Abstract

The analysis of standardization processes is dominated by the concept of positive network externalities. This paper develops an alternative view on standardization processes which is based on transaction costs rather than positive network externalities. We call this view the institutional view and distinguish it from the physical view that is associated with the concept of positive network externalities. We develop a transaction cost-theoretic model of standardization processes in the context of the development of vertical IS standards and discuss its merits and limitations. We also use some findings regarding the development of EDI-based interorganizational information systems to motivate our efforts.

Keywords: standardization, trade associations, inter-organizational information systems, collective action, transaction costs

INTRODUCTION

The development of IS (Information Systems) standards continues to pose fundamental conceptual problems for both scholars and practitioners. While there is no shortage of effort aimed at developing IS standards for electronic business, a lack of IS standards has been blamed for high costs of creating and participating in electronic business systems. This situation may seem somewhat paradoxical with a similarly intriguing paradox looming on a more conceptual level: while – in the tradition of the theory of collective action – it may be argued that firms that do not participate in developing publicly available interface specifications take a free ride by using these specifications, it is also clear that – according to the theory of positive network externalities – these same firms contribute to the production of a collective good by adopting those specifications because only such adoption decisions transform an interface specification into an interface standard.

In this paper we want to address the question of how a unified model of standardization processes could be developed, i.e. a model that explains both standards negotiation and standards diffusion processes based on the same theoretical concepts. We develop this model in view of the problem of vertical IS standards, i.e., interface standards used for building interorganizational information systems in particular industries. The purpose of the paper is to make a theoretical contribution to the analysis of standardization processes in order to mend the conceptual problems that, in our view, have plagued the analysis of standardization processes. One outcome of this effort is that we can show why often new interface specifications are negotiated which then fail to be widely used. Moreover, we can show how industry associations, which are often helpful in setting up and supervising processes of negotiating interface specifications, do, under certain conditions, hamper their diffusion. This has to do with the institutional structure of an industry and therefore often lies outside the reach of actors involved in standardization processes.

Since, so far, no unified use of terminology in the field of standardization has emerged we find it useful to provide some definitions before continuing. A number of authors have proposed ways of classifying standards (Braunstein and White 1985; David and Greenstein 1990; Hemenway 1983; Jakobs 2000; Kindleberger 1985; Krechmer 2005; Schmidt and...
that we do not wish to repeat and discuss here. We will focus on so-called communication and compatibility standards which are especially important in the IT field and which have been characterized as an interface or compatibility specification that a vendor adheres to (David and Greenstein 1990: 4). In the area of electronic business systems, user organizations become important players too. Therefore, we extend the definition of David and Greenstein to include user organizations as well as vendors. In addition, we use the term interface standard to capture both communication and compatibility standards. A specific form of interface standards are vertical IS standards, i.e., interface standards used for interconnecting information systems of buyers and suppliers in an industry or along a supply chain (Markus et al. 2003). In this paper, the expression ‘standardization process’ includes both the process leading to the publication of an interface specification which is meant to become a standard – the standards negotiation process – and the adoption of this specification by a substantial number of players resulting in its widespread use – the standards diffusion phase – (Markus et al. 2004). The term electronic business system is used synonymously with the term interorganizational information system, which is an information system that transcends the boundaries of an individual organization (Cash 1985).

In the next section we highlight some empirical findings from earlier research which have yet to be adequately addressed in the literature and which motivate our effort to develop a unified model of standardization processes. In the third section we develop a general transaction cost-theoretic concept of costs and benefits of standards and show how it differs from the standard concept of positive network externalities generally used for explaining and analysing standardization processes. Next, based on this concept, we develop a theoretical model that describes both standards negotiation and diffusion processes and how they are interrelated. In the fifth section, we discuss the explanatory value of this model in view of the empirical findings presented in the second section as well as its limitations. The final section summarizes the main results of the paper and draws some conclusions with regard to further research as well as standardization policy.

MOTIVATION

As standardization is a process of collective action, trade associations are often considered to be helpful in standardization processes, specifically with regard to vertical IS standards (Damsgaard and Lylytinen 1998 and 2001; Kubicek 1992; Kurnia and Dare 2005; Markus et al. 2003, 2004; Pigni et al. 2005; Riggins and Mukhopadhyay 1999; Steinfield et al. 2004). Consequently, overall a positive view of the role of trade associations with regard to the development of vertical IS standards has emerged in the literature (cf. also the literature reviews by Elgarah et al. 2005 and Koch 2005).

