REFLEXIVE STANDARDIZATION. INTERPRETING SIDE-EFFECTS AND ESCALATION IN STANDARD-MAKING

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ABSTRACT

In this paper, we address the general question proposed by the symposium: "What historical or contingent events and factors influence the creation of ICT standards, and in particular, their success or failure?" Based on a case study conducted over a period of two years in a Norwegian hospital on the standardization process of an Electronic Patient Record (EPR), the paper contributes to the current discussion on the conceptualization of standard-making in the field of Information Systems. By drawing upon the concepts of reflexivity (as in Reflexive Modernization as theorized by Beck) and unexpected side-effects, the paper makes two key contributions: firstly, it shows that in complex socio-technical settings, standardization processes may induce side-effects hampering the standardization itself; secondly, in such settings side-effects may be interpreted as apparitions of the reflexive nature of the standardization process. Accordingly, attempts to standardize may reinforce complexity. The research question is addressed by providing an historical and contingent analysis of the dynamics emerging from the case.

Keywords: standards, reflexive modernization, side-effects, socio-technical theory, Electronic Patient Record.

INTRODUCTION

The trend towards establishing larger and tighter information infrastructures for control and rationalization implies efforts of massive standardization and integration (see Weill and Broadbent, 1998; and for a critical perspective see Ciborra et al., 2000). However, as integration becomes tighter and as the infrastructure grows in scope and reach, the complexity also inevitably grows. When previously unconnected systems, elements or networks are being connected, new interdependencies will be introduced. This allows novel consequences and side effects to emerge and to propagate in the network.

In this paper we claim that standardization in such settings will proceed in a radically different manner from more isolated settings. When a standardization process is undertaken in a large, diverse, and tightly integrated information infrastructure, the new standard will have to adapt to existing standards through a long-term process. This demand for interaction/negotiation/adaptation greatly increases the complexity of the undertaking, and our claim is that this complexity may severely hamper the attempts to achieve standardization. Rather than reducing complexity, fragmentation, and heterogeneity, the attempts to standardize may actually reinforce or recreate these characteristics. This is the paradox which we attempt to illustrate through an empirical case study, and subsequently to analyze. For this sake, we adopt a socio-technical perspective on processes of standardization and propose the concept of *unexpected side-effect* from the theory of *reflexive modernization* (Beck et al., 1994; Beck, 1999) to interpret specific complexities.

The research presented in this paper is based on a case study conducted in a major Norwegian hospital over the period of two years (2001-2003) on the implementation of an Electronic Patient Record system (EPR). The standardization process which we describe in the paper is centered on this software product. We mean that this product, commonly intended as a communication and collaboration medium for individuals, groups, and institutions, can be seen as a shared convention/system and consequently can be seen as a standard. The process, through which this software product is being specified, prototyped, developed, implemented and redeveloped, as well as integrated with a broader information infrastructure, is what we call a standardization process. The difficulty of this standardization process to come to a closure and define the EPR as a complete standard makes it an ideal case to show dynamics and complexities of standard-making in the field of Information Systems.

Thus this paper contributes to the current debate on standard-making in the Information Systems field by providing a theory based empirical study of standard development and addressing the general question suggested by the symposium:
"What historical or contingent events and factors influence the creation of ICT standards, and in particular, their success or failure?"

The paper is structured as follows. We will first provide our conceptualization of standards and standard-making extending the theoretical perspective from economical to socio-technical. Secondly, we will describe the methodological approach and provide an account of the role of the theory in our research. Thirdly, the case will be described. Subsequently, the empirical evidence will be analyzed and findings discussed in the light of reflexive modernization. Finally, conclusions will be drawn and suggestions for further research will be given.

THEORETICAL FRAMEWORK

The aim of this section is to delineate the theoretical framework used to interpret the process of standardization observed in the case. By doing so, we position ourselves in the current debate on theories of standardization: we support the claim for the integration of the traditional economical discourse with a social perspective (Fomin et al., 2003).

