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Managing IT infrastructure standardisation in the networked manufacturing firm

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Abstract

Discusses managerial aspects of IT infrastructure standardisation in networked manufacturing firms. Shows that in these firms, where local initiative is very important and strict central hierarchical control is lacking, standardisation of IT infrastructure is nevertheless highly important for effective co-ordination of activities. Presents a strategic framework to guide managers in making sensible decisions regarding IT infrastructure standardisation, based on a number of pre-existing economic and management theories, such as transaction cost theory, organisational design, economics of information goods and organisational growth stages. Points at different standardisation requirements for different kinds of business processes. Shows that, in networked firms, managers should still strive for IT standardisation but also that the classical approach of coercive standardisation by hierarchical command is but one of the management policies possible, next to collaborative or competitive standardisation. Illustrated with examples from a multinational manufacturing firm in the electronics industry.

\textit{Keywords:} organisational networks; information technology (IT), standardisation; organisational design; business processes; IT strategy; electronics industry

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1. Introduction

It is becoming increasingly clear that the manufacturing organisation of the coming decades is the extended enterprise or the networked firm: a semi-permanent group of strongly interdependent companies that jointly serve one or more markets (Tapscott 1996, Kelly 1998, Fine 1998, Eisenhardt and Galunic 2000). Many traditional managers find this a scary concept, since they are still in charge, but no longer in control (Stone 1998): the members of the network all enjoy considerable degrees of independence and there is no clear-cut hierarchy to resolve conflicts.

It would therefore appear to be in the same line of thinking that, in these networked firms, IT infrastructure standards would be a relic from the past, not something management should be striving for in the future. However, this line of thinking is wrong. Interestingly enough, it is precisely in this type of organisational context that strict adherence to standards for communication becomes more important than ever. Many of these standards may no longer be

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recognised as such. Speaking one natural language, usually English, is taken for granted in today's multinationals. Having one standard time, e.g. Greenwich time, has also been a natural development, indeed the entire metric system is one de facto standard across most of the world today. Standards in currency, such as the American dollar or, in post-1998 Europe, the Euro, are on the increase as well.

The natural benefits of underlying standards may be less obvious in information technology (IT). The topic of standardisation of IT systems is often associated with one-size-fits-all solutions for unique business processes, with generic "best practices" that rarely fit well with the established ways of doing business in specific firms. In short, IT standardisation is firstly associated with the creativity-stifling policies of the fully integrated command-and-control firm of the past, not with the networked firm of the future.

This can be a costly misunderstanding, especially in an economy where Internet-enabled business networking has become possible precisely because of the tightly standardised the infrastructural aspects of the Internet, from TCP/IP to HTML and Java. This article will argue that standardisation of IT infrastructure is far more important for the networked firm than for the classical organisational pyramid and it will explore various managerial implications of this insight.

We see three main drivers for this increased importance of IT infrastructure standardisation in networked firms. Firstly, in the unified firm, inter-unit collaboration to achieve synergies can (in theory at least) be ordered from the top. But in the networked firm, collaboration has to be achieved through communication. For such communication to be effective, one needs not just the same natural language, but also common IT functionality to accommodate it. If "cost price" means one thing in unit A and another in unit B, there is a problem in communication. If this communication has to take place via a different E-mail system or via traditional means of communication, internal transaction costs (Coase 1937, Williamson 1975) become higher, thereby having a profound impact on the competitiveness of the organisation.

Secondly, standardisation of IT infrastructure facilitates changes in the organisational network. If a new partner is to be added to the network, one should not have to design separate interfaces to link the new partner's systems to all the individual units of the network. One standard interface should do. This allows not just for effective co-ordination of activities in the network, but also for frequent redesign of the network, which according to some authors is becoming the new lasting competitive core competence in "a world of temporal advantage" (Fine 1998).

Thirdly, there is the classic argument that standards allow for economies of scale. This has long been true for product-related aspects such as e.g. 220 Volts or QWERTY keyboards, but is becoming increasingly important for organisational processes as well. As IT costs become a larger and larger part of added value for manufacturing firms, the potential of achieving economies of scale through standardisation in this area becomes bigger and bigger as well.

This goes well beyond cost price of equipment due to larger purchasing quantities. For instance, Dell machines may or may not be technologically superior to Compaq computers, but if it one of the two is the standard machine and therefore it takes the IT department just as long to configure one non-standard machine as it costs to configure twenty standard ones, then the choice for the discerning manager becomes quite simple.

This article is structured as follows. Towards the end, in Section 9, we synthesise our argument in a number of recommendations for managers that are faced with decisions to be made regarding IT infrastructure standardisation. In the sections leading up to that we present the theory that underlies these recommendations. For instance, sections 2 to 4 are definitional in nature. That is, we discuss briefly the rise of the networked firm (Section 2), we look at definitions of IT infrastructure (Section 3) and we examine what standards and standardisation mean, in general (Section 4).
Sections 5 to 7 give an overview of existing economic and management theories that are pertinent to our subject. In Section 5 we look at the rationale for standardisation in organisational design and how this implies that the degree of standardisation of different kinds of organisational process may differ considerably. This section draws heavily on well-established theory from Galbraith (1976) and Mintzberg (1983). In Section 6 we look at how standards can be established, both within firms and between firms, both by management policy and by market forces. This section is inspired by literature on IT strategy on the one hand (Weill and Broadbent 1998) and insights from economics of information goods science such as lock-in and path dependency (Arthur 1989, Shapiro and Varian 1998) on the other. Section 7 touches briefly on various growth stage theories and standardisation, such as the product life cycle, organisational growth stages and IT maturity.

In Section 8 we illustrate how these theories worked out in practice for a European multinational electronics firm, which has been evolving from a vertically integrated monolith into an increasingly networked conglomerate. We show how the phenomena we have described in theoretical terms up to then can be found in this company’s actual IT and business history. We return to this case example to illustrate our discussion of the managerial guidelines for IT infrastructure standardisation in Section 9. Section 10 contains our concluding remarks.

