that is, whether they must be followed or can be avoided, depends on the irreversibility of the actor-network they are inscribed into. It is never possible to know before hand, but by studying the sequence of inscriptions we learn more about exactly how and which inscriptions were needed to achieve a given aim. To exemplify, consider what it takes to establish a specific work routine. One could, for instance, try to inscribe the routine into required skills through training. Or, if this inscription was too weak, one could inscribe the routine into a textual description in form of manuals. Or, if this still is too weak, one could inscribe the work routines by supporting them by an IS.

Latour (1991) provides an illuminating illustration of this aspect of ANT. It is an example intended for pedagogic purposes. Hotels, from the point of view of management, want to ensure that the guests leave their keys at the front desk when leaving. The way this objective may be accomplished, according to Latour, is to inscribe the desired pattern of behaviour into an actor-

2. Or "actant" as would be the more precise term in ANT.

network. The question then becomes how to inscribe it and into what. This is impossible to know before hand, so management had to make a sequence of trials to test the strength of the inscriptions. In Latour's story management first tried to inscribe it into an artifact in form of a sign behind the counter requesting all guests to return the key when leaving. This inscription, however, was not strong enough. Then they tried having a manual door-keeper - with the same result. Management then inscribed it into a key knob. What they did was to use a metal knob of some weight. By stepwise increasing the weight of the knob, the desired behaviour was finally achieved. Through a succession of translations, the hotels' interest were finally inscribed into a network strong enough to impose the desired behaviour on the guests.

In our study there are four aspects of the notions of inscription and translation which are particularly relevant and which we emphasise: (i) the identification of explicit *anticipations* (or scenarios) of use held by the various actors during design (that is, standardisation), (ii) *how* these anticipations are translated and inscribed into the standards, (iii) *who* inscribes them and (iv) the *strength* of these inscriptions, that is, the effort it takes to oppose or work around them.

3 Standardisation and the building of information infrastructure

3.1 Information infrastructure

The notion of II as well as basically synonymous terms like info-bahn, information or electronic highways, is elusive. It is currently receiving a considerable amount of attention from academics, politicians and the public. This poses obvious problems when attempting to approach II in a more sober manner. Some try to define the notion explicitly. Star and Ruhleder (1994, 253) characterise it by holding that it is "fundamentally and always a relation". Sugihara (1994, 84) defines it as a "structure [which] provides (...) the public with various types of (...) information in a more operative way". McGarty (1992, 235-236) gives a rather extensive and precise definition of information infrastructure with the following keywords: shareable, common, enabling, physical embodiment of an architecture, enduring, scale and economically sustainable.

The term II has been widely used only during the last couple of years. It gains its rhetorical thrust from certain so-called visions. These visions were initiated by the Gore/ Clinton plans and followed up by the European Union's plan for Pan-European II. The visions for an II are argued as a means for "blazing the trail (...) to launch the information society" (Bangemann et al. 1994, 23). The Bangemann commission proposed ten applications which this effort should be organised around within the European Union: teleworking, distance learning, university and research networks, telematics services for small and medium sized enterprises, road traffic management, air traffic control, health care networks, electronic tendering, trans-European public administration network and city information highways. The proposal is in line with the projects proposed by the Group of seven (G7) in Brussels in March 1995.

Less speculative than citing political manifestoes, it is fairly safe to expect that future II will consist of an elaboration, extension and combination of existing computer networks with associated services (Smarr and Catlett 1992). It is likely to consist of an interconnected collection of computer networks, but with a heterogeneity, size and complexity extending beyond what exists today. New services will be established, for instance, by developing today's more experimentally motivated services like video-on-demand and electronic publishing. These new services subsequently accumulate pressure for new development of the II to accommodate them.

There exist today a number of embryonic manifestations of the IIs. Internet will perhaps by most of us be considered a global information infrastructure providing general purpose services that may be used as they are or as a basis for building more specific, application dependent services. For many years, we have had application specific networks. Services provided include flight booking and bank networks supporting automatic teller machines and other economic transactions. EDI, that is, electronic transmitting of form-like business and trade information, is an illustration of an existing technology related to II (Graham et al. 1995; Webster 1995).

3.2 Standards and standardisation processes

One normally distinguishes between de facto, de jure and formal processes of standardisation (Schmidt and Werle 1992). De facto standardisation is characterised by its reliance on market forces; there are no regulating, institutional arrangements influencing the process. De jure stand-

ardisation denotes the situation, typically within a hierarchical organisation, where standards are approved by one, central organisation, for instance, a suitable, national governmental institution. The third type of process, formal standardisation, is most relevant in the present context.

II, like many other kinds of large technical systems (Hughes 1987), are standardised by formal, quasi-democratic, international standardisation bodies (Lehr 1992). These standardisation bodies have to respect predefined procedures and rules regulating the status, organisation and process of developing standards. In recognition of the limits of both market forces and hierarchical control, formal standardisation is a key strategy for developing an II (OECD 1991). There are three important institutions responsible for formal stanadardisation of II:

- the International Standardisation Organisation, ISO (and its European branch, CEN);
- EDIFACT[3] within the United Nations;
- Internet;

These three institutions organise the process of standardisation quite differently along several important dimensions including: the way participation in the process is regulated, how voting procedures are organised, the requirements proposed standards have to meet at different stages in the process, the manner information about ongoing standardisation is made public and the bureacratic arrangements of how work on one, specific standard is aligned with other efforts. For a more detailed description of these differences, consult (Graham et al. 1995; Hanseth, Monteiro and Hatling 1996; Lehr 1992; RFC 1994).

De facto standards are developed by industrial consortia or vendors. Examples of such standards are the W3 consortium currently developing a new version of the HTML format for WorldWideWeb, IBM´s SNA protocol and the HL-7 standard for health care communication.

3.3 Research on standardisation

Studies of formal standardisation processes offer a relatively rare occasion to describe the concrete mechanisms of the social construction of inter-organisational, IT-based change. Previous studies of the standardisation process of II, however, tend to focus on a different set of issues, for instance, the economical significance of standards (David 1987; OECD 1991), technical challenges (Rose 1992), the use of II (Ciborra 1992), the political nature of standardisation bodies (Webster 1995) or cultural differences (Trauth, Derksen and Mevissen 1993). The predominant view of II standardisation is that it is straightforward. More specifically, it is usually portrayed either as (i) a fairly unproblematic application of mainstream techniques for solving the technical difficulties of software engineering or (ii) it is simply glossed over or presupposed (Ciborra 1992; David 1987; OECD 1991). Those involved in the design of II have so far been very close to (i) as we will argue later (in section 5). These studies shed little light on the socio-technical complexity of establishing an II. There do, however, exist other studies which achieve this.

Within the field of social studies of technology, there are several contributions relevant to an informed study of II standardisation. Some focus on conceptual issues, for instance, the work by Fujimura (1992) on concepts for standardising procedures and interpretations across geographical distances. Others explore empirically how universal standards are appropriated to local contexts (Berg 1995) or how the interplay between stability and change is played out (Hanseth, Monteiro and Hatling 1996). The work by Bowker and Star (1994) on the development of classification schemes for deseases and nursing practise is highly relevant to our endeavour. It displays concretely how classification codes privilege some actors by having their interests inscribed.

As we see it, standards and standardisation are key elements and processes in the realisation of the envisioned IIs. This is a task raising a wide range of new challenges, challenges we will not be able to deal with properly without extensive research — to which we try to give a modest contribution through this paper. It seems as if this view is shared by a growing number of scholars, and some research is appearing, for instance analysis of standardisation strategies (Kahin and Abbate 1995), some of which base this on lessons drawn from the earlier standardisation efforts like Internet (Abbate 1994) and X/Open.

3. EDIFACT stands for Electronic Data Interchange (EDI) for Administration, Commerce and Transport.

4 Methodological issues

Studying the development of IIs is not straightforward. There are at least two reasons for this which have immediate methodological repercussions worth reflecting upon.

First, the size of an II makes detailed studies of all elements practically prohibitive. Internet, for instance, consists of an estimated 10 million nodes with an unknown number of users, more than 200 standards which have, and still are, extended and modified over a period of 25 years within a large, geographically dispersed organisation where also a number of vendors (Sun, IBM, Microsoft), commercial interests (MasterCard, Visa) and consortia (W3) attempt to exercise influence. This implies that the notion of an actor in connection with II standardisation is a fairly general one in the sense that it is sometimes an individual, a group, an organisation or a governmental institution. An actor may also be a technological artifact — small and simple or a large system or network like Internet. ANT has a scalable notion of actors as Callon and Latour (1981, p. 286) explains: "[M]acro-actors are micro-actors sitting on top of many (leaky) black boxes". If one opens one such black box, one finds an actor-network. To account for II standardisation within reasonable space limits, it is necessary to rely on a notion of an actor which covers all these cases. A large part of the actors involved are macro-actors, whose black boxes our space limits prohibit us from opening.