We recognize the importance of the economic perspective on development and use of standards and specifically the importance of concepts as: path dependency , externalities, lock in (David, 1985; Arthur, 1989; Antonelli, 1992; Arthur, 1994). The focus of the economic perspective is in general on models of standards development and their consequences on firms and markets. Standards are accordingly defined as technical elements, while little attention is given to the social shaping of standards and their social and political implications. For instance,

David and Greenstein (1990) define (technological) standards as “a set of technical specifications adhered to by a producer, either tacitly or as a result of a formal agreement” (page 4). Moreover the economic focus is much directed towards process of adoption and diffusion of standards, and not on standard making processes (Fomin et al., 2003).

Acknowledging the economic contribution, we would like to point at other aspects of the process of standard making specifically emerging from our case study. The case shows evidence of peculiar characteristics that altogether make it hard to be included in the existing economical discourse on standardization. Standardization is not a purely technical process, and is not a process that inevitability lead to closure as definition of a complete technical standard. We believe is important to analyze not just the social impact of technical standards, but to contribute to the conceptualization of the socio-technical process of standard-making and of what a socio-technical standard is. We turn then our attention to the socio-technical approach, where we recognize four elements important to our understanding.

First, we conceptualize standards as representing always *local* universality (Timmermans and Berg, 1997). By this concept it is emphasized that universality always “rests on real time work and emerges from localized processes of negotiations and pre-existing institutional, infrastructural, and material relations” (p. 275). There is no rupture between local and universal, but it is from the very local that universality emerges, and in turn transforms back the local. Understanding local universality, means therefore to commit to the understanding of the historical dimension, or trajectory, along which a standard is construct and reconstruct (Dosi, 1982; Strauss, 1993). This implies also to look at aspects of adaptation of the universal into the local (Hanseth and Braa, 1999)

Second, we conceptualize the process of standardization as a process of technology generation as discussed by Schmidt and Werle (1992; 1998) in their study on committee standards and telecommunication technology. They discuss how technology, and the process of standardization, are not neutral, but defined through an intermingled with social, political and economic factors. Similarly, Bowker and Star (1999) point out that standards are always embedded into local networks which inscribe specific believes and assumptions on the reality. This perspective is informed by the social construction of technological system approach (e.g. Bijker et al., 1987).

As third element, we see standards not as isolated elements, but as always embedded into a network of standards: one standard’s order can be another standard’s disorder (Berg, 2000).

Fourth, we recognize the significance of concepts (from STS and ANT literature) as closure (Law and Bijker, 1992), stabilization (e.g. Bijker, 1993) and alignment (e.g. Callon, 1991) in understanding processes of standardization (Hanseth et al., 1996). Specifically, closure indicates a status where a consensus emerges around a particular technology. Closure stabilizes the technology by accumulating resistance against change. In this situation, the actor network where the technology is embedded can be said to be aligned. As we will see, in our case the alignment, stabilization and closure appear not to be reached: the process at case seems to continuously be open (no closure) and negotiated (no final alignment or normalization).

Finally, we would like to highlight the specificity of standardization processes in the health care sector as indicated by Berg and Timmerman in their recent work (the golden standard). To unfold the intermingling of different standards, they propose four ideal categories of standards:

design standards, terminological standards, performance standards, procedural standards. They are presented in Table 1.We will adopt this classification in the analysis of the case.

Table 1. Four ideal typical categories of standards

Category	Specification	Example
Design	*Structure*	*Size of hospital beds*
Terminological	*Stability of meaning*	*ICD 10*
Performance	*Outcome*	*Level of complication rates for a specific operation*
Procedural	*Processes*	*Clinical practice guidelines*

Yet, when the process of negotiation to achieve standardization become so complex and diversified as our case empirically shows, we see the need to push the analysis forward to unfold the dynamics of emerging standards. We believe that what at a first glance may appear as transitional exceptions essentially hide complex dynamics that need to be analyzed, and which may tell us more about the nature of the process itself. In the analysis, we will dig into such aspects by using concepts from the theory of reflexive modernization.