2. Networked firms

The notion that networked firms are going to be the new dominant organisational form is increasingly taken for granted. After Castell’s (1996) extensive study of the network society, in which he convincingly argued that social interactions increasingly take place in networks, it soon became evident that this organisational metaphor (Morgan 1986) was highly applicable to economic interactions as well. Hence the term network economy, or, for short, ”new economy” (Tapscott 1995, Fine 1998). From there to the networked firm or ”extended enterprise” (Tapscott 1995) was only an obvious step. No standard (sic!) definition of this new organisational firm exists, but for the authors essential elements are the following: it is a grouping of a number of semi-independent organisations, each with their capabilities and competencies, who collaborate in ever-changing constellations to serve one or more markets in order to achieve some business goal specific to that collaboration.

Although it is becoming increasingly clear that networked firms are the new dominant organisational form, it is considerably less clear what is causing the demise of the vertically integrated firm. Even more uncertain are the implications for management of such networked firms: nobody knows for sure what the ”new rules” (Kelly 1998) will be, despite the claims of the gurus.

Many of the theories that attempt to explain the rise of the networked firm place the rise of IT productivity at the centre of their reasoning. One strong argument links IT productivity with transaction cost theory (Coase 1937, Williamson 1975). This economic theory states that the reason that organisations exist in the first place is that the cost of transactions, of doing business with other people or entities, is lower between units within the same organisation than across multiple organisations. For instance, in general, manufacturing firms will not aim at producing every part themselves because for many technologies the firm will lack the economies of scale. However, when starting up an activity in a new country it may be necessary to invest because the supplier market is not yet developed and local rules are prohibiting imports. In terms of transaction cost theory, the transaction costs – finding and selecting suppliers, comparing prices and qualities, ordering, inspecting, checking and paying invoices – are too high.

The globalisation of the economy and the success of world trade liberalisation have created new business environments which change the transaction costs equation; hence the strong tendency to spin off or sell units and to concentrate on the core business. Transaction costs are largely influenced by information costs and therefore it can be no surprise that this process is
accelerating now because information processing capabilities increase dramatically and information processing costs are decreasing. For intra- and inter-firm communication, EDI has been a modest step, perhaps since it was based on proprietary networks and complicated protocols, but undoubtedly the Internet has really made such communication much cheaper and hence transaction costs lower (Downes and Mui 1998).

3. IT infrastructure
IT infrastructure is considerably more than just computers and the cables connecting them, i.e. IT hardware. Weill and Broadbent (1998) define information technology as “a firm’s total investment in computing and communications technology. This includes hardware, software, telecommunications, the myriad of devices for collecting and representing data (such as supermarket point-of-sale and bank automatic teller machines), all electronically stored data and the people dedicated to providing these services.” (p.6) They view the total sum of this investment as the information technology portfolio. This portfolio is founded upon the firm’s longer-term information technology infrastructure, which is in turn linked to public infrastructures, such as the Internet and telecommunications providers. It is this close combination and integration of these internal and external infrastructures that they call “the new infrastructure” and that they consider central to the networked firm.

Figure 1: The structure of Information Technology Infrastructure (after Weill and Broadbent 1998, p. 86)

As Figure 1 shows, a certain hierarchy in this information infrastructure can be distinguished. At the bottom are generic information technology components, such as computers, printers, routers and the like. It takes human skills, policies, standards and experience to transform these into IT services and applications. Weill and Broadbent see three types of IT services. Firstly, there are shared IT services, which are stable over time, such as the management of shared customer databases or PC/LAN access. These services are used for IT applications. Here a distinction is made of local versus shared and standard IT applications.
Local applications are seen as based upon, but not part of, the IT infrastructure. Local applications are indeed local, fast-changing and used by a limited number of people. Shared and standardised applications, such as accounting or payroll services, change much less regularly and are used throughout the firm. Please note that local applications need not be standardised, and that the criteria for judging whether a specific application is to be seen as part of the IT infrastructure are: (a) its local versus integral nature, (b) its speed of change and (c) the number of people that use it. As we will see in Section 5, similar criteria have been suggested in organisation theory to determine the degree of standardisation that is desirable for a certain activity or work process.

4. Standardisation

Ironically but understandably, there is no standard definition of what a standard is. And many of the definitions that are available have tautological elements. For instance, according to the Webster Dictionary, “Standardising” is “to compare with a standard or to bring into conformity with a standard.” Other definitions emphasise the instrumental nature of standardisation. In technical terms, “the use of standards leads to the uniformity of objects and therefore enables and facilitates interaction between at least two objects (Buxman et al. 1999). But standardisation is more than just a technical process of developing and testing standards. It is also an economic, political and social process of selecting standards from competing alternatives. (c.f. Vercoulen and van Wegberg 1999).

Standards in information systems can be defined at different technical levels (Buxmann et al. 1999). Communication protocols set general rules for exchanging information, regardless of the content to be transferred. In contrast to this, a standard software solution also defines contents and to some degree even processes, e.g. the use of a specific cost accounting method. As Buxmann et al. (1999) note, “(...) loss of uniqueness of certain characteristics does not apply to all standards equally. While it seems to pose less of a problem for communication standards, it plays a significant role in evaluating the application of standard software”. So in line with the remarks made on IT infrastructure in the preceding section, IT infrastructure standardisation may consist of many detailed standards, such as for processing hardware, communication hardware, communications protocols, programming languages, data base software, data elements, and messages.

As we will see next, it is not just technical characteristics that determine the impact of standardisation, but organisational ones as well.

5. Standards and organisational design

The importance of standards has long been recognised in the organisational design literature. In particular, standards have been suggested as effective vehicles for overcoming the complexity that arises from the many interactions that occur in larger organisations with many stakeholders, be these vertically integrated or networked. In this section we will look at organisational design motivations for standardisation (5.1), at different organisational objects of standardisation (5.2.) and at degrees of standardisation (5.3.). In all cases, we will not be talking so much about IT but about standardisation from an organisational design perspective.