However, these studies have, all but one, considered only the impact of single trade associations on the development of interorganizational information systems, i.e., the unit of analysis was a single trade association. As a result, potential conflicts between the activities of several trade associations have not been investigated. The exception regards the study by Kubicek (1992) who looked at the interaction of two trade associations representing adjacent stages in the retail supply chain. He finds that cooperation between these trade associations was a crucial factor in the successful creation of an interorganizational information system in the retail industry. Still, this study was confined to vertical relationships between trade associations while the potential for disruptive conflict is more likely to stem from competing or horizontal relationships between trade associations.

One study by Monse et al. (1993) took into consideration such potential effects. Although this study is quite old and predates the emergence of Internet-based interorganizational information systems using Extensible Mark-up Language (XML) we still consider its findings to be relevant since they relate to the institutional structure and environment of interorganizational information systems and not their technology. More importantly, it is, to our knowledge, the only study that has considered the role of horizontal interactions among trade associations in the development of interorganizational information systems. Nevertheless, later we will address the question whether XML-based approaches are likely to mitigate some of the conflicts found in this study.

Monse et al. (1993) compare ten EDI-initiatives in five industries and four European countries (Grocery, Textile, Furniture, Cosmetics, Recorded Music; Italy, Spain, Denmark, Germany). All initiatives concerned the relationship between manufacturers and retailers and focused on the same type of interface specifications (purchase order, invoice). The study identifies a specific type of development problem, namely collision among initiatives. This means that initiatives were targeting overlapping communities of potential adopters of interface specifications developed by these initiatives. This led the promoters of the initiatives concerned to pursue aggressive strategies in terms of attempts to discredit or criticize competing initiatives, generally with regard to the respective technical merits of interface specifications. While this problem was not necessarily connected with an initiative’s success, it proved to be one of the main hurdles on the way to success. The reasons for the occurrence of this problem seemed to lie outside the
actors’ reach but had to do with the institutional environment of an initiative. The problem existed only for the German initiatives and all of them were potentially affected by it. The problem became most visible in the clash between the grocery and textile initiatives. While it is clear that retailing has a high potential for such conflicts due to its very nature, the interesting question is why such clashes were absent in the other three countries’ EDI-initiatives.

Analysing the institutional environments of the initiatives provides a clue to this puzzle (cf. Monse et al. 1993). While the German initiatives were embedded in a highly fragmented structure of specialized trade associations, the situation in the other three countries differed in significant ways. In Spain, to begin with, no trade association existed in the retailing sector prior to the establishment of the Spanish EAN initiative – an association of retailers and manufacturers. This association was thus created specifically for the purpose of streamlining information flows between manufacturers and retailers and developed in an ‘institutional vacuum’. It was also the organization that initiated the Spanish EDI-initiative. In Italy, the whole economy was sliced into four sectors, services, industry, agriculture and handicraft, with each sector represented by a super-association. Each of these sectors had their own ecology of trade associations, which were not necessarily limited to the industries indicated by the names of the four sectors. For example, a large retailing firm was affiliated with a trade association from the industrial sector because it had grown out of a car manufacturer. In line with this ‘sectorization’ of the economy, firms tended to maintain business relationships only within each sector. Thus, the network of business relationships and its institutional environment were closely aligned. Finally, in Denmark the very high concentration ratio in retailing and manufacturing has led to the emergence of dominant players, powerful enough to shape the whole industry. Accordingly, trade associations did not play a significant role in the Danish EDI-initiative; instead, the Danish initiative was the only one not supported by a trade association but taking place in an informal setting organized by the major retailers and manufacturers in the grocery industry.

To summarize, the difference between Germany and the three other countries lies in the way that the institutional structures of industries were aligned with business networks. While the degree of alignment in the three other countries was, for different reasons, high, it was very low in Germany. In other words, an initiative started by one trade association quickly got in the way of another because business networks were associated with several trade associations through its members.