Furthermore, the size of an II also makes a systematic, comprehensive empirical study rather unmanageable. A number of the sources are difficult to access as, for instance, there does not exist written documentation of the process. We have accordingly been restrictive while still attempting to paint a picture of II standardisation as representative as possible. Our empirical evidence is drawn from two cases of standardisation processes of EDI messages within the health care sector in Norway. A method of historical reconstruction from reports, minutes and standards documents together with semi- an unstructured interview has been employed, partly based on (Pedersen 1996). One of the authors was for a period of two years engaged in the development of the standards by one of the vendors involved with the standardisation processes (EdiCom). Our accounts of the two cases have been presented, discussed and validated with one of the key actors (KITH).

Second, the fact that IIs are currently being developed and established implies that there is only limited material on about the practical experience with which solutions "survive" and which "die", that is, which inscriptions are actually strong enough to enforce the desired pattern of use. Hence, we are caught in a dilemma. On the one hand, the pressure for grounding an empirical study suggests that we need to await the situation, let the dust settle before inquiring closer. On the other hand, we are strongly motivated by a desire to engage in the ongoing process of developing IIs in order to influence them (Hanseth, Hatling and Monteiro 1996).

Our approach is pragmatic. We present an *emerging picture* of II standardisation based on the empirical material at hand but adjusting it as more experience with IIs is acquired. Although the two EDI cases we consider in section 5 are not in ordinary, widespread use, there is some practical experience with using them. They exhibit a number of salient features of II standardisation. The notion of the strength of an inscription outlined in section 2 needs to be judged on the basis of a sequence of practical trials and errors. We accordingly cannot say as much about this now as we would like. It belongs to a later project.

5 The development of information infrastructure standards for health care

5.1 Information infrastructure for health care

Health II is use of an II within the health care sector. It has evolved over a period of ten years (see section 5.2 below) and takes different shapes over time. Its two main types are transmitting of form-like information and (possibly real-time) multi-media information. Illustrations of the former include: lab orders and reports exchanged between general practitioners (GPs), hospitals or labs and (other) labs, admission and discharge letters between GPs, specialists, and hospitals, prescriptions from GPs to pharmacies, exchange of non-medical information like ordering of equipment and food and invoices from hospitals and GPs to health insurance offices for reimbursement. Illustrations of the latter type include: telemedicine services, that is, computer based services which usually include real time multi-media conferencing systems supporting a physi-

cian requesting advise from another physician at another institution, access to data bases and Web servers containing medical information and PACS (picture achieve systems for X-rays) systems.

The various forms of information exchange are overlapping and interconnected. More specifically, the same piece of information may be exchanged as part of different transactions, for instance, by transmitting a digital X-ray image either using a multi-media conference system or attached in an e-mail. Furthermore, any organisational unit may engage in transactions with several other units. A lab, for instance, may communicate with a number of GPs, other labs and other hospital wards. To handle the interconnected dependencies between different types of communication within a health II is a major challenge.

5.2 Brief historic sketch: the global scene

Standardisation of health care information exchange has been going on for years within numerous bodies in conjunction with various collaborative and competitive relationships. An early standardisation effort started in the US in the mid-80s through the establishment of the HL-7 consortium. This consortium was established by small vendors in order to develop a shared standard as an important tool to strengthen their competitive position compared to the larger vendors. Accordingly, they did not allow the latter to participate. The resulting HL-7 standard has been actively promoted in Norway and other European countries by Andersen Consulting.

At the MEDINFO conference in 1986, an initiative to develop open, international standards was taken. This resulted in the establishment of the IEEE 1157 committee, usually called Medix. The Medix work was considered the most important effort among those believing in open standards until 1990, when the Commission of the European Community (CEC) asked CEN, the European branch of ISO, to take responsibility for working out European standards for information exchange within the health care domain. For CEC, standards were considered important vehicles for establishing the European inner market. With the financial and political support of CEC, CEN has become the most powerful standardisation body in the health care domain (CEN 1993c). The CEN work has been coordinated with health care related standardisation work in other parts of the world (US, Oceania and South-East Asia). When CEN in 1991 decided to base the development of lab messages on EDIFACT, parts of their work was delegated to Western European EDIFACT Board (WE/EB), a subsidiary of the United Nations EDIFACT Board. CEN and WE/EB established a liaison agreement covering those health messages which were based on EDIFACT.

Standardisation of information exchange in health care is a manifold activity. Lots of different bodies are developing standards within limited areas. ASTM (American Society for Testing and Materials), for instance, was among the very first bodies to start work on lab result standards. Their proposals have been more or less adopted by HL-7 as well as Medix and CEN. Within the field of medical imaging, the standardisation work organised by ACR/NEMA (American College of Radiology/National Electronic Manufacturers' Association) seems by far to be the most influential. This work is dominated by large companies like General Electric, Siemens and Phillips. US standardisation activities have since January 1992 been coordinated by ANSI (American National Standards Institute) through HISPP (Health Informatics Planning Panel). HISPP's work is supported by, and tries to coordinate the work of, eight (!) standardisation bodies, numerous federal agencies, professional organisations and health system vendors.[4]

At the moment, the institutional arrangements seem to have stabilised. However, the development of standards — not to mention their implementation in products and adoption by user organisations — has been slow. Based on personal experience, it seems that the more formal the standardisation process is, the slower the adoption becomes. Industrial consortia like HL-7 and in particular ACR/NEMA seem so far to be most successful. As, to the best of our knowledge, there does not exit any systematic evaluation, this is difficult to document. But studies in other sectors than health care exist. The evaluation of EU's program for diffusion of EDI in trade, the TEDIS programme, lend support to the view that formal standardisation is incredible slow in diffusing (Graham et al. 1996). An evaluation of EDIFACT on behalf of UN came to same conclusion (UN 1996).

4. A comprehensive overview of various international standardisation efforts can be found in (De Moor, McDonald and van Goor 1993)

5.3 Brief historic sketch: the Norwegian scene

The development of II for the health sector in Norway has basically three origins: Telenor and their telemedicine programme, a private lab, and an infrastructure programme for the public sector.

Telenor (the former Norwegian Telecom monopoly) carried out a telemedicine pilot project in 1984-85. The experience from this project convinced them that the health care sector was an interesting, future market for advanced telecommunication services, especially in the scarcely populated areas in Northern Norway. Telenor started a project called "Telemedicine in northern Norway" in 1987. Within the telecommunication sector, standardisation has always been considered important. They accordingly emphasised standardisation efforts from the beginning in order to establish larger telemedicine networks; standardisation work became one of their major tasks. As for traditional telecommunication services, they took for granted that the standards should be international and "open," that is, developed according to the procedures formal standardisation processes. Telenor viewed the Medix standardisation effort to be the most suitable one and engaged heavily in this. They also acted as standardisation "partisans" in Norway. Their perceived neutrality together with the investments in the telemedicine project, effectively made Telenor a very influential actor within II standardisation in Norway in the 80s.

An important early event in the building of a Norwegian II for health care was when Dr. Fürst's Medisinske Laboratorium, a privately owned clinical-chemical laboratory, in 1988 developed a system enabling their customers (that is, GPs) to receive test results electronically. Fürst had for a long time been a competitive, service oriented lab, advanced in their use of technology. They recognised the strategic opportunity and developed a simple solution. They paid the patient record vendors to adapt their products to it, and offered it free of charge to GPs. (They even paid their expenses to modems!). Receiving electronic reports from clinical-chemical labs makes the work of GPs significantly easier as each GP receive approximately 20 reports a day, which take quite some time to register manually in their medical record system. Fürst was very successful as their system provided them with a large number of new customers.

The competitive advantage Fürst obtained by means of their system created problems for other labs. Most of the labs are hospital labs and their expenditures are paid for by the owners, in Norway the county authorities. The county also pays when a GP orders a test at a private lab. The profit margins are significant so the counties soon recognised the need for a similar system. Most clinical-chemical labs implemented similar systems within a couple of years.

From 1989 to 1992 a government agency, Statskonsult, was running a program aimed at speeding up the diffusion of telematics applications within the government sector. Promoting OSI standards and EDIFACT systems based on OSI were key subgoals. Certain areas within the health care sector where identified as especially suitable for EDIFACT. They were selected on the basis of their stipulated transaction cost savings and increased possibilities for controlling public expenditures (Statskonsult 1992). Transmission of physician invoices to social insurance offices was chosen as the very first application for EDI. Later on drug prescriptions were attempted standardised.