METHODOLOGY

The research reported in this paper is grounded in the interpretive approach to case study in IS (Klein and Myers, 1999; Walsham, 1993, 1995). For data collection, we employed ethnographically inspired methods conducting 30 interviews, 8 instances of observations of daily work and users training sessions, documents analysis, and participation in several discussion meetings. As research group, we also met on weekly basis to report on each other fieldwork, and discuss both theoretical and practical implications and findings. The head of research of the IT department of the hospital has joined regularly these meetings to update on the project, and to suggest interesting area for further research.

Our fieldwork is the continuation of a long research cooperation between our Department of Informatics at the University of Oslo and the IT department of the hospital. Between 1996 and 1999, the implementation of the EPR has been the topic for course project in an Advanced Systems Development course. Each year around 5 groups of 5-7 Master students studied and reported on some aspects of the design and implementation process in the hospital.

The process of writing this paper from the perspective of socio-technical standard-making and reflexivity has helped us to look both at micro and macro level phenomena, and at the intertwining of the two. The socio-technical perspective on processes of standardization provided us with the conceptual and analytical tools to understand the complexity of the problem. Whilst, Beck's theory on reflexive modernization has guided us to the understanding of particular mechanisms of the standardization process of the information infrastructure in the making. In particular, it has helped us to conceptualize how the emerging uncertainties and difficulties of the implementation process were not due to external factors, but internally and reflexively produced. The reflexive modernization theory has directed our attention to the central role of side effects, and their mechanisms of production, in creating a situation perceived as risky and out of control.

CASE DESCRIPTION

Background

The case deals with the implementation of an Electronic Patient Record (EPR) in a major Norwegian hospital. An EPR is a computer-based information system for storing and presenting patient clinical data. It is intended to be the electronic equivalent of the paper-based patient record, and for decades it has been a major concern in the field of Medical Informatics because of the considerable complexity that its design, development, and implementation entail (e.g. Berg and Bowker, 1997; Ellingsen, 2002). Still, successes of deployment of EPR systems in GP (General Practitioners) offices, smaller hospitals, and specific clinical departments in larger hospitals are common. But developing a hospital wide centralized EPR substituting or integrating and homogenizing (read standardizing) the local systems and practices has proven to be a quite different task. Let alone developing a common system to replicate in several hospitals, as we will see this case is about.

In 1995 five University Hospitals in Norway started a project for the common development and implementation of an EPR, which we will call MedEPR. At that time in Norway, several local initiatives aiming at creating a computer-based support for storing and handling patient clinical data were already running. The new project merged the local efforts with the aim to share costs and risks, and to push cooperation and coordination between hospitals across the country. A vendor with adequate experience and resources was chosen and the deadline for the delivery of the system was set to be 1999.

As of today, summer 2003, the project is still running and the final product is yet to be delivered. All five hospitals have managed to implement and scale up the current versions of the system to cover the whole organization. At Rikshospitalet, where the research was conducted, roughly all 3500 potential users had been reached by the end of 2002. Behind the apparent success, the implementation (despite the delay) hides a long list of compromises, ongoing negotiations, and incomplete tasks. Moreover, in these eight years of implementation, not only have some key goals been renegotiated, but also the efforts to reach them have often produced opposite effects. Furthermore, in the same period the role of the IT department in the hospital (leading and managing the implementation process) has dramatically changed with the effect of pushing the range and scope of negotiations surrounding the MEDEPR project well outside the boundaries of the hospital.

In the following sections, we shall give an account of the observed dynamics of the implementation. We have selected three particular snapshots or stories which we think help to unveil aspects of the complexity of the implementation process.

From unity to fragmentation

The first story tells about the observed outcome of the attempt to migrate from a unified system on paper to a unified system on computer avoiding and reducing fragmentation.