While this explanation seems to be intuitively convincing, the question is how we can explain these findings in terms of theoretical models of standardization processes. Standard models for explaining standardization processes are based on the concept of positive network externalities (this concept will be discussed in the next section). According to this concept the network that will be more attractive is the one having the higher number of participants. If variations in contributions of network participants are allowed for in a model, the total value of positive network externalities will depend upon the identities of participants as well as their number. Consequently, any advantage – however small – of one initiative over a competing one in terms of network participants (or accumulated network value in the case of variable contributions) will cause this initiative to become more attractive for potential participants. Any prospective participant will evaluate competing networks based on this size-/value-differential and join that network with the largest positive differential. If prospective participants base their decisions not on existing network structures but expected participation levels, any successful standardization process would be difficult to explain. Potential participants would wait for all others to join first. The only solution to this problem consists in the assumption of a self-fulfilling prophecy (all prospective participants predict that all others participate too) or some form of mutual agreement committing each prospective participant to join if the others join too. Thus, models based on positive network externalities can either not explain the phenomenon of colliding standards initiatives (if prospective network participants base their decisions on existing network sizes/structures) or they cannot explain successful standards initiatives (if prospective participants base their decisions on expected network sizes/structures) except under rather restrictive assumptions.

Collective action theory (Olson 1965) may also be used to explain the failure of standardization processes. According to this theory, collective action is plagued by the free-rider problem: potential participants in a standardization process speculate that others will develop the interface specification and thus carry the costs of standards development. Once an interface specification has been published these actors will then adopt it without having contributed to its development. This approach would explain a lack of standardization initiatives, not a surplus of such initiatives. Moreover, once a standard is published those to whose requirements it caters would not hesitate to adopt it. Thus, this approach cannot explain the phenomenon of colliding standards initiatives either.

Markus et al. (2004) argue that standardization processes need to address two interrelated problems of collective action, namely the development of a general interface specification and its wide-spread adoption. Consequently, Markus et al. focus on the interdependency between these two processes by arguing that actors in the negotiation phase should take actions aimed at facilitating later adoption by actors not included among the actors developing the standard. As
a consequence, a failure of adoption may then be explained by insufficient attention paid to the requirements of prospective adopters not included in the negotiation phase. While this approach is sufficient to explain successful or unsuccessful standardization initiatives, it cannot explain the phenomenon of colliding EDI-standards initiatives. Rather, it would predict that in the case of competing standards initiatives those that best anticipated the requirements of prospective adopters would win out.

Thus, existing theoretical models of standardization processes cannot explain simultaneously successful standardization processes and the phenomenon of colliding networks. In the next two sections we therefore develop antecedents of a new model of standardization processes that is able to accomplish this task. Then, we will apply this model to the explanation of the findings presented above and also discuss its limitations.

**COSTS AND BENEFITS OF STANDARDS – REVISITED**

Based on the work of Commons (1990) we distinguish between a physical and an institutional view on costs and benefits of interface standards. The physical view assumes that the benefit of an interface standard consists of the value that is realized through physically connecting a new system component or communication partner to a (virtual) network. This value is twofold; on the one hand, all existing members are made accessible to the new member/compatible with the new component. On the other hand, that new member/component becomes accessible to/compatible with all existing members/components. While the former value is usually paid for by the new member/component producer or user, the latter will not be compensated through prices thus representing a (positive) network externality. The benefit of a standard can then be measured as the differential between the aggregate of these two values on the one hand and a situation in which the new member/component is not connected to the network on the other hand. The choices for a prospective new member are to become a member or to stay away from the network. This is the view that one usually finds in the literature on the economics of standards and which is also present in most analyses of vertical IS standards (Antonelli 1997; Beck et al. 2003; Berg 1989; Church et al. 2002; Damsgaard and Lyytinen 2001; Dranove and Gandal 1999; Economides and Himmelberg 1995; Gandal 1995; Katz and Shapiro 1985; Kauffman and Wang 2002; Schilling 2002; Shurmer 1993; Takahashi and Namiki 2003).

The institutional view in the tradition of Commons (1990) starts from the observation that an interface standard not only specifies technical methods of interconnecting system components/communication parties, but also implies a certain distribution of costs and benefits among members of a (virtual) network. It can thus be seen as a cost- and benefit-sharing arrangement regarding the costs and benefits of connecting to a (virtual) network (such an arrangement would be called a *rationing transaction* in Commons’ terminology). Its value can then be measured by the costs of negotiating such an arrangement with each individual member that can be saved by adopting the interface standard. The choices facing a prospective new member/component vendor or user in this view are to negotiate cost-/benefit-sharing arrangements bilaterally or to adopt a generalized cost-/benefit-sharing arrangement, i.e., an interface standard. In addition, it may be said that a third choice exists, namely unilaterally connecting with each member of the network through technical means (adapters, converters, bridges etc.). However, this is just a fringe case of a bilateral negotiation process, namely one in which the new member implicitly agrees to carry all costs of interconnecting to the network thus foregoing an explicit negotiation process. The institutional view is much less developed in the literature; the following authors writing on standardization processes may be associated with this view: Aggarwal and Walden (2005), Cargill and Bolin (2004) Hemenway (1975), Kindleberger (1983) and Weare (1995).4