The experience with lab report transmission systems were positive. Together with Telenor's Telemedicine project, fuelled by an ongoing promotion of standards by Statskonsult and Telenor, more and more people became convinced that establishing a health II would significantly benefit the health care sector in Norway.

Having identified international, open standards as a key factor, a race started among several organisations — vendors, health care institutions, network operators, professional organisations — for presenting themselves as a leading standardisation authority. The actors associated with different international standardisation efforts, claiming that their strategy was superior to the others. It was an open question which standardisation strategy to adopt. Besides Medix, HL-7 was a strong candidate in those days. But when EU in 1990 delegated to CEN the responsibility, and significant financial resources, to work out European standards, there was no doubt that the formal standards of CEN and EDIFACT would be preferred.

In Norway, the Ministry of Health started the programme "Standardisation of information exchange in the health sector" in 1991. KITH, a newly founded institution, was delegated the responsibility as well as funding for running the programme. At this point in time, international standardisation of messages had already been moved from IEEE/Medix to CEN/ TC 251. Hence

KITH aligned its work with CEN. Important here is the fact that CEN standards have status as laws.

Application areas addressed so far include orders to and reports from clinical-chemical labs, reports from X-ray clinics, reports from micro-biology labs, drug prescriptions, and physicians invoices (CEN 1992a; KITH 1991). Except for reports from clinical-chemical labs, these efforts have so far not produced any system beyond demonstration level. A number of telemedicine systems has also been developed and put into use without any seemingly concern for standardisation. Internationally, standardisation of medical images has been a major issue, but not in Norway.

5.4 The organisation of the standardisation work

The CEN standardisation work is organised by TC (technical committee) 251. Standards and work programmes are approved in meetings where each European country has a fixed number of votes. The work is organised in eight so-called work groups, from WG1 up to WG8. Each group is responsible for one area. WG3 is responsible for electronic messages. The tasks demanding "real work", for instance, developing a proposal for a standardised message, are carried out in project teams.

In areas where EDIFACT is used, the definition of the EDIFACT message is delegated to the EDIFACT standardisation body, WE/EB, which has established a so-called message design group, MD9, for the health sector. They have a liaison agreement regulating their cooperation. This alignment is furthermore strengthened by the fact that a number of the members of CEN/ TC 251/WG3 are also members of WE/EB MD9. As of July 1995, the secretary of WE/EB was moved to CEN.

CEN is committed to using ISO's OSI standards. EU and the public sectors in most European countries are committed to OSI standards through their so-called GOSIPs (government OSI profiles). The specification of which OSI protocols that should be used is delegated to EWOS's (European Workshop on Open Systems) work group on health care.

In Norway, standardisation work is organised to mirror that on the European level, except that so far there has only been established three groups corresponding to similar CEN groups: security, medical records and electronic messages. The last group has also undertaken work in areas not addressed so far by CEN, namely drug prescriptions and GPs´ invoices. At the moment (spring of 1996), a working group on medical images and multimedia is being established. This group will also cover telemedicine which so far has not been addressed by CEN.

Typical work tasks include specifying Norwegian requirements to a European standard, validation of proposed European standard messages and appropriating European standardised messages according to Norwegian needs. The work also in Norway within an area covered by a CEN working group is organised as a project. Norway has been very active in the development of EDIFACT messages, and the secretariat for MD9 is located to Oslo.

In addition to CEN, the standardisation work in Norway has cooperated closely with the development of the Norwegian OSI Profile for the public sector, NOSIP. It is decided that its recommendations are mandatory for the health care sector.

6 Two case studies: inscriptions in standards

We now turn to a more detailed exploration of inscriptions in standards. By presenting two cases, lab orders and reports together with drug prescriptions, the process through which programs of action are inscribed into standards is illustrated. This process unfolds as a sequence of translations where the strength of inscriptions are tested and new translations are negotiated among the actors involved in the standardisation process. During these negotiations different actors proposes and argue for different possible translation alternatives. Each alternative inscribe different programs of actions. The negotiations produce winners and losers, as translation alternatives reflect interests differently.

The two cases are presented from a Norwegian angle. Still, they unfold in different settings. The former, the lab case, was quickly and strongly aligned with standardisation at an international level. The prescription case, however, was basically situated in Norway and only weakly aligned with international efforts.

6.1 The lab case

6.1.1 Act 1: Choosing the proper standardisation model

There were several, alternative standardisation strategies, or models, promoted originally. These models are based on deep-seated convictions about how technology development takes place. They inscribe quite different spheres of authoritative competence and steps to proceed in the design. We describe how the open question of a standardisation model was settled at an early stage.

The development of lab information exchange systems i Norway started (cf. earlier section) when Dr. Fürst's laboratory's developed their own, non-standardised system for lab report transmission to GPs in 1987. The system was very simple — the development time was only 3 weeks for one person. It was based on the scenario that GPs would save much time otherwise spent on manual registering lab reports, and that the GPs would be very interested in this. This appeared to hold true. The system proved to be a great success for Fürst as it brought them lots of new customers. Within a couple of years several non-private labs (in hospitals) developed or bought systems with similar functionality in order to be competitive. Although these systems were more or less blue-prints of Fürst's, there were differences which inscribed extra work for the vendors of medical record systems for the GPs. This made the vendors interested in working out one, shared solution.

Exchange of lab information was among the topics which Telenor's telemedicine programme focused on. Telenor exercised their inclination for standardisation and argued that this should also apply to this area as well. As a significant number of labs, GPs, hospitals and counties acquired experience with lab report transmission systems, there was a growing awareness that this kind of technology could be useful for a wide range of different areas within health care. Telenor, together with a few GPs and IT people with interests or responsibilities for general strategies, argued forcefully for general standards. And rather soon it became an established "fact" that further diffusion of lab report transmission systems had to be based on general standards. As one of the IT interested GPs succinctly expressed it to us at a Medix work-shop: "We need standards now".

Alongside the growing focus on standardisation, Norwegian activities were aligned with international standardisation efforts. Telenor got involved in the Medix standardisation effort in 1989. Andersen Consulting and a couple of other companies tried to establish HL-7 as a standard in Norway. On the international arena, there was quite intense disputes between the different standardisation bodies about which approach was to be pursued. The issue was open. Medix, which was dominated by IT professionals working in large companies like HP and Telenor and standardisation specialists for health care authorities, adopted the dominating approach at that time, namely that standards should be as open, general and universal as possible. This implied basing them on existing OSI protocols. How to develop the parts specific for health care was less clear. After a while, Medix concluded with an apparently obvious truth. The messages should be based on a coherent data model of the health sector. In perfect line with text books in information systems development, the model should be developed as a true description of the real health care world as it was, independent of existing as well as future technology. Individual messages would be derived from the model more or less automatically. Lab reports were still the most focused area. At this time (1990), the task of developing a Norwegian standardised lab report message had been translated into the development of a proper object-oriented data model of the world-wide health care sector.

It is fair to say that the strategy first adopted, accumulating practical experience from various contexts of use within the health care sector, was abandoned in favour of a strategy focusing on modelling techniques. This amounts to a shift of emphasis from competence about health care to competence in software engineering.

CEN established TC 251 on the 23. of March 1990 dedicated to the development of standards within health care informatics. This was in response to being delegated the responsibility as well as funding by CEC. The money and authority granted CEN by CEC resolved all disputes about which standardisation body was the important one in Europe. All active participants in the other standardisation bodies now joined CEN. Although the different views persisted, CEN functioned well as a coordination and arbitration mechanism.

The EMEDI (European Medical EDI) group was established in 1990 by a group working in purchasing departments in hospitals. For them, EDIFACT appeared to be an important tool for improving their purchasing support systems (ordering and receiving invoices). Within this area, EDIFACT was already established as the leading standard. This group was convinced that EDIFACT would be useful within health care as well.

Because so many proposals for lab messages already existed, WG3, the working group within CEN TC 251 responsible for messages, first decided not to develop their own. They wanted to adopt an existing one (CEN 1991). WG3 hoped EMEDI's message specification could be proposed as a pre-standard. If so, a pre-standard for lab information could be ready already in April 1992. There was a great pressure for producing results rapidly. However, representatives of other bodies (EUCLIDES and ASTM E31.11) were not willing to accept a specific format like EDIFACT coming from a competing body. They proposed to first develop an information model for lab, a model from which the information to be exchanged based on EDIFACT and other formats could be derived. This proposal was clearly inherited from earlier Medix work, channelled to CEN by former Medix people. As more countries participated in CEN TC 251 than EMEDI, it was decided to adopt the information model approach. This work was extended by a specification for how information should be exchanged using EDIFACT.

