Social shaping & standardization: a case study from auto industry

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Abstract

Inter-organizational collaboration requires systems interoperability which is not possible in the absence of common standards. However, empirical research has shown that Information and Communication Technology (ICT) standards can be a major barrier in the progress of Information Technology (IT)-enabled inter-organizational collaboration [1-3]. Though often portrayed as a narrow technical matter, standard setting is a complex social process, shaped by an array of factors and representing embodiments of social relationships between the actors. This paper approaches standardization from a Social Shaping of Technology (SST) perspective. The paper explores the characteristics and factors that shape the development and implementation of a standard in the case of a portal implementation in the automotive industry.

1. Introduction

The advent of Internet technologies during the last decade has accelerated the diffusion of inter-organizational networks and has intensified the collaboration between organizations. In such an increasingly networked world, ICT standards aim to ensure interoperability between different IT systems within and between organizations. As IT enabled collaboration becomes a decisive tool in the fight for competitive advantage, the compatibility within and between organizations and standard setting have become of strategic significance for companies of all sizes and in all industries [4-6].

ICT standardization is to a large extent influenced by technological innovations in the area of ICTs. In practice, the standardization process itself and the success and failure of a standard takes place in complex socio-technical settings that are shaped by a variety of factors and a multitude of actors. As a result, industry structures in many areas of technology are much more complex than it is usually captured in existing studies which depict a simple image of suppliers, users and markets [7]. For example, some technologies are complex to configure and adapt for use in different contexts. Additionally, implementations are approached differently by developers and users. To reconcile their differences, intermediaries are needed who shape a basic technology provided by the suppliers and configure the different technological components to meet the users' needs. In this process, universal technical knowledge and local knowledge of the organizational and cultural context of use are combined by the diverse actors involved, such as intermediaries, IT developers, managers, and end users within adopting organizations. They not only adopt and allow the diffusion of the technology, but also help users to understand the possibilities and to formulate the requirements, and they also mediate between users and suppliers [7-9].

According to [4], a standard is understood as "a set of technical specifications adhered to by a set of producers, either tacitly or as a result of a formal agreement" [4]. A variety of perspectives – notably technical, economic and lately institutional – have been applied to understanding the development and implementation of standards in general, and ICT interoperability standards in particular. Such theoretical perspectives have shaped the outcome of the standardization studies. Researchers in the economic domain have studied standardization in terms of market driven or formal standardization and their respective effects of their adoption (notably in terms of lock-in) [10-22]. Other standardization researchers have used political theory to study how policy and governance processes influence the choices in standardization and its outcome in terms of standards development [23-29], whereas institutional theory has been applied to study the institutional rules and procedures of standardization that shape technological systems, and hence standards development process [30-32]. Social studies on standardization have focused on identifying the socio-economic factors that shape the process. Such studies acknowledge standard setting as locally constructed and negotiable between the actors involved in the process [33-34]. These factors and the relevant actors cannot be reduced to a narrow explanation in terms of the economic or technical side of the process. However, one key problem with existing social studies in standardization is that standards development is often analyzed separately from standards implementation. A notable exception is [35] which addresses the dynamics of standardization in an integrated approach.

In this paper, the social shaping of technology (SST) perspective is applied on a case study to analyze the ICT standardization process which can be characterized by a highly complex socio-technical setting, involving a diversity of initiatives, and a variety of economic and social factors. The case study identifies and explains the factors that influence the standardization process in its environment. The case discusses the factors that shape the development and implementation of the standards, as well as the factors that have triggered the standardization process in the first place. The paper is structured as follows: the next section lays out the background of the study: it discusses the nature of the technology which is the object of this study and the theoretical perspective employed in the study. The third section of the paper discusses the case study: the research methodology which has guided the empirical research, as well as the description and discussion of the case. Finally, a discussion of the results and the implications of the study conclude this paper.