5.1. Standardise why? — To overcome complexity

In his groundbreaking work Designing complex organisations Galbraith (1976) based his theories on the assumption that, the greater the uncertainty of the task, the greater the amount of information that has to be processed between decision-makers during its execution. To accommodate this, the organisational designer has to balance rules and programs, hierarchical referral and goal setting. The quality of the resulting organisational design depends on the combination of the frequency of exceptions and the ability to handle them. According to
Galbraith, the designer has two basic options to improve this ability. Firstly, by reducing the need for information processing (by creating or accepting slack resources like stocks or by creating self-contained tasks like product groups). Secondly, by increasing the capacity to process information, either by investing in information systems or by creating lateral relations between organisational units.

The networked firm was still a concept to be thought out when Galbraith wrote up his ideas. Nevertheless, we would like to maintain that his ideas still apply today. Moreover, his theory shows how standardisation becomes all the more important for a network of semi-independent entities. This is because the design options for overcoming complexity are much more limited in such a network. Design options such as hierarchical referral are impossible; programs and rules have to be negotiated. Common goal setting remains an essential prerequisite for networks but often remains limited to specific goals for a short period, e.g. to develop and manufacture a new type of car. What remains is the ability of networked organisations to increase the capabilities of information exchange between the entities. And for this, standardisation (or formalisation, as Galbraith calls it) is essential because it provides an efficient method to identify all relevant data, which increases the ability to co-ordinate activities.

5.2. Standardise what? — Skills, processes or outputs

Organisational scientist Henry Mintzberg also saw an important role for standardisation as coordinating mechanism in organisational design. Mintzberg goes on to distinguish between different objects of standardisation. Figure 2 illustrates his thinking. It shows how standardisation of the skills required to do the work can be seen as the most decentralised way of co-ordinating. This is in fact a very common degree of standardisation, observable in organisations as diverse as hospitals, trucking firms or football teams.

![Figure 2: Mintzberg's co-ordinating mechanisms on a continuum of decentralisation (from Mintzberg 1984, p.108)](image)

The most extreme form of standardisation, on the other hand, is one where the work processes themselves have been standardised also. This may apply to nurses, accountants and factory line workers alike. The middle ground is taken by standardisation of outputs, where people are free to decide how they wish carry out their work, as long as their outputs confirm to certain criteria. Obviously, which degree of standardisation is preferable will be dependent on many factors specific to the organisational setting under investigation. To mention one criterion: the more diverse and changing the work conditions and requirements are, the more difficult it will be to standardise up to the work process level. But different types of business processes have different degrees of predictability and repeatability, as we will see next.
5.3. Standardise to what degree? — Dependent on nature of processes

It has long been recognised that not all organisational processes and transactions have to be equally rigorously standardised. In his *Structure in Fives* (1984), Mintzberg described five different views, or theories, of how organisations function. These five could be seen as five different systems of flows”, or, in our terminology, business processes:

- The flow of formal authority, supported by e.g. the accounting infrastructure;
- The flow of regulated activity, supported by e.g. ERP systems;
- The flow of informal communication, supported by e.g. electronic mail;
- The flow of work within a set of work constellations, supported by e.g. design management systems;
- The flow of ad hoc decision processes, supported by e.g. a decision support system (DSS) or executive information systems (EIS).

Roughly speaking, the need for control, predictability and hence for standardisation becomes less for each subsequent flow. Annual reporting will often be fully standardised, not just in terms of its outputs (profit & loss statements, balance sheets) and its processes but even in the allowed inputs. On the other hand, strategic decision-making processes are almost by definition not standardised in any way and, if they are, usually fairly unsuccessfully (c.f. Mintzberg 1994). These profound differences in needs for standardisation are often not understood, especially by IT departments but also by business managers asking for standard IT solutions.

Please note that the nature of specific processes can change over time. What started out as an ad hoc decision-process may evolve into an ongoing work constellation and eventually even in a regulated activity. One example of this is quality management. Several decades ago, sharing of quality information may have been an ad hoc process in many manufacturing organisations. However, the rise of the quality movement has made this evolve from a work constellation into a regulated activity, in which information is permanently shared between different units according to standard data specifications. If senior management then wants quality data included in their regular management reports according to ISO900x-specified procedures and definitions, one can start seeing the process of sharing quality information with senior management a part of the flow of formal authority. As such, the need for standardisation of specific processes may change over time and hence the need for standardisation in the IT infrastructure supporting it.

6. The dynamics of standardisation

6.1. A typology of standardisation mechanisms

In this section we look at different ways in which standardisation can be achieved. As in the preceding section, we look at processes of standardisation in general. But this time our focus will be more IT related. Also, our view will not be limited to individual firms or organisational networks, but will also include standardisation in markets and industries, since standardisation processes in these different domains have important common characteristics.

In general, we can distinguish two extremes of standardisation, which we will label coercive and competitive. The traditional management view on standardisation is that it should be achieved in a coercive manner, i.e. ordered by some governing body. The other classical way of achieving standardisation is by competitive forces, in which standards emerge out of market transactions without hierarchical orders or even despite such orders for a specific standard. This is in line with classical transaction cost theory: standardisation either lowers transaction costs within a firm or it lowers transaction costs in the market place. Nowadays, a third way of standardisation is increasingly recognised as being well suited for the network economy: collaborative or alliance-led standardisation (Doz and Hamel 1998).


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Table 1. Typology of standardisation mechanisms

As is illustrated in Table 1, this collaboration mechanism can again take three different forms. There is the centrally ordered alliance, such as can be observed in the telecom sector where formal government-ordered standardisation preceded industrial adoption. On the other side is the consortium-led standardisation effort, such as can be observed in the computer sector, where alliances emerge out of fierce competition amongst rival groups of companies, all striving for their product to become the standard (c.f. Shapiro and Varian 1999). And, there is a middle form, voluntary alliances, such as those that brought about the standardisation—and hence the success—of the World Wide Web, in particular HTML and HTTP (c.f. Cargill 1999).