In the very same year the MEDEPR project started (1995), Rikshospitalet centralized the paper-based patient record. Previously, each department kept a separate record, so that the same information was stored, displayed and used in a variety of ways and places, with serious problems of consistency and redundancy. The centralization consisted of an intense standardization process, where hundreds of paper forms in use in the different departments were merged and gathered in a structured paper record organized in 10 chapters containing predefined forms. Basically, the aim of the MedEPR project was to replicate and replace the centralized paper record, while allowing for workflow and statistics to route and crunch the

information. In the envisioned scenario the MedEPR would substitute paper and constitute the preferred medium and system for storing and using the patients' clinical data.

Since the project started, new components of the MedEPR were delivered regularly, but the full transition from the paper to the electronic record was never accomplished. As of today, both systems (paper-based and the incomplete MedEPR) are still running in parallel. We have identified three main problem areas related to the incomplete transition.

Firstly, the challenges involved in the design and development of the electronic version were expected to be less complex. As a result, the MedEPR, after eight years of development, is only storing and displaying text, while much critical clinical non–text-based information is still on paper forms.

Secondly, the MedEPR project team had to engage in numerous technical and political negotiations with the departments already owning local EPRs. Often, users perceived the local systems to better support their work routines. Thus, substitution was not a viable solution; neither was technical integration. Technical integration with local systems may be eventually pursued, but is for the moment too time consuming. Currently the systems have functional overlap and coexist, while doctors and secretaries need to perform double entries and cut and paste information between the systems. Moreover, the paper-based record never really threatened the existence of "local" solutions, but it often simply stored its output on the standardized paper form.

Thirdly, the transition from paper to electronic media included also documents previous to 1995 and not standardized. In order to address this issue, the IT department decided to scan older and relevant information and link it to the MedEPR.

Thus the MedEPR has emerged in the years as a partial, continuously negotiated and reinvented artifact striving to substitute and complete the transition from the centralized paper-based patient record. As a result, clinical patient-related information is stored in the central paper record, in the MedEPR as text (as partial copy of the paper record), in local systems, and soon as scanned forms (Table 2). Apparently, the attempt to reduce existing and avoid new fragmentation had instead the effect to increase it. Our evidence shows that it is a *chronic* temporary transitional situation.

We may summarize the described situation in the following table:

Table 2. Summary of current situation of the MedEPR implementation

	Centralized paper record	**MedEPR Vision**	**Current Situation**
Location of Clinical Information	All on paper	All on MedEPR	Most text on MedEPR. Drawings and Graphs on paper or on local systems. Old information scanned and linked to MedEPR. Concurrently, the central paper record has a copy of all the clinical information.
Relation with Local EPR systems	Co-existing with paper record	Substituted with central MedEPR	Loosely integrated with central MedEPR. Negotiations still ongoing.

The quest for integration

The second story provides an account of the results of the attempt to integrate the hospital infrastructure of clinical systems under MedEPR.

The MedEPR, in its original conception, is the ultimate system for storing and routing patient centered clinical information. Ideally, its implementation in a hospital places it in the middle of a hierarchy of systems: upwards it has to integrate with the central Patient Administrative System (PAS), downwards it has to integrate with all sorts of laboratory systems (e.g. EROS, a system for storing and delivering test results). Additionally, as we have mentioned, it has to undergo lots of "horizontal" negotiations with competing local systems (e.g. Berte, a local EPR system developed in the pediatric cardiology department). This vision is a qualitatively different vision (in terms of ambition) compared to the original one, where the MedEPR was supposed to be the one system in the hospital substituting or integrating all the others. As the complexity of the integration slowly emerged, the vision of MedEPR changed and evolved accordingly. Yet, still in this more humble vision, the role of the MedEPR as the central integrated system to access all clinical data needed to be adjusted again (Figure 1).