2. Background

Inter-organizational systems (IOS)

Inter-Organizational Systems (IOS) refer to the computer and telecommunications infrastructure developed, operated and/or used by two or more firms for the purpose of exchanging information that support a business application or process. These firms are suppliers and customers in the same value chain, or strategic partners or even competitors in the same or related market [36-38]. Through IOS, the business partners arrange routine business transactions. Information is exchanged over communication networks using prearranged formats. In the past, IOS were delivered on proprietary communication links. Today, many IOS have moved to the Internet [39].

One of the most prominent types of contemporary IOS in business are portals [39]. A portal is defined as a linked electronic platform with a single point-of-entry, independent of time and space that enables collaboration through access to multiple sources of information [40] differentiates between three different types of portal: employee portals, customer portals and business portals. Employee portals are platforms designed to facilitate internal activities of a company, whereas customer portals present information in a structured way to end customers. Business portals focus on business partners, for example they provide suppliers with information and/or access to internal systems. The functionalities incorporated in a business portal facilitate the buyer – supplier relationship and ensure tighter collaboration [40].

In this paper, the focus is on business portals that integrate content, applications and processes between different business partners in order to:

- Improve communication and collaboration between your organization's suppliers, partners, employees and customers,
- Provide real-time access to information held in disparate systems,
- Personalize each user interaction and provide a unified window into your business,
- Integrate and access relevant data, applications and business processes.

The Social Shaping of Technology (SST) perspective on standardization

The Social Shaping of Technology (SST) perspective arises from a shift in social and economic research on technology that explores and analyzes both the content of technologies and the processes of innovation [41-43]. SST has emerged through a critique of the dominant rhetoric of technological determinism which portrayed technology as a vehicle for achieving organizational change, without taking into consideration the difficulties in implementing technologies, as well as their frequent failures to deliver predicted and desired outcomes. SST research investigates the ways in which social, institutional, economic and cultural factors shape (1) the direction as well as the rate of innovation, (2) the form of technology (content of technological artifacts and practices) and (3) the outcomes of technological change for different groups in society [44].

Based on the seminal contribution of [42], SST goes beyond traditional approaches, merely concerned with assessing the “social impacts” of technology, to examine what shapes the technology and the way in which these impacts are achieved [41, 42]. Central to the SST is the “concept of choice”, though not necessarily conscious choice, inherent in both the design of individual artifacts and systems, and in the direction or trajectory of innovation programs [44]. At every stage during the development and use of a technology or standard, a number of technical choices are available to the actors involved [34, 45]. These choices depend on a number of social, technical, economic, organizational and political factors. SST studies aim to unveil the interactions between these factors, the way in which they shape the technology and their outcomes on the innovations processes [46]. For example, a number of SST and similar studies focus on standardization as an important form of alignment amongst actors and as a process of competition among visions or early variants of a technology. In this context,

standards can take different forms, and the motives and pressures vary between settings [47].

A range of writers from a social shaping of technology perspective, has sought to develop a complex processual account of the standardization process. A number of accounts have focused on standardization as a social process. For example, according to [33], the standardization process represents an attempt to align interests, business practices and expectations of an array of people with an interest to develop and use the system that is to be standardized. Therefore, standardization is not only about providing workable solution, but most importantly, it refers to articulating and aligning expectations and interests [41]. Earlier work from a broadly social constructivist perspective [30-32] has highlighted the influence of actors and broader institutional factors in the standard setting process. Their approach to the study of standard setting has been adopted in further work on standardization that refutes narrow economic approach as limited in its ability to explain the processes through which standards develop. [48-49] For example [48] adopts a similar approach to [31] in combining the institutional approach with social constructivism and social shaping of technology, although the emphasis in this case is clearly on the social processes. [50] describes standard setting as a highly intricate social process, negotiated and mediated by the actors involved. This follows upon earlier strand of research which applied the emerging social shaping perspective to understanding addressing the development and unfolding of Electronic Data Interchange (EDI) [34]. Some work by [51] reflects on the shape and social character of standards and how they impact the actors involved.