When conceptualizing the benefits of an interface standard as implied in the institutional view, its costs either consist of the costs of negotiating the specific cost-/benefit-sharing agreement that it represents or of the costs associated with adopting a standard in case a firm does not participate in the negotiation process. In both cases, these costs are caused by the need for evaluating potentially better deals that might be possible on the basis of bilateral negotiations with individual business partners. For example, a supplier with high bargaining power *vis-à-vis* its business partners may conclude that a particular proposal for an interface standard puts too high a burden on suppliers in terms of adaptation costs. In the case of negotiating interface specifications, each participant will have to respond to all other participants’ proposals implying the need to evaluate them in the first place. In contrast, a firm considering adoption of a standard cannot influence the specific cost-/benefit-sharing agreement that it represents. It can only accept or reject it. As a consequence, the firm will have to evaluate whether that standard would burden it with too high a share of costs and/or provide it with sufficient benefits relative to its market position.

The costs of this evaluation process will be further increased if the firm speculates that it might have other choices in the form of other possible interface standards that already exist or whose development is underway. Each possible alternative interface standard has different cost-/benefit-sharing implications for the firm considering its adoption. Thus, the firm has to evaluate these different implications if it considers them to be
alternative solutions that have a certain likelihood of becoming actual possibilities.

A MODEL OF STANDARDIZATION PROCESSES

The question to be addressed now is how firms can actually make the type of cost comparison suggested above as a cost–benefit calculus describing decision making of firms considering to adopt a standard or join a standards negotiation process. We will begin with an analysis of standards negotiation processes and then consider standards adoption processes.

According to our suggested method of evaluating interface standards from an individual firm’s point of view, a firm considering joining a standards negotiation process has to compare costs it would have to incur based on a bilateral approach with its business partners with costs resulting from negotiating an interface standard, i.e., a generalized cost-/benefit-sharing agreement with regard to interconnecting business systems across company boundaries. The main problem in this case is how to estimate the value of cost savings regarding hypothetical bilateral negotiation processes with business partners and how to predict transaction costs of multilaterally negotiating a generalized cost-/benefit-sharing agreement.

There are two reasons why agreements on ways to interconnect business systems are difficult and thus cause costly negotiation processes. One, internal business processes and information system structures vary due to firms’ different histories, cultures, products etc. (PfEffer and Salancik 1978). Two, most firms are competing with other firms for customers, personnel, investors etc. (Porter 1990). Thus, when negotiating terms of interconnecting systems firms are likely to attempt to differentiate themselves from competitors through these terms. While the magnitude of negotiation difficulties stemming from internal variations in business processes etc. cannot be anticipated without actually engaging in negotiation processes, we propose that the desire to differentiate oneself from one’s competitors can be anticipated in a given market based on the intensity of competition in that market. Intensity of competition is a result of the behaviour of business partners. Only if business partners compare product/service offerings of several firms will these firms be exposed to competition (Caves 1982: 21).

Proposition 1: As the degree of competition increases in an industry, costs of negotiating terms of interconnecting information systems across company boundaries increase too.

Since the effect of internal requirements of firms on the costs of bilateral or multilateral negotiation processes cannot be generalized we will focus on the second effect which, according to Proposition 1, can be generalized for a given negotiation context. Multilateral negotiation then involves negotiations among competitors who will have to agree on a common approach towards specifying an interface standard, again involving a certain distribution of costs and benefits, albeit among competitors only. Later, we will discuss the limitations of the model that arise from this decision.

The question then is how transaction costs of engaging in a multilateral standards negotiation process among competitors will probably develop. It might be argued that the same types of difficulties would arise if competitors engaged in a multilateral effort aimed at creating a unified system interface standard as would result from a bilateral approach with their business partners because competitive behaviour would fully manifest itself as a source of transaction costs in both cases. Thus, transaction costs savings would be unlikely except in the form of concentrating negotiation activities (for example, through concentrating negotiations in one place). However, apart from concentrating negotiation activities, a potential advantage of a multilateral approach among competitors is that a firm does not have to negotiate with all its competitors. Rather, it might choose to negotiate with a smaller group of competitors and then hope that the remaining competitors will implicitly agree by later adopting the standard, i.e., through creating a bandwagon effect. This would effectively lower expected transaction costs resulting from negotiating an interface specification because business partners could neglect the additional proposals originating from competitors not included in this negotiation process (since they will also assume that these firms will later adopt the result of their negotiation process).