At that time, EDIFACT was gaining momentum in Norway. The Norwegian company being most active (EdiCom) in developing and marketing information exchange systems for the health care sector decided to promote EDIFACT. They developed in 1991 a proposal for an EDIFACT lab report (based on the HL-7) message. An information exchange system based on this message was also installed in a few Norwegian labs that year. This company also participated actively in the Norwegian standardisation project, EMEDI and CEN WG 3. Their message proposal was more or less adopted by all of these.

KITH aligned with Statskonsult´s "Infrastructure Programme" and argued that NOSIP recommendations should be followed in the health sector. This implied using EDIFACT and X.400 for transmission of lab reports. An indication of the impact of these argument, one vendor (Profdoc) reported that it was impossible to marked information exchange systems towards the health care sector if they were not NOSIP compliant in 1992.

The initially open question whether one should focus directly on gaining practical experience was blocked by the persuasive rhetorics and prospects of international standardisation, standards which only much later could be implemented and function as a source for acquiring practical experience. This delay of practical experience by aligning with international standardisation bodies inscribes much fewer and less direct channels for end-user input from health care (see section immediately below).

The diffusion of the standardised messages has been very slow, close to nothing. The non-standardised systems developed and adopted by users in the period 1987 to 1992 still dominate although their further diffusion has stopped. There is a wait-and-see situation today.

6.1.2 Act 2: EDIFACT inscriptions - EDIFACT as actor

As outlined above, basing the international standards for lab messages on EDIFACT was far from obvious some five years ago. In order to obtain a firmer grasp of the implications of this, we spell out programs of action inscribed into EDIFACT. It is crucial to recognise that EDIFACT is not a self-contained piece of technology. It is a heterogeneous actor-network which includes: syntax for defining data structures; tools like converters and data bases for messages and elements; a hierarchy of standardisation bodies on a global, regional and national level; established practices for how to define and implement messages; an EDIFACT industry of vendors and consultants; artifacts like manuals, documentation and educational material about EDIFACT.

The size and complexity of this network make the inscriptions strong and difficult to work against. We look at programs of action related to the standardisation process of EDIFACT first, then we turn inscribing patterns of use in EDIFACT messages.

EDIFACT technology and the organisation of EDIFACT standardisation processes make it virtually impossible for users to be involved in, not to say influence, the standards. They are controlled by a group of more or less professional standardisation people who work for large companies or bureaucracies. Inspired by MacKenzie´s (1990) notion of the "gyro mafia", this group may be dubbed the "standardisation, or EDIFACT, mafia". This mafia's control is neither a

feature of the EDIFACT format itself nor the organisation of the standardisation process, but it is a result of the interplay between the elements of the EDIFACT actor-network outlined above.

The fact that the standardisation work takes place on an international level, creates a wide gap to ordinary use situations. To be involved in the standardisation work, one needs to know all the rules of the game, that is, the technological details of EDIFACT, the formal rules of the standardisation bodies as well as all the informal practices. One of the important EDIFACT rules says that existing standardised messages and message elements should be used as far as possible. This rule creates links between all such elements. When making lab standards, one has to be familiar with standards and standardisation processes within all other sectors as well. The specification of the data format used in the first proprietary systems may literally fit on one page of paper and is easily understood by those who need it. The specification of the European standardised EDIFACT message, however, is a voluminous document of 500 (!) pages. Where these messages are used, the information exchanged is almost exactly the same as when using the old systems (CEN 1992b, 1993a, 1993b). This biases attention towards technical and general standardisation issues at the expense of the specific problem at hand, namely lab communication (KITH 1994). In this sense, the bureacratic and procedural arrangements of EDIFACT inscribe few and indirect opportunities for user influence.

This tendency of the EDIFACT process to down-play practical aspects of use patterns is no well-kept secret. One version of KITH's functional description of the lab message was distributed for comments in 1992. Several hospitals complained that the description was rather incomprehensible due to its emphasis of technical aspects. Similar complaints were raised among a large number of institutions commenting on the proposal for European standard in 1993. They requested, for instance, information about which user scenarios were intended to be supported. Graham et al. (1996) point out exactly the same problem in the evaluation of EU's program on diffusion of EDI in the trade sector, the TEDIS programme.

Moving from inscriptions in the organisational arrangements of EDIFACT to inscriptions in the EDIFACT syntax itself, the syntax is, compared to modern programming language constructs, quite primitive. Technically speaking, it lacks constructs for subtyping (or inheritance), pointers and recursive data structures. The ability to subtype would come in very handy when defining standards covering different geographical areas and different disciplines. Subtyping provides a mechanism for defining a standard as a collection of modular building blocks. The lab messages have been defined in order to serve the purpose of a large number of labs (for instance, clinical-chemical labs, micro-biological labs and X-ray labs). In addition, there are geographical differences. Using EDIFACT, a number of different subsets or specialisations of the message have to be worked out. As support for subtyping is lacking, the only way of enabling this is to define a European message covering *all* local variations as optional elements. Local specialisations are then defined by specifying which of the optional elements are mandatory and which ones should not be used. As the message is put into use new needs will be discovered. When a new element is needed, this must be added to the general European message definition. With subtyping, the modification would be contained within one module, leaving all other intact.

A more modern data specification language would make it easier to define simple structures, making local changes as user needs changes simpler. In this sense the EDIFACT syntax inscribes centralised control and impedes local flexibility (Hanseth, Thoresen and Winner 1993).

EDIFACT inscribes certain patterns of use. This is partly inscribed in the broadly established view that EDIFACT is mimicking today's physical exchange of paper forms such as orders and invoices. This view is also translated into the choice of communication carrier for exchanging EDIFACT messages, using e-mail as standardised by ISO (X.400) as the following example for lab tests illustrates.

Using e-mail implies that the receivers get information when the senders want to provide them and not when receivers request it. For clinical-chemical laboratories, the results will be sent to the ordering physician when the ordered tests are completely analysed, or at predefined intermediate points in the analysis process. This inscribes a behaviour which blocks what is possible with the current, non-standardised INI. The leading laboratory of electronic lab result transmission in Norway and its customers use an INI where the physicians can at any time get the results produced in the analysis process up to that moment. This function will not be provided by the standardised solution.

In principle, the EDIFACT format may be used to define any kind of data structures. One may even find a way for defining object oriented structures. Similarly, EDIFACT may, in principle, be

used for any kind of information exchange. As will become evident immediately below, the strength of the EDIFACT inscriptions make it very difficult to exercise these, in principle, alternatives.

An example of what we mean by the concept of a standardisation model is what we may call the EDI or EDIFACT model. According to this model standards are defined as messages. In addition, one has to agree upon which underlying protocol to use to transmit the messages. It also includes a format for defining the messages. The model is closely tied to the metaphor of physical exchange of paper forms. The standardisation model is often closely tied to a system architecture. In the EDI case, this system architecture is one of independent local applications, between which EDI messages are exchanged. Another architecture is the one to be discussed in the prescription case (section 6.2) where all prescriptions would be transmitted from the GPs to a central database, which the pharmacies would retrieve as needed. Fürst's solution is based on a client/server architecture.

The HL-7 model includes messages and a message format close to that of EDIFACT. However, rather that the exchange of forms model, it is based on what is called a "trigger/event model": when an event takes place certain information exchange actions should be triggered. For instance, when a patient is discharged from the hospital, this information should be transmitted to all systems that needs it. This model is tied to a system architecture containing one central system accessible to everybody at a hospital.

6.1.3 Act 3: Content and scope of the messages

The larger the scope of the message, the larger and more complex the message becomes. As the complexity grows, so does the work necessary to implement the message properly in a system (like a medical record system) as well as the work necessary to ensure that two communicating partners interpret and use the message consistently. We provide illustrations of open design issues related to the scope and complexity of lab messages. The alternatives inscribe different patterns of use of the message.

In the system Fürst developed only basic result data were included. The HL-7 message used later on as a prototype, included more information. Reflecting the US organisation of the health sector where payment information is always present due to the private financing, economic information was included. Some economic information may be relevant in Norway as well, in particular if the message is seen in the context of the overall economic organisation of the sector, that is, who is paying for what, who is responsible for quality control and cost containment, which institutions are involved in the payment and which information do they need.

Based on use scenarios worked out in the Norwegian lab messages working group during 1991-92, it was concluded that the data set in the HL-7 message did not satisfy the needs (KITH 1991). The message proposal was distributed together with a request for comments. It was, however, decided that economic information should not be included in the first official message standard for reasons of simplicity. This was not uncontroversial. NAF, the association of pharmacies, expressed in their comments that the areas of use should be expanded to include information exchange between labs, GPs and institutions outside health care such as social insurance and banks.