We will now discuss all these different mechanisms for standardisation, both from the perspective of the industry sector and from the perspective of management of a networked firm.

6.2 Coercive standardisation

According to Weill and Broadbent (1998), senior management of any firm that wishes to keep its information technology infrastructure strongly supportive of its overall business strategy should be leading the way in making IT investment decisions, such as deciding on standardisation of IT infrastructure elements. This goes a fortiori for firms that want to drive their business strategy by IT, not just have IT respond to demands from strategy. Only senior management can push through IT investments that are for the common good of all the organisational units but which may not be locally optimal for many of the individual units. Weill and Broadbent provide a framework to link these IT investments systematically with decisions on overall strategy and existing IT infrastructures and label this approach “management by maxim” as opposed to the in their view much weaker “management by deal” that they observe with many of their clients.

This policy is ideal if management (a) has the power to enforce this standardisation, (b) has made the right strategic choice for a specific type and degree of standardisation and (c) the environment does not change so much or so rapidly as to invalidate the wisdom of this earlier choice. At an industry sector level, a successful example is that of the telephony sector, where at the ITU (International Telecommunications Union) government officials of the member states of this body routinely decide on selection of standards.

However, if product life cycles are much shorter than in telecom and network effects are less profound, points (a) and (b) can make management by maxim much more problematic (c.f. Vercoulen and Wegberg 1999). Indeed, in general the de facto evolutionary character of standardisation processes in complex organisations makes life difficult for coercive approaches. Monteiro and Hanseth (1999) point out that this evolutionary character takes place not just at the moment when a standard is defined, but also once it gets implemented. During the defining stage, “there is a necessary vagueness and shifting character of the information infrastructure (...) which immediately translates into a critique of the assumptions [underlying coercive standardisation] about stability and well-definedness” (Monteiro and Hanseth 1999, p.3). And once such a standard is implemented, it becomes by definition a localised phenomenon: Standards are not universal (...) they are only universal as abstract constructions. When they get implemented, they
are linked to and integrated with local systems and practices. (..) Their universality and homogeneity disappear as standards get implemented. They are locally embedded (..) and they are continuously changing — in different directions in different localities.” (ibid, p.3) We will provide examples of successful and unsuccessful attempts at coercive standardisation in our discussion of experiences with IT infrastructure standardisation in our case study in Section 8.

6.3. Competitive standardisation

Standards need not be ordered from the top, they will emerge anyway when networks of people start interacting more frequently. Our daily lives are filled with standards that have emerged out of fierce competition between different possible standards in which, in the end, the winner took all. Classical examples are the width of railroad tracks, the QWERTY keyboard, compact disk (CD) technology and — still ongoing — English in academic discourse.

Standards emerge in markets because of the interactions between a number of dynamic effects. The first effect stems from the before-mentioned transaction cost theory: if interactions take place based upon a common standard, costs become lower and so the units in the network that use the standard will have lower costs than those that don’t.

The second effect is lock-in (Shapiro and Varian 1999). Lock-in relates to the switching costs that are inherent with any investment decision that you make. Once you have become an Apple Macintosh computer user it becomes increasingly costly to transfer to another type of hard- and software, since you will no longer be able to utilise your previous investment. So units that use a standard will be inclined to keep on using it. But since the transaction costs with the standard are lower, non-standard using units will be tempted to switch to the standard as well. Which brings us to the third dynamic effect, which is increasing returns (Arthur 1989).

The concept of increasing returns is the opposite of a well known low in Economics for conventional material goods, which is the Law of Diminishing Returns. This says that the bigger your share of the market becomes, the more difficult it becomes to sell additional items to a saturated market population. But for many information goods, higher market shares only lead to higher popularity of the market leader. The more people use Microsoft Windows as the operating system for their PC, the more applications will be developed for this platform. The more applications are being developed, the more attractive the platform becomes and hence the more users it will attract. In the end, Windows becomes the de facto standard for many PC users, until the next technology discontinuity may make it obsolete again.

A collary of increasing returns is Metcalfe’s Law, named after the founder of 3Com Corporation, who stated that the value of a network goes up as the square of the number of nodes that are in it (Downes and Mui 1998). If two people own a telephone, the value of the network is limited. Three users can have two one-on-one conversations, but four can already have six conversations, five ten conversations and so on. In general, n users can have a maximum of \( n(n-1) \) separate interactions. So if the size of a network is determined by its underlying communication standards, as with the Internet in general and E-mail in particular, then the usefulness of that standard (and hence its value to users) increases exponentially as the number of adherents to that standard increases.

The concepts of increasing returns and Metcalfe’s Law explain the importance of path dependency (Arthur 1989, Sterman 2000), which is a main driver for the desperate urge with which Internet start-ups are trying to obtain market leadership for their type of product very early on, regardless of the costs. As more begets more, it becomes extremely important to establish the lead position for a standard very early on.

Finally, there is market tipping. Path dependency does not mean that every early leadership leads to a final outcome of winner-takes-all; not every market tips towards a single dominant technology standard, in the words of Shapiro and Varian (1999). High demand for variety and low economies of scale both make market tipping unlikely, they point out. This is a negative, or
balancing, feedback loop that can counteract the positive growth loop of increasing returns. For any network, there is a critical combination of user interactions, increasing returns and switching costs that is just great enough for the positive growth loop to dominate the negative loops. That threshold is known as the tipping point (Sterman 2000). Once the growth loop becomes the dominant one, the new standard "can spread like wildfire — that is, by positive feedback — limited only by the depletion of the (...) population." (Sterman 2000, p.306)

6.4. Collaborative standardisation

Standards lower transaction costs for all parties involved in exchanges. Hence, establishing a standard can be seen as being for the common good. Not surprisingly then, that governments, as the natural champions of the common good, have been active in establishing standards by setting up official standards bodies. One successful example of this is the ITU or International Telecommunications Union, which is a formal treaty organisation and run under the auspices of the UN (Cargill 1989, Vercoulen and Wegberg 1999). The telecommunications industry has relied on the ITU to set international standards starting with the telegraph in the 1860s, through radio in the 1920s to a multitude of standards today (Shapiro and Varian 1999). We will call this hierarchically ordered collaboration. This model can and has also been applied successfully at the firm level. Many if not most large manufacturing firms have some form of a central standards department that owns the right to set standards on data format, transactions and the like.