From an individual firm’s point of view, transaction costs in a multilateral negotiation process with competitors increase geometrically: if two competitors join, one competitive relationship has to be accommodated, if three competitors join, three competitive relationships have to be considered with this number rising to six in the case of four competitors joining and so on. Thus, any new competitor joining a multilateral negotiation process affects a geometrically increasing number of competitive relationships causing all existing participants to potentially re-position themselves and their proposals. As a consequence, negotiation costs increase geometrically too because the firm has to evaluate these proposals and adapt its own position accordingly.

In contrast, competitive behaviour affects transaction costs of bilaterally interconnecting information systems through making negotiations with all business partners that are shared with competitors more difficult. If symmetrical competitive relationships dominate (i.e., competitors share the same set of business partners with comparable business volumes; limitations due to this assumption are discussed later), transaction costs incurred through a bilateral approach towards building
interorganizational information systems increase linearly with the number of competitors.

Therefore, if the number of competitors participating in multilateral negotiations can be limited, the value of transaction costs caused by these negotiations is smaller than that resulting from a bilateral approach because some competitive relationships are ignored in multilateral negotiations while all competitive relationships affect the costs of bilateral negotiations. Therefore, participation in a multilateral approach involving a firm’s competitors is only worthwhile if the number of competitors participating in that negotiation process can be limited.

Proposition 2a: A multilateral negotiation process involving all relevant competitors does not result in transaction cost savings as compared to bilateral negotiations with business partners, given a positive level of intensity of competition.

Proposition 2b: A multilateral negotiation process in which the number of competitors is smaller than the total number of relevant competitors results in transaction cost saving, given a positive level of intensity of competition.

Let us now turn to the case of firms considering the adoption of a published interface specification. As suggested above, in this case costs of standards consist of resources needed to evaluate a given interface specification vis-à-vis the firm’s own bargaining position. If several alternative interface specifications exist or are likely to be established for the same domain, i.e., with regard to the same functions of interorganizational systems and the same set of business partners, then these costs are higher still since uncertainty about the final outcome and thus the firm’s new bargaining position will increase too. As in the case of standards negotiation processes, the benefit of adopting a published interface specification consists of saving transaction costs that a firm would have to incur had it opted for a bilateral approach towards interconnecting business systems. Similarly, the relative value of transaction costs that would result from a bilateral approach is affected by the number of competitors and the intensity of competition since negotiation with business partners becomes more difficult as more competitors are attempting more fiercely to improve their competitive position through idiosyncratic interorganizational information systems. However, costs of adopting an interface specification, in contrast to the case of negotiating one, are independent of the number of other competitors that have adopted the specification because the firm has to evaluate its own competitive position only with regard to a given interface specification.

Proposition 3a: The costs of adopting a published interface specification are independent of the number of competitors that have also adopted it.

Clearly, this individual decision situation implies a critical mass problem. Any firm considering adopting a published interface specification will do so only once a certain number of competitors have also adopted it, depending upon its individual estimation of its benefits and costs. These thresholds might be different for different firms so that a bandwagon might be started or not or may start and then be halted again.

It is now possible to construct a more complete model of standardization processes by combining the two mechanisms described above. Firms will join a negotiation process aimed at creating a standardized system interface representing a generalized cost-/benefit-sharing agreement for interconnecting information systems if they are able to limit the number of competitors in this negotiation process. Once a generalized system interface has been agreed upon among these firms, other competitors may adopt it if their individual threshold levels are reached by the size of the initial group of competitors (assuming that all of the latter will actually adopt the generalized interface specification as well) thus triggering a bandwagon that may lead to widespread use of that interface specification. Such an idealized process is depicted in Figure 1. Note that this model depicts the decision situation from an individual firm’s perspective. Thus the position of curves and, consequently, of the points A (the point of maximum net benefit of multilateral negotiations), B (the threshold level of firms considering adoption), and F (the value of transaction costs caused by internal requirements of business partners) can and will vary for each firm. The net benefit curve for firms considering adopting a published interface specification has not been drawn since this curve is rather obvious as it results from subtracting the constant AD-curve (depicting the costs of adoption) from the linearly increasing BN-curve (depicting the costs of bilateral negotiations) but would render the graph visually complex. Beyond the threshold value B net benefits of adoption are positive and continue to increase linearly with the number of competitors. The net benefit curve of multilateral negotiations (NBmn) shows a maximum due to the geometrically increasing shape of MN, the curve depicting the costs of participating in multilateral negotiations, and the linear shape of the BN-curve. The figure combines the decision situations of a firm considering adopting a published interface specification and of a firm considering participating in a multilateral negotiation process in order to demonstrate how the two processes are linked. It implies the ideal scenario in which the size of the group of firms participating in a multilateral negotiation process (at point A) coincides with the threshold level of firms considering adoption (B).
There are two problems that can get in the way of this process. First, a negotiation process might not be initiated because of the free-rider problem; second, the group of competitors that have successfully negotiated a generalized system interface may be too small to start a bandwagon. Clearly, these two problems are related to each other. On the one hand, negotiation becomes easier to initiate and to complete successfully if the number of negotiation parties can be kept small. On the other hand, the smaller this number is the less likely it is that a bandwagon can be started.