In some European countries, the patients (through the GPs) pay part of the costs of the tests, but not in Norway. For this reason, the price the GPs pay for each test is included in the European report message. The GPs are invoiced periodically. The price information is important in order to control that the amount they have invoiced is correct. Accordingly, the European standard message include this economic information, and so does the Norwegian subset.

Another open issue was whether the information in a lab order should be included in the result message as well. Usually the result is returned to the ordering physician knowing the order specification already. Accordingly, in most cases the order information would be unnecessary. In some situations, however, the result is returned to another GP than the ordering one. This is the case in ambulatory care, where the GP visiting the patient orders a test while the result should be returned to the patient's ordinary GP. In hospitals the ordering GP may have left work and a new one has taken over the responsibility of the patient when the result arrives. In these cases, the result should include the order information as well. If this information is not available, the GP may try to guess (which in many cases would work pretty well), or call the lab and ask them.

The arguments against including the order information are the increasing complexity and size of the messages it leads to. One proposal put forth was to send the order as a separate message when needed. This solution needed a reference in the result message to its corresponding order message to avoid confusion. Such references, however, are not a part of EDIFACT as it is used. Technically, it would be very simple to find a working solution. The problem was that it would not follow the "rules of the game" of defining EDIFACT messages. It worked against deeply inscribed practises of specific ways to use EDIFACT so it was ruled out. It was instead decided that the order information could be included in a result message.

These examples illustrate that the inclusion or not of a data element in a standard is an negotiation over which programs of action should or should not be inscribed into the standard. In these negotiations, EDIFACT acts as a powerful actor in the sense that most alternatives are close to the intended and customary way of using EDIFACT.

6.1.4 Act 4: Semantics of elements of a message — identifiers and codes

Lab information contains elements which uniquely identify patients, GPs, other hospital units, specimen and orders. Depending on how widely the system is used, the requirements for unique identification vary. If it used among only a given pair of communication partners the need for identifying the GPs and the ordering unit are relaxed. The different solutions for handling identifiers inscribe different behaviour as we proceed to illustrate.

When exchanging orders and results on paper forms, patients and GPs are identified by their ordinary name and possibly their address. In Norway, the orders must contain the patient´s social security number because the labs must include this information in their reports to the social insurance authorities, who use it in their control routines. On the other hand, the GPs are not authorised to use the social security number in their electronic medical record systems. They use identifiers generated by their own system. These identifiers are unique within the scope of that system. These identifiers are put on the orders and used in the pre-EDIFACT systems for electronic transmission of lab results. As these identifiers can only identify a patient within the medical record system of the receiving GP, it is impossible to identify which patient the results belongs to if anybody illegally get hold of the report information during its transmission. Encryption mechanisms are accordingly unnecessary. These locally defined patient identifiers satisfy the needs of GPs and labs. But the electronic orders must contain the patients' social security number due to the social insurance authorities´ requirements.

Orders on paper forms are uniquely identified as each lab produces their own ordering forms, each copy having a unique number. In the GPs medical record systems, orders are identified by the local patient identifier combined with the date the specimen was taken. This identifier definition inscribes that there may only be one order per patient per day. The lab systems use their own local identifiers. In the European standard message, an order is uniquely identified by the combination of the sender's and the receiver's local identifiers. As both parties have to store this identifier, this implies considerable work to change the systems as such identifiers are usually crucial parts of a system affecting most of its components.

An essential part of a lab report is the results of the analysis performed. Most labs use their local coding schemes to represent the semantics of the result. The meaning or semantics of the codes are distributed to the GPs on paper. GPs usually develop their own codes in their patients' records. When the GPs receive reports on paper forms which are manually registered in the medical record system, the conversion from the lab's to the GP's result codes are done manually on the fly. The first non-standard systems for electronic transmission of reports were all based on the sending labs´ own codes. The electronic medical record systems used by the GPs were adapted and extended with simple facilities for code conversion. The GPs had to manually update the system with the labs' and their own coding schemes and the mapping between them.

During the standardisation activities, agreeing on standard result codes has always been considered an issue of utmost importance. Such an agreement, however, has still not been reached. As each GP communicates electronically with several labs, lack of standards causes increasingly time consuming work-arounds. Similarly, the vendors of the medical record systems are urged to develop increasingly sophisticated support functions for this task. Systems for electronic distribution of the coding lists are wanted by the GPs.

6.1.5 Act 5: Lab orders

Labs want to receive orders electronically as they may save much manual registration work. Ordering GPs, however, have to do the same amount of work anyway. A crucial aspect of ordering tests is to ensure that an order and the specimen it belongs to are not mixed with others. A procedure followed by some GPs and labs today is the following. Each copy of the paper forms representing orders is given a unique number. This number is printed on two different places on the form, one is an adhesive label that should be removed from the form and glued to the specimen container. In addition, the paper order is also connected to the specimen container. Reproducing this level of security in the scenario with the order transmitted electronically will not be easy, and will certainly include the design of specific technological as well as organisational arrangements. The design of a solution for lab orders invariably involves the align of the complete heterogeneous network of the collection of associated work routines as well as computer systems.

An option much discussed is one including label producing machines (bar code printers), label reading machines, manual routines and new computer applications. Each time an order is filled out, a bar code label will be printed by the GP's system for being glued to the specimen container. The unique number represented by the bar code is also a part of the specimen identifier in the order message. When the lab receives a specimen, a machine must read the bar coded label and ensure that it is attached to its proper order (already received electronically by the lab). The standardised message will reflect the working routines, they will be inscribed into the message. For instance, what kind information is necessary for carrying out the control routines depends on how these routines are defined. This information must, of course, be represented in the message.

However, as the GPs do not have any obvious advantages from electronic ordering, it is reasonably to expect that they are not interested in investing in bar code printers and other technological components these proposal demands.

At the moment, two different solutions are tested out in Norway, each involving one lab and just a few GPs. One of them is based on what is called two dimensional bar codes. The complete order information is represented by a two dimensional bar code and printed on a label glued on the specimen container. The other solution is based on electronic transmission of the order using the standard European EDIFACT message, while a paper form is also printed and sent together with the specimen as in the current practice.

When orders are sent electronically, some new possibilities and advantages for the GPs as well might appear. One such is the possibility for ordering new tests when the result is received. Usually a physician order several tests of the same specimen. Which combination of tests that are most interesting depends on their actual results. Accordingly, it would be useful to order some tests, look at their results and depending on these ordering some more. When both orders and results are transmitted electronically, this possibility may become practical. It might, however, be easier to implement the needed functionality based on the on-line connection in Fürst's original system than when using EDIFACT according to its inscribed and institutionalised practice. Fürst wants to experiment with communication technology to develop new services so that they together with GPs can give patents better service and treatment. However, they consider EDIFACT technology as too complex and inflexible and will probably wait until simpler and more flexible technology is available.[5] Web might fulfil the technical requirements for such technology, but is currently not adaptable in the standardisation networks.

6.2 The prescription case

6.2.1 Act 1: Politically correct standardisation

Unlike lab messages, there has up till now not been much done on an international level regarding electronic prescriptions. The effort in Norway we report on accordingly represents an early attempt to standardise prescription messages. As will become evident further below, the institutional arrangements of the standardisation process which link national and international efforts

5. Interview with IT director Sten Tore Fiskerud, Feb. 1996.

tightly, have resulted in a proposed, international standard for prescriptions heavily influenced by the Norwegian project.

About 13 million prescriptions are prescribed every year in Norway. Given a population of 4 million, this implies more than 3 prescriptions a head on average. These prescriptions represent about 10% of the overall health care budget in Norway. Viewed from this angle, it makes perfectly good sense to try to improve the effectiveness and quality of prescribing drugs by considering an electronic version of it. This is exactly what was suggested by Statskonsult's "Infrastructure programme" (Statskonsult 1992). Telenor´s Telemedicine programme also considered prescriptions. As part of the Infrastructure programme, KITH worked out a preliminary specification for prescriptions (KITH 1992).

It was pointed out that using electronic prescriptions should not conflict with the current practise of prescribing. Today 80% of the prescriptions are basically filled out by the secretaries leaving only the signature to the GPs. This is because the bulk of prescriptions are renewal of old ones. Studies have documented that the process of prescribing takes place under severe time constraints — occasionally leaving only one minute each. The handling of ordinary paper prescriptions is very flexible at the pharmacies in the sense that anyone may hand out the drugs.