Since standards are for the common good it is, even in our increasingly individualistic society, not surprising that voluntary collaboration on standards has been quite prolific as well. The ISO (International Organisation for Standardisation) is in this a classic example, but W3C, the World Wide Web Consortium, is a much more recent phenomenon. W3C has been responsible for establishing the two HTML and HTTP standards. These two innovations have provided the ability to easily transmit pictures, drawings and variant types of text over the Internet, which has made it an interesting medium for a wide variety of activities and has been highly instrumental in bringing about the success of the Internet (Cargill 1999). Once again, the same phenomenon can be observed at the firm level, where such voluntary associations often start out as special interest groups that grow in scope and membership as they gain momentum.

Standards may be for the common good but most common people do not care much about how the standard was created and who owns it, just as long as there is one (Cargill 1999). This basic notion has spurred the growth, especially in the information technology domain, of attempts at consortium-led collaboration in the standards-setting process. Firms build alliances with other firms around a common standard against other groups with competing standards because they see that they have little chance of becoming owners of the standard on their own. In dynamic markets, this approach to collaborative standardisation has advantages over the previous two because these are inherently slower. Their decision processes are designed to be open to all participants and to foster consensus, which next to many advantages does tend to slow down the decision-making process considerably (Shapiro and Varian 1999, Vercoulen and van Wegberg 1999).

A drawback of consortium-led standardisation efforts is that they may result in multiple standards, which may still be better than no standard at all but is, from a transaction cost perspective, inferior to having a single standard. As has been shown by Axelrod et al. (1995) in a formal analysis of the efforts in 1988 to create UNIX operation system standards, the likelihood of a deadlock situation occurring between two competing alliances can be very high in a market with high rivalry and considerable benefits from being on the winning side in a "standards war" (Shapiro and Varian 1999).

Again, similar phenomena can be observed at the firm level as well, but usually much less openly, since organisational units are not supposed to compete with each other. Nevertheless, de facto alliances with other business units (BUs) to have your current E-mail system or ERP
package become *the* standard package for the whole company can be identified in many large companies, not necessarily just networked ones.

6.5. Hybrids

In practice, all of the above-mentioned standard-setting mechanisms can be witnessed, and often in conjunction with each other. There are many grey areas as well: company management may start endorsing a voluntary attempt at standardisation; individual firms will see it in their interest to join a successful alliance; an official standards body may choose an existing technology for which a specific firm holds essential patents. In the view of Vercoulen and van Wegberg (1999), such hybrid forms are on the increase, especially in dynamic, complex industries. They provide the example of standardisation in Internet telephony, where two official standard setting bodies develop and select architectures, one of these and three corporate alliances focus on interoperability. In all these standard bodies many of the same firms are taking part, postponing their definitive choice until it becomes clear what the best bet will be. Some parts of the future standard look set to be determined by the dominance of a single firm, Microsoft, in the browser market. Similar hybrid situations can be expected to exist in corporate environments, as will be illustrated in sections 8 and 9.

7. Growth stages and standardisation

This section touches briefly on the third and final set of existing economic theory that can be instrumental in guiding management policy towards standardisation in networked firms: theories of organisational growth stages. We start with the most generic and well-known one, the product life cycle concept.

7.1. The product life cycle (PLC) concept

The term PLC has its roots in the marketing literature (e.g. Kotler 1967). Here it was first noted that products have limited lifetimes, and that during their lives they pass through distinct stages, each posing different challenges to the seller, with different volume and profit levels and hence different appropriate strategies for dealing with these challenges. Typically, four stages are distinguished in the product life cycle: introduction or development, growth, maturity and decline. During the development stage, market growth is slight but technological change in the product design is very great. "Engineering changes" become less frequent during the subsequent growth stage, but market growth is very large then. This growth gradually declines until it becomes practically zero. The product has now reached its maturity stage. Here there are relatively few technological changes. In the last stage, the decline stage, technological change is slight and sales growth becomes negative i.e. decline sets in. This is summarised in Table 2.
Table 2: Stages in the product life cycle and managerial aspects of standardisation

<table>
<thead>
<tr>
<th>Stage</th>
<th>Development</th>
<th>Growth</th>
<th>Maturity</th>
<th>Decline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage growth rate</td>
<td>Slight</td>
<td>Very large</td>
<td>Moderate to nil</td>
<td>Negative</td>
</tr>
<tr>
<td>Technological change in product design</td>
<td>Very great</td>
<td>Great</td>
<td>Moderate to slight</td>
<td>Slight</td>
</tr>
<tr>
<td>Appropriateness of standardisation efforts</td>
<td>No, immature</td>
<td>Possible, or multiple</td>
<td>Yes, in 1 or 2 standards</td>
<td>Yes, 1 or 2 standards</td>
</tr>
<tr>
<td>Preferred standardisation strategy</td>
<td>Competitive</td>
<td>Collaborative</td>
<td>Coercive</td>
<td>Coercive</td>
</tr>
<tr>
<td>Presence of technology that will become the standard</td>
<td>Possible (path dependency)</td>
<td>Likely</td>
<td>Essential</td>
<td>Essential</td>
</tr>
</tbody>
</table>

We can apply this PLC concept not just to products, but to new (information) technology as well. And we can investigate its workings not just at the industry level, but also at the level of the firm, networked or not. Finally and most relevant to the current article, we can draw conclusions from this theory on the managerial relevance of standardisation efforts. One obvious conclusion is that it is generally unwise to strive for standardisation during the introduction or development stage, because of the high number of changes that are likely to occur in the technology. On the other hand, once a technology has reached maturity, standardisation has become essential. Volume is largest then and so is its use; hence, also the potential of lowering transaction costs by standardisation. This implies that managerial efforts to establish standards should become opportune between introduction and maturity, somewhere during the growth stage.