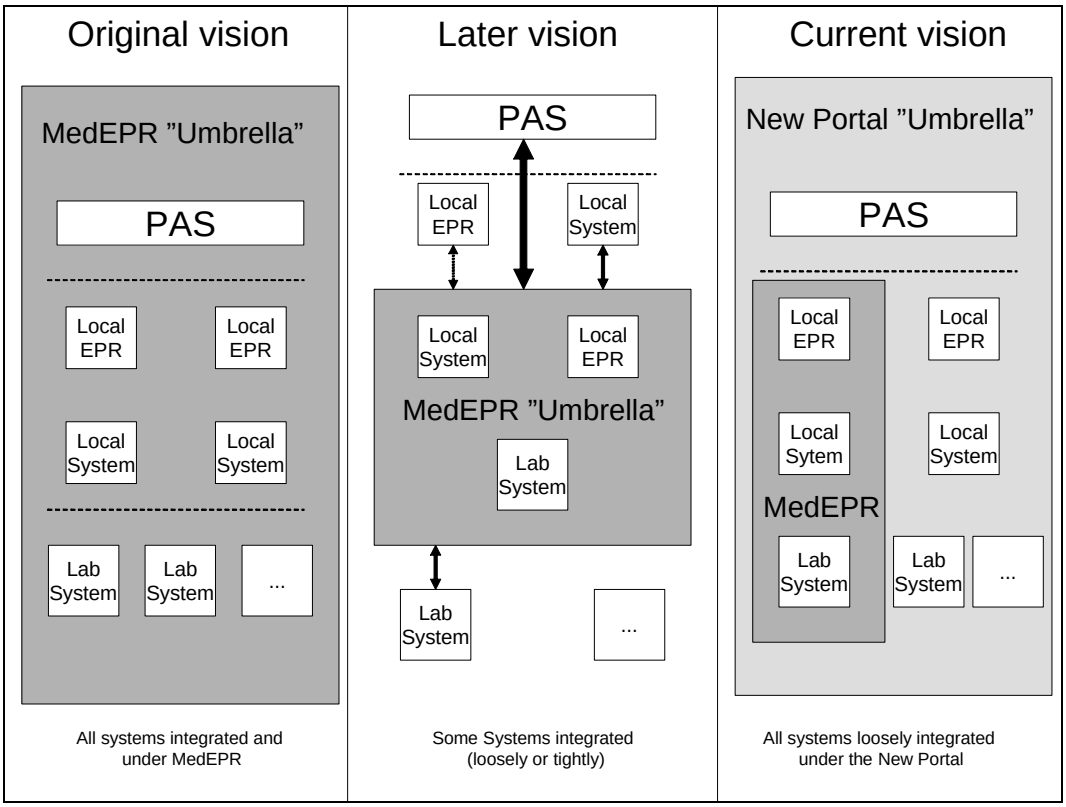

Figure 1. Three stages of the envisioned role of MedEPR

In order to address the growing complexity of integrating MedEPR with the other systems the IT department at Rikshospitalet started a new integration project. The project aimed at loosely integrating the many clinical (including the MedEPR) and laboratory systems into one portal. The portal is a software application specifically dedicated to providing a single point of access to the variety of systems present in the organization. The systems are separately accessible through separate windows while their access is negotiated once for all as a "single-sign-on". While visualization and access to the systems are integrated, the systems themselves need not

to be integrated with each other. This solution, which is currently under development, tries to gap one of the shortcomings of the MedEPR, i.e. the ability to integrate all systems acting as a portal. Moreover, it expands the envisioned role of MedEPR which it substitutes, by providing a new range of services (e.g. activity handling) which were not yet present in MedEPR.

Apparently, the effort to integrate the clinical systems in the hospitals (including PAS) through the MedEPR required yet another integrating system to be implemented and integrated.

Escalating the standards war

The third story describes how the project has progressively enrolled a larger number of stakeholders to assure its survival.