Concluding this section it may be asked how the concept of network externalities fits into this model. What we propose, in effect, is to substitute a concept of network externalities based on competitive relationships for one based on complementary relationships. While network externalities resulting from complementary relationships have a positive sign, network externalities resulting from competitive relationships are negative in the standard sense of this concept because new participants (competitors) in a network can actually make agreement on cost-/benefit-sharing arrangements among the other members more difficult. This is the situation that dominates the case of creating interorganizational information systems. Actually, this is a side-effect of the general competitive mechanism which is considered to be beneficial for innovation and efficiency. However, it also increases transaction costs. Thus, we propose to interpret transaction costs as externalities of competitive behaviour. While such externalities are likely to exist and have long existed in all kinds of markets, they become most visible in the case of networked systems involving many players including business partners as well as competitors. Communication networks and virtual networks of mutually compatible computer components are just the most visible of these systems.

Finally, the question is how, in our concept, would the notion of sharing fixed costs of building networks be considered. Specifically, it has been argued that the advantage of a standard interface consists in replacing a multitude of pair-wise technical links with individual communication (business) partners/system components through a general one (cf. for example, Braunstein and White 1985). However, whether, from an individual firm’s point of view, this provides the less costly solution may, at least in principle, be questioned. Depending upon the specific context it may be entirely worthwhile for a business firm to establish a number of individual links with important business partners. This would be the case if the costs were lower than those of supporting a generalized interface, which might have to accommodate the requirements of thousands of business firms in different industries and different countries. Again, the issue boils down to a negotiation problem: Who should be involved in negotiating the general interface? How should costs and benefits be shared among these parties? Arriving at a satisfactory solution is possible with both a bilateral and a multilateral approach. The advantage of the multilateral approach is that it saves transaction costs over the bilateral approach, under the conditions set out by our model.

DISCUSSION

This model can be used to interpret the findings regarding the comparative study of EDI initiatives in different industries/countries presented earlier. All initiatives, except the Danish, were initiated either by a
trade association or by a third party that later sought support by a trade association. This was clearly an efficient solution to the free-rider problem since trade associations and third parties are motivated by other incentives than user organizations thus representing selective incentives in the sense of Olson’s theory of collective action (Olson 1965). For example, trade associations are generally eager to support standardization initiatives because this can increase their perceived legitimacy (Doner and Schneider 2000). In addition to helping overcome the free-rider problem in standardization processes, trade associations provide an established platform for negotiating processes, e.g., through rules of fairness, which should greatly facilitate negotiation among competitors and thus reduce transaction costs of developing interface specifications. Also, collaboration among competitors within a trade association provides a measure of legal protection in terms of antitrust laws.

On the other hand, their very support increases uncertainty for user organizations considering the adoption of a published interface specification if there are competing initiatives supported by different trade associations. In other words, standards initiatives supported by different trade associations representing overlapping business networks make it more costly to adopt any one standard thus slowing down or even preventing diffusion of these specifications. As this situation was pervasive in the German cases but absent in the others our model of standardization processes could account for the findings of that study.

We think that this model is potentially useful for explaining standardization processes in general for two reasons. First, it provides a unified framework for explaining both the negotiation and adoption of published interface specifications based on a single transaction cost-theoretic concept of benefits and costs of standards. In contrast, most models used for explaining standardization processes focus on either the negotiation or the diffusion phase of a standard (an exception regards the work by Markus et al. (2003, 2004) who explicitly consider the interaction between standards negotiation and diffusion). Second, it posits that standardization processes consist of several interrelated processes of collective action that are characterized by different types of problems that need to be overcome for a successful standardization process. It, therefore, seems to be more in line with the observed reality of actual standardization processes than models based on only one mechanism and, accordingly, one type of problem that needs to be solved. Again, this is an advantage our model shares with that of Markus et al. In addition, our model is able to cope with the phenomenon of colliding standards initiatives distinguishing it from that of Markus et al.