The Infrastructure programme started their work on electronic prescriptions in order to speed up the diffusion of EDIFACT in the public sector making it difficult to consider alternatives. And there were alternatives, alternatives which would have inscribed a very different behaviour for the patients, pharmacies and the GPs in ways we proceed to explain.

Kleven (1992), a representative of one of the vendors of medical record systems (Profdoc), suggested early on that one should use bar codes instead of electronic messages. This inscribes a scenario where the GPs, using a special printer, produce a bar code tag which they stick on to the paper prescription which the pharmacies read using a bar code reader. This solution is dramatically simpler that an EDIFACT solution: it needs no coordination with international standardisation bodies, it reduces the number of involved actors to a minimum and it relies on well-known, mature technology only. However, every GP needs a bar code printer. The bar code solution, it seems, was never considered in detail despite the fact that a similar idea had been experimented with in Sweden. But as we shall see later, the idea was not forgotten.

In much the same way as the bar code solution was incapable to resist the inclination towards a solution based on messages, there was yet another alternative which was suggested in vain. Again, this alternative would inscribe a different behaviour than the EDIFACT one. This difference in behaviour was indeed the reason why it was suggested in the first place by the health insurance authorities. They proposed an architecture where prescriptions where stored in a data base instead of being transmitted directly to the pharmacies. The important behaviour which is inscribed in this architecture but not in the one based on pure EDIFACT messages, is that the pharmacies should retrieve the prescriptions only when the patient actually arrives at the pharmacies. This entail that the health insurance authorities no longer would pay for prescriptions which never actually get picked up. According to the health insurance authorities, this represents a substantial loss. The data base solution would also inscribe a different patient behaviour, namely the freedom for the patient to choose herself which pharmacy to visit to get the drugs. This is particularly important for reiterated prescriptions.

Despite several alternatives, the prescription project never seriously considered deviating from an EDIFACT message based solution in line with predominant conceptions on politically correct standardisation strategies. The project was effectively enrolled in the network of the EDIFACT mafia, where solutions not being in close correspondence with their ideology are rarely implemented. It now remains to explain how the process of working out the contents of the EDIFACT solution ran.

6.2.2 Act 2: Small is beautiful — defining message content

The prescription project started as a small pre-project lasting for only three months during the autumn of 1992. It built upon the work done by KITH for Statskonsult (KITH 1992) and aimed at (i) working out a message specification and (ii) an implementation guide. The pre-project was financed by NAF-Data, the provider of applications for the pharmacies. Only three actors were represented: the association of GPs, the association of pharmacies and KITH.

The interests of the pharmacies were primarily improved logistics and eliminating unnecessary retyping of information (Statskonsult 1992). By integrating the system receiving prescriptions with the existing system for electronic ordering of drugs, the pharmacies would essentially have a just-in-time production scheme established. In addition, the pharmacies viewed it as an opportunity for improving the quality of service to their customers. A survey had documented that as much of 80% of their customers were favourable to reducing waiting time at the pharmacies as a result of electronic transmission of prescriptions (cited in Pedersen 1996). The pharmacies also wanted to include information about so-called "bonus" arrangements (frikort) into the message. Certain categories of patients get (up till 100%) bonus on their drugs. This bonus is subsidised by the health insurance authorities on the basis of special reports from the pharmacies.

The interests of GPs in the project had different sources. Electronic prescriptions would eliminate retyping a lot of information which already was stored in the medical record system. It would also greatly support the reports the GPs send to the health insurance authorities, some of them being the basis for their payment. More importantly, however, electronic prescriptions were viewed as an element of the association of GPs' ongoing programme on quality assurance (cited in Pedersen 1996). Electronic prescriptions allow automatic cross-checking to be performed (for instance, that all fields are filled in properly). The GPs were also attracted by the prospects of getting access to the pharmacies' drug item list. This list is provided to the pharmacies by their provider of drugs (NMD) through the pharmacies' application supplier (NAF-Data). The list contains information useful also for the GPs, for instance, about price and synonymous drugs. It is updated on a monthly basis. As we shall spell out in more detail further below, this list turned out to become the source of much controversy. Today, the list of drugs accessible to the GPs medical record system is either manually entered and updated or is provided through the vendors of medical records systems at a substantial cost.

During this pre-project phase, the proposed inscriptions contained in the message was tested by manually "running" different scenarios of use for the involved actors. This was intended to ensure that the content of the message was appropriate. They also attempted to keep the contents as small and simple as possible through a minimalistic solution (KITH 1992). Only later would it become evident that this was not satisfactory. More specifically, it became clear that the pre-project had not covered the scenarios all the involved parties were interested in.

There were essentially three alternatives for a basis of the prescription message considered by the pre-project: (i) the EDIFACT message ORDERS which seemed appropriate as a prescription might be viewed as a kind of order, (ii) a proprietary, Danish message for prescriptions or (iii) to develop a new message. Each of these alternatives inscribe a different behaviour because they imply quite different programs of actions for different actors. Alternative (i), for instance, entails that the project gets aligned with the revisions of the message named ORDERS. As ORDERS is used in a number of sectors outside health care, this alternative forces revisions of ORDERS stemming from, say, manufacturing, to have implications on transmission of prescriptions in Norway. Through the standardisation bodies, Norwegian authorities are obliged to keep up with the latest version.

The pre-project only worked out a specification for what should go into the message (KITH 1992). One did not decide on the alternatives (i) - (iii). The issue was open. Only after the pre-project had started did one learn about an effort within MD9/WG3 within WE/EB which was to look at prescriptions. What settled it was that a Norwegian (Ellen Brox) became the leader of MD9/WG3. She was well acquainted with the work of (KITH 1992). As international standardisation activities concerning prescriptions are modest, she suggested for MD9 that (KITH 1992) should become the basis of a new, international EDIFACT standard for prescriptions. During the autumn of 1992 this was submitted as a so-called "request for new message" to WE/EB under the name MEDPRE. It received status 0 on 1. of March 1993, less than half a year after (KITH 1992). Soon afterwards, KITH worked out an implementation guide for MEDPRE status 0 for use in Norway (KITH 1993a).

The fact that the results of the pre-project so quickly — and surprisingly — gave rise to an international standard, was decisive for the so-far unresolved issue over alternatives (i) - (iii). Now one adopted (iii), namely to base the next phase of the project on MEDPRE, their "own" message.

6.2.3 Act 3: Getting serious — implementing the standard message

During the pre-project, the involved parties had gone to some pains to keep the message as simple as possible. This enable the pre-project to come up with a proposed specification within 3 months. An important simplification was that the whole issue over privacy and security was postponed. According to Norwegian regulations, the kind of personal information in prescriptions is tightly controlled, usually by cryptographic techniques including digital signatures. The pre-project was granted a suspension from these regulations, but was to implement them in a subsequent main project. According to the project leader at KITH, the work on digital signatures have started only in the autumn of 1995 (Yang 1995), three years after the pre-project finished.

In terms of inscriptions, delaying issues over security have immediate consequences. It means that the pre-project did not have to consider identifying the required expertise, various software and hardware solutions, the compatibility of those with the existing collection of medical record systems, ordering systems and communication modules and how to distribute and make sure that a solution was actually feasible in practise for the GPs.

The results from the pre-project, (KITH 1992) together with the implementation guide (KITH 1993a), were circulated to the participants of Norwegian counterpart of WG3 and one medical doctor acquainted with KITH for commenting before proceeding with the main project. Reactions varied greatly. The comments from the vendors of medical record systems were important because these vendors needed to be enrolled into the project to make an integration of electronic prescriptions and the GPs' existing systems feasible. The two largest vendors expressed quite different attitudes.

One (Infodoc) embraced the idea. As they already had some experience with similar work in Sweden on electronic prescriptions, they were favourable. They expected to be able to integrate a prescription module with their medical record system relatively quickly thus giving them a leading edge on competitors. The other principal vendor of medical record systems (Profdoc), however, was quite hostile in their comments (Profdoc 1993). Their comments were questioning the very idea of electronic transmission of prescriptions. They demanded that the scenarios should be spelled out in more detail in order to make the usefulness more visible. They furthermore maintained that among their user group of GPs there was only very modest interest for electronic prescriptions. This vendor also pointed out the alternative based on bar codes which "died" so quietly at the outset of the project (ibid.).

A reasonable interpretation of this seems to be that the standardisation mafia was in a position to define the problem as a standardisation problem, a definition which effectively excluded the bar code alternative in a "natural" way.