In order to better understand the role of the MedEPR project in the trajectory of the information infrastructure in the hospital, the historical perspective needs to be considered. At Rikshospitalet the MedEPR project represents the first serious attempt to create a common platform across the clinical department for storing and accessing patient-centered clinical information. On the one hand, enough knowledge and competence for developing EPR solution was available in the vendor. On the other hand, the existing IT infrastructure based on LAN and PCs made the project technically feasible. The decision to embark in such a project affected the mission and organization of the IT department. Throughout the 1990s, the IT department acquired employees with medical and administrative background (until then there were only employees with technical knowledge) and grew in size and budget. At the beginning of 1990s the IT departments' staff was approximately 20 persons on a budget of approximately 10-15 MNOK (NOK 10 ≅ $ 1.35). Currently over 80 people are running projects on a budget around 80 MNOK. Moreover, for the next four years (2003-2006), the IT department has set up a budget of 267 MNOK alone for development and implementation of clinical information systems. The budget for similar projects before 1995 was 0 MNOK. The competence of the department expanded from the development of administrative systems to the development of clinical systems.

On another level, the range of strategic influence was enlarged from a departmental scope to a regional scope. Historically, we may identify three phases of the role of the IT department concerning its strategic influence.

1. Before 1995: the IT department mainly served as IT technical support and maintenance
2. 1995-2001: the IT department struggled to create a common IT platform (the MedEPR) between clinical departments
3. After 2001: the conditions in the health sector change. IT strategies need to be orchestrated at regional level.

The last phase implied that the survival of MedEPR was dependent on the ability of the IT department (representing Rikshospitalet) to impose it as a common strategy at regional level. We have already mentioned as the MedEPR project was the product of a national effort between 5 regional hospitals. In the current configuration of the health sector, each of the hospitals participating to the project is in a separate region, while strategic decisions are taken for each region separately. Thus, each hospital adopting MedEPR is "alone" in its region and has to fight to impose their system to the other hospitals in the same region.

The implementation of EPR solutions pushed further and enabled cooperation and integration of the IT infrastructure between hospitals in the same region. At the same time, as different hospitals owned different EPR solutions, the need to rationalize the variety of systems in a coherent regional IT strategy emerged. As a result, the IT department at Rikshospitalet decided

to push MedEPR as the standard to be adopted by other hospitals as well. Moreover, Rikshospitalet applied to become the center for delineating and implementing regional IT strategies. MedEPR is in this situation presented as a defined standard, while in fact it is still incomplete: its integration with the rest of the infrastructure still ongoing, its use fragmented, its design and development under continuous change. MedEPR more than "a" standard may be seen as an evolving system of interrelated standards.

This last account of the case lets emerge how the implementation of MedEPR as a process of standard making tended to escalate in order to guarantee its survival. While the IT department is still struggling to develop it and implement it inside the hospital, it is using it as a finished product to be adopted and imposed at regional level. In other words, while still in-the-making and in order assure its existence, MedEPR is *blackboxed* as a finished standard and used as argument in the political and power struggle at regional level.

DISCUSSION

In this section, we start the discussion by justifying the relevance of interpreting the implementation of MedEPR as a standardization process. Subsequently, we highlight its peculiarities. Then, we will propose an interpretation of the phenomena emerging from the case as side-effects. Finally, we contextualize such interpretation in the larger framework of Reflexive Modernization.

MedEPR Implementation as a Standard-making process

The implementation of an Information System may not be necessarily always seen as a process of standardization. Nor is an Information System necessarily always a standard (as often with ERP solutions; see Pollock et al. 2003). Yet, the Electronic Patient Record is a kind of Information System which is in continuous negotiation with standards, and the effort to develop it and implement may be seen as a process of standardization. In our case, we can interpret the implementation process of MedEPR as a threefold process of standardization:

1. Standardization as integration of existing Standards (e.g. medical and technical, local and global)
2. Inter-departmental Standardization
3. Inter-hospital Standardization

Firstly, the implementation of MedEPR (and EPR systems in general) is a process of integration of a variety of standards into a single solution (Berg 2000). In this sense, instead of being a single standard, MedEPR can be seen as a set of interlinked standards. Using the classification of medical standards proposed by Berg and recalled in the theory chapter, it is evident from the example in table (Table 3) that MedEPR involves all sorts of standards, ranging from technical to medical, from local to global.