However, this model also has a number of limitations. These can be grouped into three problem areas: limitations that are due to simplifying assumptions; limitations related to assumptions that have been made about alternative explanatory models, specifically those based on the concept of positive network externalities; and limitations related to the fact that empirical data which motivated this model ignore newer technologies such as XML.

Regarding the first group of issues, the model does not explicitly consider the impact of powerful business partners, switching costs, the process of implementing an interface specification, characteristics of particular competitors, existence of a multilateral negotiation process among competitors on both sides of a prospective interface, nature of the product/service underlying an interorganizational information system, different types of technologies to be standardized, different types of standards (proprietary vs. open, de facto vs. de jure), and the process of writing an interface specification.

The influence of powerful business partners is, without doubt, an important factor in implementation decisions regarding vertical IS standards; this omission, however, is a logical consequence of the institutional view adopted in this paper; in that view, ‘adoption’ refers to a decision by a firm to use a certain interface specification in its negotiations with business partners, i.e. the use of a particular interface standard is part of a firm’s business policy; in contrast, ‘adoption’ in the physical view implies the implementation of a particular interface specification in concrete (physical) systems. As a consequence, implementing a particular interface specification as a result of pressure of a business partner would count as an adoption decision in the physical but not in the institutional view. Instead, the decision by those business partners to require use of that interface specification in their dealings with their business partners would be considered the act of adopting an interface specification. Consequently, our model cannot explain the diffusion of an interface specification if that diffusion is a result of one firm unilaterally imposing that specification on its business partners. Therefore, our model is not applicable to standardization processes in monopolistic or monopsonistic markets. The strength of the model becomes visible only when competitive relationships play a significant role in the diffusion of an interface specification.

In contrast, characteristics of competitors, which so far are not included, could be accounted for by making the model more complex. For example, the model could account for characteristics of competitors by ranking them by business volume in a certain market etc. However, complexity would be increased significantly because the assumption of symmetrical decision situations would have to be dropped making it necessary to consider the interactions of individual decision models of all relevant players or types of players. Therefore, we suggest that this model will be most useful in markets
characterized by more or less symmetrical relationships among competitors.

While integration of characteristics of individual competitors would probably make the model significantly more complex because multiple interactions among individual decision models would have to be accounted for, the existence of multilateral negotiation processes on both sides of a prospective interface standard could be relatively easily incorporated into the model since only two decision models with one interaction would have to be considered. Such cases are rather common in vertical IS standards initiatives (cf. Kubicek 1992; Gosain et al. 2003).

Regarding types of products/services and types of technologies to be standardized we assume that the former has an indirect impact through, for example, the complexity of product descriptions and thus should be considered as a possible external factor in concrete cases; we have developed the model in view of both standardization of interfaces for interorganizational information systems as well as of standardization of IT products; however, to which extent the model is applicable to the latter situation needs to be evaluated in appropriate case settings. Regarding different types of standards, we submit that the model can accommodate the distinction between proprietary and open standards since it explicitly views an interface specification as a cost-/benefit-sharing arrangement; thus, efforts at writing an interface specification may involve research and development expenditure which may be spread over users of that specification through royalties. This argument also clarifies how the process of writing an interface specification enters into the model. Regarding the difference between de facto and de jure standards a consensus is emerging that this distinction is rapidly becoming irrelevant (Cargill and Bolin 2004; Jakobs 2005; van Wegberg 2004). However, different characteristics of organizations facilitating standards negotiation processes are likely to have significant impact on the outcome of standardization processes (Jakobs and Wallbaum 2005); indeed, we have used one such characteristic as our main explanatory variable, namely the extent to which trade associations’ areas of representation overlap in a certain business community. We suggest extending the model by incorporating a list of institutional characteristics that have been found to be relevant in standardization processes.

The second group of issues regards assumptions about alternative explanatory models, specifically those based on the concept of positive network externalities. For example, it may be possible to extend these models so that they also would be able to explain the phenomenon of colliding networks. Such extensions could come from the idea of studying the diffusion of knowledge (percolation) in local networks or networks of neighbourhoods (Antonelli 1997). However, we think that, while such extensions are certainly possible, institutional characteristics of standardization processes would be much more difficult to incorporate since these models have no immediate ‘interface’ for institutional characteristics; instead, institutional characteristics would have to be modelled as characteristics of individual members of business networks which is likely to make such models very complex. In contrast, our notion of interface specifications as agreements about cost-/benefit-sharing arrangements allows for relatively easier integration of institutional characteristics.