In conclusion, the existing SST studies understand standardization as socially shaped, i.e.:

- there are a range of choices possible at every stage of the standardization process
- the choice depends not only on technical but also upon economic, social and organizational factors within the broader socio-technical setting
- the impact of standardization is causing social change in organizations because the standard is importantly negotiated and socially mediated [44]

The locales in which standardization (standards development and implementation) takes place are populated by different kinds of actors – differing widely in their expertise, context, commitments, and perceived interests: software providers, business consultants, technical experts, market intermediaries, and their suppliers. Often the same actors or actors from the same industry/sector are involved in competing standard setting processes, e.g. suppliers often have to accommodate different customers with different standards requirements.

The complexity of standard setting is increased by the multiple level of representation of the actors involved in standards development. There are at least two levels of representation of the actors in standardization bodies: every actor can be seen to represent their employer on the one hand and their individual professional interests on the other [31]. Sometimes, for example in formal, official Standard Setting Organizations (SDOs), a third level of representation is added, the national representation. As a result, a complex web of interests characterizes the standardization arena.

Another factor shaping the dynamics of standardization, which underpin the unpredictability and obduracy of the standard setting and standards implementation process, is the complex set of interactions between the actors and factors that populate the standardization arena. At every stage, the standardization process is influenced by the choices these actors make in a given context. These choices cannot be reduced only to the "technical" issues, since they are influenced as well by economic, social and organizational factors [43]. In the existing literature, a number of authors have developed theoretical frameworks in an attempt to capture the dynamics of standards, for example [35, 44-45]. However their explanatory schemas remain relatively simple. Our current research goals are to extend this line of analysis to better theorize both unpredictability and obduracy in standardization - addressing both stabilizing and destabilizing factors and the relationship between short-term developments and the longer-term evolution. Here we have drawn upon the concept of development arena [42]. This framework stresses the contingency of outcomes, 'surprises' and the possibility of realignments of hitherto stable configurations that may result from complex interactions within the arena. These processes need however to be explicated empirically in different settings. To this end our research program addresses both standards development and implementation, and their evolution over multiple stages in the standards life-cycle.

This paper proposes to apply the SST framework to explore in depth the standardization process in a particular case, i.e. the automotive industry. The aim of the study is neither to test the theory nor to exemplify every aspect of the theory within this single case. Rather, this paper aims to explore the socially shaped nature of the processes that occur within a standardization arena, and thus to advance the development of a framework that addresses the complex patterns of interactions within the standardization arena.

3. Research methodology

The SST approach maintains that technology develops as a result of a mutual shaping between technology and its environment. Existing structures and configurations of expertise pattern the design and implementation of technology/standardization and its outcomes [44]. As a result, the context in which a technology is deployed is crucial in shaping the development and use of that technology. At the same time, SST conceptualizes technology as shaped by an array of interests, locally constructed and negotiable. Following [52-53] recommendations, in the situation in which the context is crucial to understand the phenomenon, and when such phenomenon is seen as socially constructed, a qualitative case study design is required. Such an approach allows to explore in depth the phenomenon within its context [52-53], and sees the reality as socially constructed by the people involved [54] therefore acknowledging the socially shaped nature of the technology.

The empirical research involved a single instrumental case study [52] as the focus of the research is on gaining in depth insights into the standardization process. Rather than attempting to identify general patterns that apply across a multitude of contexts and technologies, this research aims to understand the dynamics of the standardization phenomenon within a particular context: how does it occur and what are the factors that shape its evolution. Such a research design allowed to understand the dynamics present within a single settings [55].