Table 3. Example of multiplicity of standards in MedEPR

Category	Example
Design	*-Clinical information organization in chapters* *-Electronic forms layout* *-Departmental templates for discharge letters*
Terminological	*-ICD 10: international diagnosis coding system* *-Formal and informal abbreviation systems for hospital, departments, or disciplines*
Performance	*-Availability and completeness of information according to national laws* *-Security levels* *-Database performance*
Procedural	*-Workflow routines between doctors and secretaries* *-Departmental agreements on documentation procedures* *-Request and reply routines between departments and laboratories*

The development and implementation of MedEPR tries in fact to align, incorporate and link a great variety of medical coding systems, hospitals security standards, formal and informal abbreviation systems, departmental adaptations, national guidelines and policies and so forth. The implementation tries to achieve a *closure*, a stable *alignment*, and *normalization* of this heterogeneous network of actors representing standards (Hanseth et al. 1996).

Secondly, the implementation of MedEPR constitutes a standardization process between the clinical departments, as it performs the integration of existing standards (point one) in each department in a coordinated and centrally controlled fashion.

Finally, MedEPR is the result of a national common effort of standardization of multiple EPR initiatives ongoing in the five main hospitals. It is now pushed at regional level in other hospitals to favor cooperation and information exchange.

Accordingly, we may conceptualize the development and implementation of this very information system (and of EPR systems in general) as a process of standardization. Yet, there are some characteristics of the process at case which tend to challenge its categorization as a traditional technical standardization process:

- The process seems to never come to a *closure* (Hanseth et al. 1996)
    - *Empirical evidence:* after eight years of the development, including four years delay from the planned final delivery, MedEPR is covering 30-40% of the clinical information contained in the paper-based record. The role of the MedEPR has changed, so have the requirements. The changes in national regulations are also affecting further development.
- It is hard to define the boundaries of the network of actors involved in the process of alignment and normalization (Timmermans and Berg 1997).
    - *Empirical evidence:* Actors influencing the development and implementation are active at departmental, hospital, regional, national, and international level. The source of influence ranges from negotiation and adaptation to medical protocols, to laws and regulations on patients' rights to own information.

- It has proven to be extremely difficult to define in advance the full specification of the EPR standard (Hanseth & Braa 1999)
    - *Empirical evidence:* Never in the eight years of development did the vendor of MedEPR or the hospitals managed to create a complete specification of what MedEPR should be. The process has always been emergent and dynamic.

Hence, it is meaningful to interpret the implementation process as a dynamic trajectory, that is, looking at its change, evolution, adaptation and emergence over time, as the result of continuous tensions and negotiations in the socio-technical network (Hanseth et al. 1996). This trajectory entails aspects of socio-technical complexities which need to be investigated. We sustain that it is relevant to study and understand the dynamics of this process of standard-making, and develop interpretive theoretical frameworks.

For this purpose, we will now highlight particular phenomena observed in the case (side-effects), and we will propose a sociological theoretical framework for their interpretation (reflexive modernization).

SIDE-EFFECTS OF STANDARD-MAKING

In the first part, the case presented two particular accounts of the implementation process. It highlighted the struggle to reduce fragmentation and increase integration, and their apparent contradictory effects of increased fragmentation and increased need for integration.

In the story on fragmentation, the attempt of achieving the same unity of medium and location present in the paper-based record system (all information on paper located in the same single folder) in electronic form (all information in digital form accessible through one single system) produced fragmentation in the type of media used and the location of clinical information. What we called here “attempt” is indeed the whole process of design, development and implementation of MedEPR. This process had to engage on the social level as much as on the technical with a great number of actors: from single users in the hospital, to political institutions involved in defining strategies at regional level; from departmental established work routines and traditions, to tensions between professional categories. Our concern is the understanding of how the described complexity of the implementation process of MedEPR generated effects in the opposite direction to the intended one; and how those effects in turn affect and change the way the problem (or challenge) of standardization is conceived.