Finally, the question is whether new technologies, specifically XML, have not made large parts of former EDI-based systems superfluous, especially those relating to standardization requirements. However, it is increasingly becoming clear that XML-based interorganizational information systems require exactly the same types of agreements as EDI-based systems (cf. Reimers 2001; Markus et al. 2004). The main difference between EDI-based and XML-based systems lies in the use of different data communication networks which were mostly private and expensive in older EDI-based systems while increasingly the much cheaper Internet is being used for XML-based interorganizational information systems.

CONCLUSIONS

In this paper, we have developed a novel model of standardization processes that can be applied to the analysis of the development of vertical IS standards and, potentially, the development of IT standards. It is based on a transaction-cost theoretic concept of the costs and benefits of an interface standard as seen from its prospective adopter. It distinguishes between a negotiation and a diffusion phase, which are characterized by different problems, namely a free-rider problem with regard to the negotiation phase and a critical-mass problem with regard to the diffusion phase. It specifies the conditions under which a negotiation process and a diffusion process will take place.

This concept is different from the standard concept used to explain standardization processes, namely positive network externalities. We have argued that there are two views on standardization processes, a physical view and an institutional view and have associated the physical view with the concept of positive network externalities. In contrast, our model is based on negative network externalities that arise as a result of competitive behaviour. This behaviour increases transaction costs for business partners when their products or services are tightly linked (networked). The advantage of standards, we have argued, then consists of neutralizing some of these externalities by agreeing on a generalized method for interconnecting system (network) components implying a certain distribution of costs and benefits. Thus, an interface standard replaces bilateral negotiations aimed at the same purpose.
(interconnecting system components) and the transaction costs associated with them. However, negotiating or adopting an interface specification carries costs too which we have also modelled as transaction costs thus facilitating the evaluation of costs and benefits of standards. We have then developed a model that shows how such an evaluation could actually and realistically be accomplished by prospective participants in a standardization process based on the number of competitors that also participate.

While the development of this model was motivated by some early findings with regard to the role of trade associations in the development of vertical IS standards which, we have argued, cannot be explained by existing models of standardization processes, the main benefit of our model consists of its implications for future efforts aimed at building interorganizational information systems based on vertical IS standards. The model can be used to examine the likely effects of particular governance structures on the success or, rather, failure of a standards initiative. For example, the use of trade associations to foster the initiation of a standards negotiation process may be detrimental to the diffusion of a negotiated, published interface specification in a fragmented institutional environment. In these situations players with an interest in starting standardization processes may consider creating specific new governance structures that facilitate the diffusion of a published interface specification as well as its negotiation. One example of such a specialized governance structure is RosettaNet, an organization created to facilitate negotiation of XML-based vertical IS standards as well as to support their wide-spread adoption (Gosain et al. 2003).

We are fully aware of the rudimentary character of the model as it stands. Its main assumptions, formulated as propositions, need to be tested empirically. In addition, the model needs to be extended by carefully selecting additional variables, for example with regard to institutional characteristics of standards facilitating organizations or the institutional environments of standardization processes, in order to fulfil the task outlined above. Still, we believe that it is worthwhile to develop further this model of standardization processes in order to explore the limitations and uses of both existing models based on the concept of positive network externalities as well as of the model presented in this paper.

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Notes

1. EAN originally stands for European Article Number; nowadays, it means Global Trade Item Number.
2. A virtual network is a network of system components that can be freely combined due to standardized component interfaces.
3. The concept of positive network externalities has also been subject to heavy criticism as put forward most prominently by Liebowitz and Margolis (1990, 1994, 1995, 1996, 1998, 2002) but also by other authors such as Carlaw and Lipsey (2002).
4. In some cases, authors cannot be clearly associated with the one or the other view such as Greenstein (1993) and Venkatraman et al. (2004). In addition, a strategic choice-view may be differentiated as represented, for example, by von Burg and Kenney (2003) and Funk (2003).
5. Note that this concept of negative network externalities is related to, but different from, that proposed by Riggins and Mukhopadhyay (1999), who suggest that positive network externalities may be compensated by negative ones since the competitive advantage of joining a network decreases with its size. Our concept, in contrast, does not refer to diminished benefits of network participation but increased costs as a result of competitive behaviour.

References