Data collection was done over a period of 4 years, as the researcher was involved in the project from its inception. Ethnographic observation was used as the major method for data collection as the focus was on what people do rather than on what they say [56]. Observation was facilitated by the researcher working on the side during the period of data collection, which thus enabled the researcher to obtain a deep understanding of the people, the organization, and the broader context within which they work [57]. Following [56] where observation was not possible, informal, open ended interviews were used to collect the data (e.g. with suppliers). A questionnaire sent to suppliers together with secondary sources of data such as internal documentation, reports, presentations as well as information publicly available was used to provide a context for the case [58] and to triangulate the data obtained through observation and interviews [59]. Following [52] recommendation, the analysis of the case was based on making a detailed description of the case and its settings and followed the iterative model proposed by [60]: data collection, reducing the data through open coding, displaying the data using descriptive and explanatory data displays, and drawing conclusion and verification.

4. Case study

Triggers

The automotive industry can be characterized as a dynamic and complex socio-technical setting, involving a diversity of initiatives and actors, and a large variety of economic, technical, organizational and social factors. The locus of development for the standardized portal technology is the automotive industry. The industry hence represents the standardization arena for this project. The industry is presently characterized by continuous cost pressure and demand for rapid innovation in order to meet the customers' requirement for "more car" [2]. This pressure forces large car manufacturers (OEMs) and their suppliers to pursue new forms of closer collaboration in order to improve customer satisfaction and increase revenue growth as well as shareholder value. However, such collaboration will lead to a shift in the added value from the OEMs to suppliers and other business partners as activities, resources and knowledge are passed onto the suppliers.

The automotive industry is also characterized by extremely complex processes which means that in order to meet production requirements standardization of processes and data is inevitable. In addition, driven by challenges such as shorter product life cycles, increasing cost pressure in stagnant markets or increasing complexity of the electronics embedded in modules and systems, OEMs constantly outsource parts of their manufacturing [2]. This creates new challenges in relation to the integration, and hence the standardization of processes. OEMs have already started to integrate applications with Inter-Organizational Systems (IOSs), frequently through the use of portal technology to give real-time access to data to their suppliers.

Like the OEMs, the supplier community is also undergoing strong shifts as the result of the increasing collaborative pressure that characterises the automotive industry. Increased collaboration forces suppliers to develop the ability to manage project-based cooperation and provide organizational structures to allow focused partnerships. Increasing model variety and common platforms such as portals require advanced deals and project management capabilities. Consequently, in terms of innovation management, suppliers have to be able to provide leading-edge technology and efficient simultaneous engineering processes, which matters particularly for tier-1 suppliers who are taking over from

OEMs systems integration responsibility and management of the supply chain. However, this also means that they also take an increasing share of risk that used to be incurred by the OEMs [45].

The launch of Electronic Data Interchange (EDI), more than 30 years ago, was the first step of the automotive industry to collaborate closer with its supplier community by means of Inter-Organizational Systems (IOS). The use of IOS allows organizations to integrate their various business processes and enables the formation of networks of inter-organizational relationships. Until the advent of open, cheap and flexible standard based Internet-related technologies during the late 1990s, EDI was the dominant standard in the area of Business-to-Business (B2B) e-commerce. Apart from the lack of flexibility inherent in EDI standards, the high costs associated with the implementation and use of EDI meant that only large suppliers became involved in the IOS. During the late 1990s, driven in part by the Internet hype, the automotive industry initiated a range of new projects to tie suppliers into B2B e-commerce networks by means of IOS. Such projects included electronic collaboration projects that integrated parts of the product development process, and electronic catalogue projects that presented product and service data in a common structured format.

Large Car Company (LCC) had, prior to 2002, launched a strategic program to ensure the networking of the entire value chain beyond the company's boundaries. These projects had already reduced costs and shortened throughput times to some extent, but LCC aimed at an all-out effort to press forward inter-organizational collaboration with suppliers on a global basis. In LCC's vision, such collaboration should include the integration of individual projects in the business units as well as the integration of LCC-specific applications into a global supplier portal.