In the story on the quest for integration, the attempt of integrating all clinical systems (including PAS) under the “umbrella” of MedEPR produced the need for the implementation of yet another integration “umbrella”. Also in this case, more than a mere technical limitation or an unforeseen obstacle, the integration effort brought to light the underlying (and thus maybe not always visible) complexity of links, dependencies, and trajectories of the existing technical and social systems. In this sense, the attempt to integrate generated a greater need to integrate, while changing the envisioned role of some of the actors. For instance, the role of MedEPR changed from one of integration system to that of a component system to be integrated.

The last story of the implementation process presented in the case description regards the escalation of the scope and ambition of the MedEPR project. As we have shown, the escalation was not merely the attempt to expand the influence and acceptance of an established standard. It was used as a strategy to assure the survival and sustainability of a standard which was still in the process of making. In other words, the attempt to address the already complex local standardization required the redefinition of the ambition and scope of the standardization attempt, thus increasing its very complexity and eventually its risk of failure.

We can summarize the three observed aims and actions of the implementation process and their outcome in the following table (Table 4):

Table 4. Aims and Actions of the MedEPR Implementation Process

Aim and action	Observed effect
Achieve unity of media and location of clinical information	Clinical information fragmented in different media and (physical and logical) locations
Achieve integration of systems under MedEPR	Need to implement new integration framework over MedEPR and other systems
Achieve closure of standardization by managing its complexity	Increase complexity of standardization by escalating its scope and ambition

Reflexive Standardization

In order to make sense of these manifestations of the observed phenomenon, we will apply the concept of *unexpected side-effect* borrowed from the theoretical framework of Reflexive Modernization as delineated by Ulrich Beck (Beck 1994, 1999).

In his analysis of contemporary society, Beck underlines the increased importance of *side-effect* of human actions. He identifies an increased *unawareness* or *non-knowledge* at the basis of *side-effects*. As the modern world becomes more and more integrated and interconnected, it is increasingly difficult for humans to be fully aware of all effects caused by their actions. As side-effects become acknowledged, they challenge and question the basic knowledge of the modern society.

In our case, increased fragmentation, increased need for integration, and escalation appear as side-effects that contradict the actions which have generated them, and increase the complexity of the problem those very actions were trying to solve. They could not be predicted: the initiators were *unaware* of how their actions could propagate. In this discourse, a process of standardization can be interpreted as a process that aims at achieving greater *awareness* by developing control. Reflexivity tells us instead, that the more we try to become aware of our society by modernizing it (e.g. by processes of standardization), the more we will cause unawareness, thus side-effects. That is, the more we try to standardize the information infrastructure in the hospital, the more difficult and complex such standardization process will become.

This reflexive dynamic provides an explanation of why the standardization process of MedEPR seems to never come to a closure, and instead evolves over time in an unpredictable trajectory.

CONCLUSIONS

In this paper we have engaged in the discussion about the conceptualization of standard-making processes in the field of Information Systems. For this purpose, we have presented a case of standardization of the information infrastructure in a major Norwegian hospital. Applying the concept of *side-effect* from the theory of *reflexive modernization*, we have proposed an interpretation of the complex dynamics emerging from our empirical material. We submit that the *side-effects* are inherent to the nature of standardization as attempt to control a complex

reality. We believe that the proposed framework has proved useful for unveiling the mechanism behind paradoxical outcomes of standardization processes.

ACKNOWLEDGEMENTS

We would like to thank the IT department of Rikshospitalet, Oslo, Norway. Particularly, Ivar Berge and Arve Kaaresen for setting up the research project and for the long lasting research relationship with the Department of Informatics, University of Oslo. Eric Monteiro and Marc Berg for providing useful comments on draft versions of this paper. Gunnar Ellingsen for comments on the current version.

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