If we look at standardisation and the PLC concept from the perspective of the preceding section, i.e. the dynamics of standardisation processes, then coercive standardisation has the highest chances of success in the maturity phase and is extremely risky in the introduction phase. The growth stage is likely to see a competition between multiple standards, each striving for market dominance, so here efforts for collaborative standardisation will be most appropriate. In the dynamic and complex settings that are typical of the introduction stage of new technology, only competitive standardisation — or, from the perspective of the individual firm a “wait-and-see approach” (Krieb 1999) — may work.

The theories of path dependency and increasing returns theory are also relevant in this context. For one, they explain why betting on a specific technology to become the “winner”, i.e. the standard during the maturity phase, is very risky during the introduction stage and remains risky during the growth stage. On the one hand, path dependency explains why this eventual winner is likely to have been around during the introduction stage (although not necessarily as the very first to appear). It certainly will have to have been one of the contenders in the growth stage. But, on the other hand, the same theory explains that predicting this winner so early on is virtually impossible, since very small changes in the competitive setting may have profound impacts further down.
7.2. Information management growth stages

The PLC model, originally thought out for products, can not only be applied to technology but also to organisations and the way they deal with IT as well. Richard Nolan (1982) was among the first to do so. In a close analogy with the PLC stages, he defined six stages of what was in the 1970s called "data processing growth":

1. **Initiation**. IT usage by IT specialists, who experiment with technological possibilities, with a hands-off managerial attitude.

2. **Contagion**. Great enthusiasm with IT users, diversity of systems without coherence, increasing investments without integrated planning, more dedicated IT staff.

3. **Control**. Reorganisation of IT, high maintenance and adaptation costs, more formal planning of IT projects, managerial priority-setting, productivity increases in system development;

4. **Integration**. System integration and data structuring and standardisation; communication via networks and terminals, focus on education of users and IT staff, decentralisation of IT management.

5. **Data orientation**. Centralised data management, decision support tools, system development by users, decentralised data processing;

6. **Maturity**. Information management at board level, IT strategy and business strategy aligned, decentralised IT system responsibilities.

Important to note about this framework is that Nolan claims that every company has to go through each of these stages; there are no shortcuts. The only thing management can strive for is that certain stages take less long than without managerial guidance. One other thing to note is that Nolan sees a typical growth path for managerial efforts at standardisation of data and processes. In the initial stages, management should maintain a hands-off attitude, but as IT usage proliferates, more strict project control will become required. System and data standardisation come next, up to the point where data are fully standardised and IT system responsibilities can again be strongly decentralised.

7.3. Evolution and revolution in standardisation

Transitions between developmental phases typically do not proceed naturally or smoothly, regardless of the strength of management. This is one of the key insights from organisational growth theory, such as formulated by Greiner (1998). In complexity theory this phenomenon is known as "punctuated equilibrium" (e.g. Gersick 1991). Long periods of gradual, small improvements are interceded by short periods of major changes. This suggests that standardisation efforts will typically be conducted in relatively short, condensed bursts of focused energy, followed and preceded by relatively long periods in which little seems to change. A critical management skill may be to sense when the timing is appropriate for the next "standardisation revolution".

8. A case study

8.1. From hierarchical control to network control at Electroco

Electroco’s core business is the production and sales of electronic products for the consumer market, such as TV’s and audio equipment. It also produces goods for industrial markets, such as machine goods or medical equipment. In addition, it produces many of the components and subassemblies it uses in its electronics equipment. For instance, it has a semiconductor product division of substantial size.

Electroco is not a network of independent legal entities. Rather, it is a firm on its way from being a fully vertically integrated firm to a much more networked organisation. To zoom in on its semiconductor branch, this supplies less than 20% of its production to other Electroco branches,
the rest is sold on the open market, amongst others to direct competitors of these Electroco branches. Substantial parts of its production, such as assembly and testing of IC’s, are outsourced to third parties, in which Electroco may or may not have a minority interest. It own production facilities have to meet reach high loading levels to be profitable and therefore are starting to work for external customers as well. Increasingly also, business units of this semiconductor division engage in very close partnership with its key customers, for instance when an IC needs to be designed-in with a new product of these customers and short PLCs require joint design of the total product. Although Electroco is not a network of legally independent entities, we feel that the lessons it may teach on standardisation are applicable to integrated as well as to networked firms in the 21st century.

8.2 Standardisation of IT infrastructure at Electroco

Electroco has a long history of attempts at standardisation of IT infrastructure, with mixtures of success and failure. Back in the 1970s, the company described itself as a matrix organisation (Mintzberg 1983). One axis of this matrix was formed by relatively independent national organisations, who conducted market-driven trading in all products of the company but also in products which were bought from third parties. The product divisions (PDs) formed the other axis; they were responsible for the development and manufacturing of products.

Such a matrix structure is heavily dependent on information flows. In the 1970s, Electroco put great emphasis on two regulated control flows: the supply chain management (SCM) flow and the accounting flow. Large sums were invested in the automation of the information processing to increase the capability of the organisation to process information. In those years, communication costs were very high so the regulated flows were built as a number of connected systems processed in different locations. Standardisation efforts in this period were aimed mainly at the bottom level of the infrastructure pyramid of Figure 1: standards for information equipment like communication hardware, processing hardware, data base management systems, programming languages and the like were established. The purpose of this effort was to ease communication between the various organisational units, hence to lower transaction costs and of course to keep information processing costs under control. It gradually became more and more apparent that technical infrastructure standardisation alone was not enough. The regulated flows in accounting and SCM required standardisation of data elements and messages as well. Therefore substantial efforts were spent on this standardisation.