Apart from the leverage of supplier partnerships, a second trigger was the internal pressure to standardize and streamline inter-organizational activities, not only to reduce costs but also increase the efficiency of information and data exchange and take advantage of leading-edge technology. The vision of a global supplier portal included:

- taking advantage of standardized Internet technology
- the merger of all portal activities into a single supplier portal, which was driven by the idea of a "single point-of-entry"
- the provision of an industry standard interface for suppliers to link into a shared marketplace infrastructure and thus leading to an increased supply base for the LCC.

The use of standardized Internet technology was in line with the global corporate IT strategy which aimed to provide business units (BUs) with a scalable and consistent IT infrastructure with global access to all key infrastructure components and with the reuse of technology across multiple projects and replication of common solutions worldwide. Furthermore, the reduction of costs and risks involved in using dated technology (e.g. no updates available) and crash of systems (out time) was also very much in the focus. The integration of all portal activities worldwide in one single portal was intended to reduce multiple sign-on as well as redundant data entry. An integration and the sharing of LCC-owned applications as well as non-LCC systems was seen to improve supply-network efficiencies through system-driven workflows and alerts . Another goal included to provide a single user interface to the supplier community and to gain access to a wider number of suppliers, through the use of a standardized technology with the benefit of a shared marketplace infrastructure. As a result, both external and internal triggers within the automotive arena led to the approach to develop and implement a standardized industry solution.

Development

The development phase was characterized by the Internet hype and by internal and external cost pressures. The automotive industry saw the use of standardized technology as a means to support their extended collaboration efforts. In order to develop standardized industry processes, in 1999 an Internet hub named Covisint was founded by a number of large OEMs such as DaimlerChrysler, Ford and General Motors and software companies such as Oracle and Commerce One. The aim of Covisint was to connect the automotive industry to a global exchange marketplace.

Whereas Covisint was seen by its founders as "streamlining" the business processes of all participants and enabling them to "collaborate seamlessly" across organizations borders, this was not necessarily the perception of suppliers. Suppliers, which were not (initially) included in the Covisint development phase, had to deal with a number of such "standardized" portals in the automotive industry. Moreover, as they had been excluded from the development process, their requirements were not part of the "Covisint vision". Consequently, despite the acclaimed aim of Covisint to address the costs and risks reduction pressures across the industry, the development stage included the requirements

and vision of the large OEMs rather than that of the entire industry.

In the first instance, following the "tradition" of all projects in the industry, standards development was related to best practices in the industry and had been worked out by a limited number of specialists from the OEMs that were involved in Covisint. At a later stage, this small group approach to standard development was replaced by a consortium of the Covisint stakeholders and the software companies which delivered pieces of software to complete the Internet hub. The consortium approach was more similar with the typical approach to standard development, following specific procedures and having different working groups that met regularly. Additionally, industry experts of associations were invited to presentations and workshops to contribute to the standards development.

The development process was characterized by an iterative approach. Before LCC started to develop and implement the standardized portal technology, another of the OEMs founders had already started to develop a portal registration process (based on the best practice in the industry: the development of standards has benefited from the development of portals by other organizations before).

Due to the "fast-to-market" strategy of Covisint, the standards were developed in parallel with systems development and implementation. The emphasis of the standardization process was on speed and on finding compromise solutions that fitted all parties rather than on long-term quality solutions.

Implementation

There has been constant feedback between the implementation and the development stage of Covisint. Facilitated by an interdisciplinary on-site project team at LCC, regular videoconferences and document exchanges on a collaboration project tool between the implementation and the development team facilitated the communication. An important factor that facilitated this communication was the good inter-personal relationships between LCC and Covisint, for example some of LCCs former employees changed to Covisint at its start. Good personal relationships lead to good communication and ease the feedback process, which also meant that the pace of implementation was quicker.

The implementation of standardized portal technology with LCCs business processes, applications and security environment was a complex integration scenario and brought up a number of issues at LCC and at the suppliers influenced by organizational, cultural, political technical and economic factors [45]. Another key challenge was the integration of the portal architecture and functionality in the existing corporate IT infrastructure.