Despite partly critical comments, an implementation project was established. It was basically financed by the participants themselves. The project was organised to mirror the fact that a number of actors not involved in the pre-project had interest in prescriptions. The main project was organised in a project team and a coordination group. The project team would do the real work while the coordination group was to have a supervising function and being an arena for discussion. The coordination group met every forth month or at demand. In the comments from the pre-project, the health insurance authorities complained that they ought to be involved in the project. They were very much interested in electronic prescriptions as a possible vehicle for effective cost containment. In May 1993 they complained that they ought to have been included at an earlier stage. Another governmental agency responsible for legislation and monitoring the medical work, the Health Directorate, was interested in the project due to the prospects of having a way to control the total amount of drugs each patient gets (prescribed by different physicians and bought at different pharmacies) as well as the total amount of drugs prescribed by each physician. The participants in the coordination group were those from the pre-project together with:

- the professionals in the pharmacy;
- the health insurance agency and the Health Directorate
- the national EDIFACT-organisation (Norwegian TEDIS);

The project team was the operative unit and had the responsibility to work out an implementation guide (that is, how the MEDPRE message was to be used in Norway), specifications for the pharmacies' and the GPs' systems and the final evaluation of the project. The project team met approximately once a month and had representatives from:

- one of the two large suppliers of medical record systems to GPs (Infodoc);

- NAF-Data, the (only) supplier of applications for pharmacies in Norway;
- EdiCom, a supplier of an EDIFACT converter;
- the national association of GPs;
- KITH;

As pointed out above, the pre-project had worked out a minimalistic solution. Several relevant scenarios — including the actual work routines at the GPs' offices and the pharmacies — were poorly elaborated. The data elements of the message were identified but their inscribed behaviour were not spelled out in any detail. Recall that one of the medical record system vendors used this as a basis for questioning the rationale of the whole project. The inscriptions of (KITH 1992, 1993a) from the pre-project were not powerful enough to inscribe a determined behaviour for all aspects of the handling of prescriptions. Examples of identified behaviour which were not properly spelled out include: should the prescription determine which pharmacy or should this be a choice of the patients, how should reiterated prescriptions be handled, should it be possible for the GPs to include short notices to the pharmacies and how should security be ensured (Carlsen 1993; NAF-Data 1994; Profdoc 1993).

6.2.4 Act 4: Making inscriptions strong enough

In section 2 we explained how, according to ANT, inscriptions have to be linked to larger actor-networks in order to give them enough weight to be imposed on users. Exactly how much larger and heavier is difficult to state beforehand, it is a question of trial and error. This is nicely illustrated by studying more closely the effort to have one specific inscriptions, namely the data element for the drug identification number, actually inscribe the desired behaviour.

A principal reason for the interest in prescriptions from the point of view of the pharmacies was the prospect of improved logistics (Statskonsult 1992; KITH 1993a). Integrating the existing electronic ordering of drugs from the drug depot, NMD. This overall behaviour was attempted inscribed into the prescription message through one data element, the one identifying the prescribed drug by using the same drug identification numbers used when the pharmacies order drugs from NMD. In this operation each drug has a unique six digit number. NMD maintains a list containing the identification numbers for all drugs.

Early in the pre-project, the representative from the pharmacies suggested that these numbers also should be used for identifying the drugs in the message (KITH 1992). None seems to have objected to this. This should not be taken to imply that the pharmacies had their ways in every respect. At the same meeting the pharmacies also suggested including a data segment for "bonus" arrangements which would have substantially improved their reporting routines the health insurance authorities. This suggestion was declined, mainly for reasons of simplicity (ibid.).

So the initial idea was simple: streamline the overall operations at the pharmacies using the drug identification number. The scenario which was inscribed was not spelled out in any detail. More specifically, the pre-project did not decide exactly how the GPs should find the correct id number when making a prescription. The GPs do not make any use of this number. They identify drugs using their type or brand names, not their identification number. It is not feasible to increase the workload of GPs by assuming that they look up the number manually. If so, electronic transmission would require more work than using paper prescriptions, and most GPs would see no reason to change. In the pre-project this issue was settled at a fairly general level only. The representative from the GPs' association suggested that it could be solved if the GPs were granted access to an electronic version of drug id number list the pharmacies had. As mentioned earlier, this list is continuously updated and contains useful information for the GPs concerning synonymous drug and prices. In ANT terms, the pre-project presupposed a certain behaviour which basically was inscribed into the semantics of one single data element. What remained was to be seen, however, was whether the intended program of action was followed in practise. After the pre-project was completed, the task was to strengthen the drug identification number inscription by aligning it with a larger actor-network.

In their comments on the results from the pre-project, the sceptical vendor was also critical to how the issue of drug identification numbers should be solved (Profdoc 1993). The solution this vendor suggested was to extract the identification number from another source, the so-called Common catalogue (Felleskatalogen) instead of the pharmacies' drug list. The Common cata-

logue is a paper based catalogue which all GPs have. It contains information about all registered drugs in Norway including their identification number. In addition, it contains information about treatment of acute poisoning, drugs that interfere each other, and a register over drug producers and pharmacies in Norway. The catalogue is printed once a year, while additions regarding new or obsolete drugs are printed and distributed continuously. The Common catalogue is produces by a publisher (Fabritius) and was recently available also electronically in the form of a CD-ROM. In terms of inscriptions, a solution based on the Common catalogue would imply a quite different program of action. The required integration work between the medical record system and the prescription module now would involve the publisher but not the pharmacies and their supplier of drugs (NMD). Besides simply pointing out a, technically speaking, perfectly feasible alternative to a solution based on the drug list from the pharmacies, Profdoc also had a more self-centred interest in it. During the period after the pre-project was completed, Profdoc had a series of meetings with the published of the Common catalogue. Profdoc explored the possibility, regardless of the prescription project, to integrate their medical record system with the Common catalogue. They had never taken pro-active part in the prescription project. When the issue of drug identification number surfaced, they apparently seized the opportunity of inscribing a role for themselves in the prescription project.

The alternative suggested by Profdoc was not pursued in the main project. Rather, the project worked on how to make the drug list available. This soon turned out to be a lot more complicated than they had imagined. The heart of the matter was that the list belonged to an actor outside the project, namely the supplier of drugs to the pharmacies, NMD. The list contained information which was confidential, for instance, about profit margins on pharmaceutical products. Thus NMD had commercial interests in the list and did not want to hand it over free of charge. An array of issues accordingly needed to be solved: how to obtain the list from this non-project actor, how to process the list to make it appropriate for use for prescriptions, who should do it and, not least, who should pay for this. This implies that in order to make the inscription of the GPs behaviour strong enough, they also inscribe a rather complex program-of-action involving actors in several different organisations into the semantics of the same single data element.

The fact that the participants in the project had to finance their activities themselves, made negotiations difficult. The problems with working out an agreement with NMD dragged on. In a coordination meeting in January 1994 it was stated that an agreement was to be reached. By June 1995, still no agreement had been reached.

Due to the EEA treaty, the earlier monopoly status of NMD had been dismantled as of 1. of January 1995. This paved the road for several distributors of drugs to pharmacies beside NMD. Each would have their own drug identification number scheme, no "global" identification scheme exists. This makes NMD's earlier situation a lot more vulnerable. To the project leader, NMD has stated that they now are willing to let give GPs free access to their drug list (Yang 1995). In these days (spring 1996), the provider of applications for the pharmacies, NAF-Data, is setting up a data base for all distributors of drugs in Norway including NMD. This data base is intended to be made accessible to the GPs it was stated in the last coordination meeting in 1995. It is decided that a new organisation will be established and given the responsibility for giving each drug its unique id number.

Late in 1995, the testing of the system for electronic transmission of prescriptions started at a pilot site (one GP and one pharmacy). In this first version of the system, drugs are identified by their ordinary brand names. People at the pharmacy will map this name with its id numbers. When the name is incomplete or misspelled, as it is assumed quite often will be the case, so they cannot understand what which drug the GP actually has prescribed, they will call the GP. This version will not be used for reiterated prescriptions either.

The WE/EB has during 1995 reached a principal agreement to promote MEDPRE from status 0 to status 1. This is expected to take place fairly soon, pending scenarios of use for prescriptions in the US, Australia and New Zealand. This means that, at best, an international EDIFACT message with status 2 could be reached during 1996.

7 Discussion

7.1 The emerging picture of II standardisation

As pointed out earlier, there is a wide variety of different kinds of II standards produced within ISO, EDIFACT and Internet. These standards are on different levels. They deal with message definitions, syntax specification, protocols, file type formats, general purpose vs. sector specific ones (for instance, health care), global vs. regional ones. Most of them are currently in-the-making (cf. section 4). Our study does not provide evidence for drawing far-reaching conclusions regarding all types of II standards. We believe, however, that the health care standards we are analysing in this paper are representative for a large part of the standards of the IIs envisioned in for instance the Bangemann report (1994). The emerging picture of standardisation contains important features. We point out its main characteristics.