In the 1980s the matrix was simplified. The product divisions gradually got control over "their" part of the sales organisations and the role of the national organisations became a supportive one. Efforts concentrated on the use of standard information systems in each of the units and on PD level systems to support the control of the supply chain. Each product division started to standardise the regulated flow in the SCM area by means of ERP (Enterprise Resource Planning) systems. Meanwhile, the corporate body concentrated on the consolidation process in the accounting area.

During the 1990s, technological developments such as client-server architectures, PC’s, multiple ERP packages and the associated different languages, hardware and database management systems made the IT infrastructure picture for the whole company very diverse indeed. Towards the end of the decade the strategic apex came to realise that, as a result of this, Electroco ran the risk of falling apart in separate, disassociated entities and decided to take action. The goal as stated was that the company should standardise the information infrastructure in such a way that specific entities could be sold or added without major disturbances or efforts.

A working group came to the conclusion that it would be essential to have (1) a highly standardised communication infrastructure based on internet standards, (2) a single standard for PC and the basic PC software and (3) a common e-mail system to facilitate informal communication and groupware. It was left to the divisions to decide about the choice for specific
ERP packages but at the same time renewed effort was put into standardisation of messages and data elements. This standardisation effort has been successful. In its latest annual report the company states that, because of these measures, it feels it will be able to take part in the new economy and is ready to build up relationships with other companies to take part in e-business. In other words: to operate as a networked firm.

After this general description, let us look at standardisation efforts for specific business processes and IT infrastructure aspects at Electroco.

8. 3. Standardisation of accounting processes at Electroco

Typically, one would expect that systems that support the flow of formal authority such as an accounting system should be relatively easy to standardise throughout a firm. This is not true in a multinational company: in each country there are quite different opinions and traditions in accounting and every government has established its own rules.

Already in the 1970s, Electroco realised this and therefore decided to concentrate the standardisation efforts on the consolidation of financial data. The legal entities of the firm were forced to send their reports in a structured electronic way every month to company headquarters. A great deal of effort was put into the standardisation of data elements and the messages. A specialist group in the centre drove this standardisation. The Board of Electroco supported the development by forcing the accounting community to deliver reports within ever-shorter periods. These days, the result has been twofold: Electroco is able to give detailed accounting reports just a few days after closing of the months and the entities in the countries have standardised their accounting procedures so that they are now able to deliver accounting information timely. This we may call a successful example of coercive standardisation, even up to the level of processes, not just output data. Nevertheless, at the same time this whole process has been strongly influenced by institutions like the SEC in the USA that placed more and more formal requirements on financial reporting for companies listed at the stock exchange.

8.4 Standardisation of supply chain management processes at Electroco

Manufacturing firms have huge flows of regulated activity, especially in the SCM area. As stated earlier, Electroco organised itself after the war into a matrix with country-based sales organisations and international product divisions that were primarily responsible for development, production and some marketing. The sales organisation ordered the goods at the PD centre, which planned the production in the factories. The results were, as could be expected, high stock levels, obsolescence costs and long time to market.

As early as in the 1960s, Electroco started to work on these issues by introducing automated information systems both in the sales organisations in the PD centres and in the factories. Interfaces between these on the operational level were maintained by messages, notably order and invoice messages. Standardisation was supported by attempts to standardise the packages used for these information systems. Results were mixed. Each system helped considerably in improving operational efficiency in its unit but overall stock levels and customer service did not improve to the required levels. The use of the standardised messages by means of EDI was below expectations, so a great deal of manual re-keying had to be done to transfer the data from system to system.

In the 1980s, Electroco undertook a huge effort to improve the situation in its consumer product divisions. Two projects were started, one in the factories and one in the product divisions. The first one was a success; both MRP 2 and JIT concepts were implemented and flexibility in the factories, measured in terms of manufacturing throughput time, increased enormously. Stocks as percentage of turnover decreased with 30%, freeing up a great deal of working capital. But the PD level project failed, basically because of disagreements about the business processes and the
required levels of standardisation. Here political strife ruled and coercive standardisation did not work.

Towards the end of the 1980s, Electroco gave up its matrix organisation and made the product divisions the dominant axis. As a result, each of these PDs embarked on its own project to structure and standardise the SCM systems infrastructure on a world-wide basis. This proved to be not easy, even with strong hierarchical support and the extensive use of international working parties, i.e. collaborative standardisation. The emphasis in standardisation was placed on the use of standard packages and the available technical infrastructure. But to arrive at common procedures and common product and other data definitions turned out to be a very complicated effort. Each organisational entity had its own position on the market place, its own distribution channels policy, etcetera. Even when voluntary collaboration provided the willingness there to adhere to common standards, time consuming discussions remained necessary to bridge the present with the future.

8.5 Standardisation of Electronic Data Interchange (EDI) at Electroco

Electroco has started the standardisation of data elements for some major business processes as early as the seventies. In the beginning this was a proprietary effort within the company. On corporate level an Office of Data Element Standardisation was established to organise the effort (i.e. hierarchical ordered collaboration in our terminology). Its goal was to supply information systems designers with standard data elements to improve speed and quality of the development of information systems. Soon it became clear that the effort should be complemented with an effort to standardise messages as well because different systems should be able to communicate with each other. For instance, the logistics system in the sales organisation should produce order and invoice messages for the central warehouse system.

Gradually, the need to be able to communicate electronically with systems outside the company became apparent which led to the conclusion that it would be required to switch where possible to external standards. Therefore, the company became active in standard official setting bodies like UN Edifact to speed up the development of standards. The results of these efforts have been less than expected for reasons in line with the overall developments in the world of EDI. Nevertheless, the difficulties in setting collaborative standards for transactions do point at a potential bottleneck for the growth of electronic commerce, given the huge diversity of possible electronic transactions (Biemans 2000).