Discussion

(1) Factors in Development

The development of Covisint was driven by the requirements of its founders (the OEMs) which were seeing Covisint as an opportunity to streamline and extend their business processes in order to reduce their costs and risks by enabling them to work seamlessly across organizational borders. The intention of the stakeholders who spent each several million dollars in the Covisint business could be seen by and large as a business opportunity to exercise power in the industry by inventing standards to 'set the course'.

The change in the approach to standard development was due to the need to ensure legitimacy of the standards in front of OEMs suppliers. An approach that would resemble more with the typical procedures to standard development was seen to assure suppliers of the legitimate character of the standards. Higher legitimacy would increase the confidence of suppliers in the standards, which would benefit the adoption rate. However, participation in the consortium was however closely controlled, and the working procedures were less rather than more transparent and open. The restrictions in participation, the lack of transparency and openness regarding the work within the consortium could be explained by the desire of the OEMs to achieve the initial goal of a standardized industry solution.

As all the founders were very interested in taking the most benefit out of Covisint, they were highly motivated to develop standard processes which later could be implemented in their own organizations. As the technical integration of applications in a portal is a challenging approach, the technical requirements that had to be in place were developed in a step-by-step approach reflected in different layers. Additionally, each of the stakeholders had sold the "Covisint story" and the expected benefits to its own company. Therefore, internally, everyone was expecting a success story. The founders also aimed to feed the industry-related publications as soon as possible with successful developed and implemented standards to show and present their success and power in the market. The development phase of the standardized portal was very complex because on the one hand, the complexity of the technology itself and the difficulty to integrate all the different technological pieces in an overall portal architecture, and on the other hand, because of the

difficulties to integrate the business requirements in a complex industry such as the automotive industry.

(2) Factors in Implementation

Implementation has followed a pragmatic approach, in that it aimed to integrate into the solution each new user requirement within the range of the budget restrictions. For example, within the implementation project team tensions appeared between people from IT and BUs related to the issue of which extent to include organizational specialties in the standard and what happens after the implementation of a standard that does not include functionality which is already in place and relates to various systems. Such discussions, as well as the solutions, were triggered and approached based on the budget restrictions. Therefore, transforming the standard involved a "work around solution" to fit the users needs at the same time as the limitations in the budget. Such a pragmatic approach called into question the vision about the 'best practice solution', as "best practice" was sacrificed in order to comply with the financial limitations. In the end, organizational and technical factors together with economic deliberations have led to a mutual shaping of what become 'the best practice solution' and the inner-organizational process.

One trigger that led to the development of Covisint was to facilitate collaboration in the industry. Personalized and integrated access was seen as integral part of this goal. Therefore, one of the first deliverables was the design of the user interface of the supplier portal accompanied by the corresponding structure of subsequent pages and the navigation path through them. Starting from the perspective of the already existing LCC Employee portal, it became evident that the layout approach for the web pages was technically not feasible with the portal technology that Covisint provided. Another important point was the structure of the web pages which should reflect the portal goal of providing an "easy-to-access-and-surf" tool. Additionally, the planned approach to re-use portlets that may already exist in other LCC web sites to reduce content management cost, depended on the level of integration. Due security concerns, the integration level chosen did not allow to integrate much of the already existing portlets. Therefore, the goal to provide real-time content collided with security concerns. Consequently, in order to ensure sufficient real-time information, the choice of a content management system (CMS) became the focus of attention. Unfortunately, LCC had already implemented a company-wide content management system different from the one Covisint was offering.