As sketched in section 6.1.2, a standard in the form of an actor-network as outlined here, is a part of larger one including tools, practices, standardisation bodies and other institutions and existing network of IIs where parts of the standard (for instance EDIFACT) are already installed together with their users and user organisations. Whether a program-of-action is followed by a user depends on its strength, that is, how large actor-network it is inscribed into and how easy it is to work around the inscription (cf. section 7.2 below).

The experiences from standardisation of information exchange within health care indicates that the actor-networks constituted by standards easily grow very complex. A striking feature is the extent to which the socio-technical problems of establishing an II have been underestimated. The massively dominant approach to date has met with surprisingly few objections. The statement from EDIFACT cited in (Graham et al. 1996, p.10, emphasis added) illustrates how problems are down-played and benefits are exaggerated: "It should be understood that the benefits of having a single international standard outweigh the *drawbacks of the occasional compromise*".

The actor-networks are difficult to grasp, control and change. And alignment of one standard with an existing actor-network is very slow. If anybody has control over the standardisation process and its outcome, it is the professional standardisation people, that is, the standardisation mafia. The complexity of II standardisation is illustrated by the CEN standard for lab messages. Its description fills close to 500 pages of cumbersome writing. The implemented version used for demonstration purposes in Norway today is functionally almost identical with the original, ad-hoc lab message. The description of this fits comfortably onto a single page of written paper and is comprehensible for the bulk of potential users.

The inclination of considering II standardisation as "ordinary" standardisation of technical communication protocols is clearly evident in the thinking and actions of the standardisation mafia alluded to earlier. It was simply "obvious" that establishing lab messages in Norway should be translated from acquiring experience from situations of use in Norway to aligning the specification with perceived European requirements. The standardisation mafia had a role which allowed them to define the problem. And the definition of the problem was accepted. Proponents of alternatives (for instance, Profdoc´s bar codes) was incapable to market their solutions to users.

Our empirical material is limited in its documentation of whether inscribed programs-of-action really are followed by the users. It gives, however, some indications. To the best of our knowledge, after the standardisation of the EDIFACT message for lab reports started in Norway, the further diffusion of non-standard systems has stopped. And the few standardised installation seem to be used as described by the scenarios worked out as part of the standardisation work. Similarly, the EDIFACT messages implemented adhere to the practice inscribed into the actor-network constituting EDIFACT technology. These examples, together with earlier ones and the theoretical analysis, support the hypothesis that IIs easily turn into large actor-networks making their inscriptions very strong — irresistible as well as irreversible.

Let us briefly point out a few implications for design[6] in line with the above picture of II standardisation. The programs-of-actions inscribed should be as flexible as possible both in the sense that users may interpret and use the standard differently as needs changes or improved ways of using it are discovered as experience grows, and in the sense that the standard is easy to change when changed use does not satisfy new needs. Flexibility is achieved by constructing small actor-networks (Hanseth, Monteiro and Hatling 1996). Complex networks and programs-of-action, like the one implicitly inscribed into the proposed definition of the semantics of the drug identifiers (section 6.2.4), should be avoided. This is an argument against universal standards.

There is, however, a great danger for being enrolled into a large network like EDIFACT as the ideology of universal standards is manifest among most people involved in standardisation. This ideology is furthermore closely related to the technical-rational thinking of software engineering and most other fields based on technical and scientific education, including medicine. On the other hand, not all global standardisation activities put equally little emphasis on flexibility. There are striking differences between the ISO/OSI and Internet communities. For instance, we find it reasonable that being enrolled in the Web actor-network gives more flexible standards than those the EDIFACT network has produced.

7.2 The strength of an inscriptions

The earlier outline of inscriptions illustrated through two cases is also intended to motivate a more general interest for the notion of an inscription. We elaborate a selection of issues relevant to judging the fruitfulness, in connection with II standards, of inscriptions.

Granted that technological artefacts never fully determine patterns of use, the issue is really to what extent a specific artefact in a given context inscribes a certain behaviour. Analytically viewed, the strength of an inscription relies on three aspects: the size and complexity of the surrounding actor-network which is linked to the inscription, the degree to which it is aligned with this surrounding actor-network and the strength of the inscription on its own.

The notion of the strength of an inscription offers a different handle on grand, at times dogmatic, issues such as "empowerment", "politics" of artefacts or the debate over technological vs. social determinism. Rather than, say, inquiring whether IS have or have not "politics" on a fairly general basis (Winner 1993; Woolgar 1991), the interesting question — which a notion like the strength of an inscription helps tease out — is to describe the extent to which inscriptions in a given case actually succeed in disciplining use.[7] From this point of view, to talk about the "politics" of an artefact is nothing but a convenient shorthand for a situation where the strength of the inscriptions of the artefact in question is very strong.

When analysing large technical systems like IIs, it is difficult to keep track of the contributions from the various components, that is, the constrains mediated by the inscriptions of the other components. What we are interested in are interesting, that is, strong, inscriptions. To illustrate, consider the case of the ongoing process of developing Internet standards extending the WWW. The inscribed programs of actions are linked to inscriptions in other Internet standards, which are linked to Internet's origin as a Darpa project, which in turn is linked to the US DoD.[8] The "military-industrial complex" has, in principle, inscribed behaviour in WWW standards. Leaning on the notion of the strength of inscriptions, we would maintain that (for most purposes) these inscriptions are too weak to be interesting.

We have so-far embraced (our minimalistic version of) ANT. There is, however, one aspect of ANT which does not do justice to the phenomena in our cases. ANT is relatively goal-oriented in the sense that the scenarios of the inscription is quite well-defined. The inscriptions are different means of enforcing the same scenario. For instance, the sign at the door and the knob on the key are two alternative inscriptions with the same, well-defined scenario in mind, namely to have the guests leave their keys at the desk. The hotel manager, in Latour's pedagogic example, combines and tests these inscriptions in a goal-oriented manner. In our cases, however, this fairly goal-oriented behaviour is difficult to find. Rather, the stepwise development of the standards is characterised by a lack of well-defined scenarios. The scenarios are only spelled out as one goes along,

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6. ANT is developed to disclose the different perspectives and interests involved in design processes, how they are moulded together and the power games involved in these processes. Design guidelines are normative and based on one perspective, usually reflecting one kind of interests. In proposing such guidelines we have to make a choice of interest which we for some reason consider to be superior. When proposing design guidelines here, we choose a perspective from which we believe we most successful develop IIs that most successfully can support the health care personnel and institutions providing best care for patients. Vendors, standardisation bodies, individual institutions and groups might have more specific interests, preferring other guidelines or strategies.

7. This is in line with the argument of Berg (1995).

8. We are grateful to Geoff Walsham who raised this issue at the IFIP WG8.2 working conference in Cambridge, UK in 1995.

constantly improvising and open to surprises. The problem of making the drug identification numbers available to the GPs illustrates this well. The actors started out with very vague scenarios in the beginning relying on later adjustments and elaborations. Not all scenarios are made explicit. The kind of use scenarios captured by user requirement documents are typically only implicit about use scenarios. In the standardisation efforts we have presented, however, use scenarios are attempted made explicit by employing CEN TC 251's standardisation methodology document which stresses explicit use scenarios.

Although never thematised as such, Hughes (1983) account of the development of an infrastructure for electricity contains numerous examples of the same.[9] Our critique of the goal-oriented nature of ANT is related to the argument of (Bowker, Timmermans and Star 1995) where she holds that there are always several, alternative actor-networks, never only one. Berg's (1995) notion of localisation of rationale also frames this process of stumbling, negotiating and refining the scenarios as one goes along.

8 Conclusion

IIs are complex and so is II standardisation. This not a new and original statement, neither one that is difficult to argue. Nor is it our main point. Rather, we seek to illustrate how standards and standardisation of II can be conceptualised as actor-networks, how standards are means to stabilise large actor-networks. This enables us to show how all elements of a standard (viewed as an actor-network) inscribe use behaviour. Here the notion of an inscription may help us in dealing with dealing with the complexity of IIs and develop more appropriate standards.

It is no exaggeration to say that the difficulties of establishing an II have been grossly underestimated by the ones involved. Coupled with unrealistically high expectations about future benefits, this has created a lot of frustration. What is lacking is a better developed sense of the nature of these socio-technical difficulties together with suitable concepts for framing them. The notion of inscriptions seems to us to be a promising vehicle for achieving this. It helps unravel the complexity, both technical and non-technical, which needs to be curbed in order to establish a practically working II.

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9. One might ask whether this lack of clear and stable scenarios is intrinsic to the development of large technical systems like an II — is it possible to have a coherent, overall conception of something that big?

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