For example in terms of security, due to the complexity of technology and the existence of legacy systems, the Single sign-on (SSO), which enables the access to different information sources and applications with only one login and password, was difficult to implement in the overall IT infrastructure. Closely linked to that was that the difficulties to integrate (1) the portal authorization system (the possibility to adopt different user roles and responsibilities linked to the login) and (2) the authorization processes for some of the applications were underestimated. The same issue appeared for the user data management where user data was stored in different databases and needed to be integrated in a single database in order for the data to be efficiently used in the portal. A huge implementation issue also was the integration of applications. First, these applications were either standard software such as SAP having a separate login process, or legacy systems particularly programmed to fit the needs of distinct business units, and which were not considering the web-based frames. As a result, the cost for additional programming to "web-enable" these applications had to be discussed with the different application owners concerned. As IT budgets at that point of time were limited, discussions focused around which department had the responsibility to cover additional costs. Second, the above-mentioned legacy systems inherited functionalities that were either portal functionalities or functionalities that were not in the standard portal package and therefore not available. The difficulty here was to convince the application owners to integrate their application in a first phase with a reduced functionality.

As finally, the integration took longer than originally planned, the budget for the project was several times called into question. During the project, the main LCC sponsor, a strategic department for B2B projects, was re-integrated in the corporation. From that time on, the funding for additional requirements was difficult to allocate as well as the distribution of cost for application integration. Different cost models were discussed. Eventually, one of the BUs overtook the responsibility and got the budget which was then to a large part distributed to the IT which was operating the portal. Closely related to this issue was the governance of the portal. After the pilot project phase, it had not been sorted out which department, for example IT or procurement would be in charge of the portal. For political reasons, the question was not quickly sorted out. In the meantime, the implementation of the second phase was on-hold and opponents of the project saw their opinion confirmed that the project has failed and EDI could not been replaced by standardized XML solution.

The overall inconsistent strategy of the OEMs in what concerns the implementation of the e-collaboration tools significantly affected the suppliers' negative perception of portals in general. Whereas some of the OEMs prefer the

standardized industry solutions such as LCC, others such as the VWGroup, vote for the in-house option. Additionally, Covisint was not able to work out clearly the benefits for suppliers and their distribution. As one result, a number of large tier-1 suppliers founded another e-marketplace called «SupplyOn» which became one of the major competitors in the field.

4. Conclusion

The case study has shown that standardization efforts are triggered by a complex array of economic and political considerations. The locus of standardization (and consequently the range of actors involved and their manner of involvement in the process) has changed between the development and implementation stage. Although there were different teams involved in implementation and development stage, communication was strong and the process was characterized by a continuous feedback. Standards also appear to suffer significant transformations during implementation. Such transformations occur as a result of the effort of the users/adopters of standards to fit the standards and consequently the standardized technology to their specific needs and requirements. The most immediate factor that appears to influence the nature of such transformations in the character of the standard during implementation is organizational culture. The embedded rules and procedures, the specific working practices within each organization shape and transform the standards during the implementation stage. The strong influence of the user organizations' culture during this process could be explained by the change in the locus of standardization process: whereas development takes place within the specific standard development consortium, team or group, implementation takes place within the settings of each individual organization. Another factor that appeared to influence this transformation is economic pressure, and a wide concern with cost reductions.

Finally, personal relationships and a clear allocation of responsibilities within the organizations involved have appeared in all three cases as strong facilitators or/and inhibitors of the success of standards implementation. Personal relationships facilitate communication and understanding between actors, which ease the implementation process. The lack of clear allocation of responsibilities within the participant organizations was found to impede progress during implementation. Other factors that have contributed to the delay or even failure of the implementation process were the users' perception regarding the standards' benefits (if they are not clear, or were perceived as distributed in an unbalanced way between actors then progress is hampered), the level of coordination between the different actors within the organizations implementing the standards, the existence of sufficient resources to support implementation, and the absence of confidence that the technology that will deliver the desired outcomes.

The picture we have found is far removed from the simply (technical or economic) rationalities envisaged by economic, strategic management or technocratic accounts. The case-study highlights instead the close interplay between the unfolding standardization effort and the complex socio-technical setting in the array of firms involved, including supply chain relationships; the array of existing installed technologies and attendant relationships between technology supply; and the complexities of inter-departmental and inter-organizational politics. These shaped and moderated the standards development and implementation process and its evolution and outcomes in the course of the project.

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