8.6 Standardisation of electronic mail (E-mail) at Electroco

The use of E-mail systems started at the end of the 1970s. In the beginning, E-mail software was developed in house but gradually each organisational unit at Electroco made a choice for an E-mail system from an external supplier, in most cases related to the hardware environment they were using. This selection was most often made by the national organisations and they understandably selected systems that could support the local language. In this manner, a considerable number of different E-mail systems became used at Electroco. Communication between these systems was very difficult in the beginning. For instance, the E-mail package Profs was limited to IBM environments and its counterpart All in One to Digital platforms. It should be noted that, in the same period, the fax became popular so a part of the intra-unit communication needs was supported by this medium. Therefore, pressure to improve the situation was not very high.

In the 1990s, the suppliers of the E-mail packages started to develop bridge software to make the systems communicate. Besides that, the Internet grew which made it possible to exchange mail with people outside the firm based on the SMTP standard. From an infrastructure point of view the whole picture became rather messy and the costs to support the different systems and the bridges were growing at a fast pace. Several attempts were made by the strategic apex to come to
a standard using working parties to select one. (i.e. attempts at collaborative standardisation). However this did not work: all parties underlined the need to standardise but wanted to have their current system as the standard to avoid considerable changeover costs (i.e. lock-in costs).

At the end of the century, using E-mail had become an essential element in the communication and disturbances could not be allowed anymore. Besides that, the much-feared Millennium bug would require an overhaul of some of the E-mail systems and the replacement of others, which would require considerable efforts and would bring high risks for the continuation of E-mail services. In view of this, corporate management decided to select one E-mail system and replace all the others (i.e. coercive standardisation). A working party made the selection and before the end of 1999 all the former E-mail systems were replaced by a single system.

9. Managerial guidelines

A key message of this article is that management of IT standardisation is not fundamentally different in the networked firm than in the classical integrated firm. The preceding sections have presented existing economic theories of the past three decades that continue to be relevant for this management challenge in the 21st century as well, as Shapiro and Varian note: "Technology changes. Economic laws do not." Shapiro and Varian 1998, p. 1-2). Our discussion of three decades of standardisation efforts at Electroco has illustrated that important lessons can still be learned from the past. In this section we translate the theories from the preceding sections into a set of managerial guidelines. We do so on the basis of a specific example, which is standardisation and product data management (PDM) at Electroco.

9.1 An example: Standardisation and product data management (PDM)

Product data management is concerned with the creation, storage and maintenance of all product-related information and the associated business processes affected, starting with product creation and penetrating from this most other business areas such as purchasing production, sales, logistics and accounting. Historically, product data management had been very much a local issue at Electro, if an issue at all. Applications to support it were inherently local and workgroup-specific. Under the criteria laid out by Weill and Broadbent (1998), these applications were often not part of the IT infrastructure, hence their standardisation was not an issue. In recent years, this picture has changed considerably. The use of PDM has proliferated and moved up on the Nolan curve. No longer is product data management a local issue, but one that is becoming crucial for interactions between different business areas.

One such interaction is between product design, marketing and customers. More and more, interactions between product designers, marketers and customers are driven by product data specifications rather than by the product themselves. For instance, given the short product life cycles in the electronics industry, customers usually buy newly designed products on the basis of product specifications, not after inspection of the physical products themselves. If these product specifications arrive late from the design department, or worse, have to be created within the marketing function, time to market is delayed which hurts profits considerably.

Another example is between product design and manufacturing. For instance, in semiconductor manufacturing, new IC types first have to be tested before they can be finally released. This requires that they be manufactured in small batches. If references to such products do not yet exist in the production database then planning their production becomes problematic.

But also within the same business areas, communication regarding product data would increasingly benefit from data standardisation. In the design function, new products are more and more developed by multiple design teams operating in different geographic locations. They should be able to use the same underlying databases to work effectively. And in production, third parties increasingly perform significant parts of the production and distribution of products. If
different business units use different coding mechanisms and product data creating and modification processes, this makes such outsourcing difficult, time-consuming and costly.

In short, the business benefits from closer integration and standardisation of product-related data and their associated business processes are clear and considerable. But next comes the question: how to achieve such integration and standardisation? We suggest the following steps that are presented here sequentially, but that in practice will often be conducted in an iterative manner:

- Assess present growth stage and critical mass of business process and technology involved;
- Determine business benefits of standardisation;
- Assess desired degree of standardisation;
- Determine standardisation mechanisms
- Apply and remain adaptive.

We will discuss each of these steps more in detail.

9.2. Assess present growth stage and critical mass

Is the business process involved, as well as the underlying information technology that supports it, still in its early stages of development? If so, strong managerial action may backfire. We saw in the case of E-mail, that Electroco management waited a long time until it took strong and decisive actions to achieve a single company standard. In the case of PDM, the technology as well as the processes appear to be in the growth stage, or what Nolan (1982) calls the contagion stage. One can observe a great deal of local enthusiasm, but also a diversity of different systems without any central co-ordination. This may point towards an approach of collaborative standardisation.

The obvious next question to be asked is if critical mass has been achieved or is about to be achieved in the short term. In our example, if PDM is still very much a local affair and typically small groups of people are involved that use local, ad hoc applications, is it then worthwhile to start a major standardisation effort? As noted above, technically speaking, the IT applications do not even belong then to the IT infrastructure in the definition of Weill and Broadbent (1998). Then, waiting until the next growth stage is achieved may be a wise managerial decision.

9.3. Determine business benefits of standardisation

What would it be worth if some degree of IT standardisation were achieved? As in most investment decisions, not just IT-related ones, the investment costs are usually considerably more tangible than the benefits. Business benefits may or may not be quantified into some monetary value, depending on managerial preferences. What would be the monetary value of X weeks shorter time-to-market? At any rate, X should be possible to calculate. Cost savings as a result of standardisation are usually less difficult to determine, but it is lost sales and lower profit margins that tend to have a bigger impact and raise more managerial interest.

If, as in this PDM case, the adoption of the information technology is in its growth phase, then these business benefits should definitely take into account the expected future growth of usage. During the growth stage, usage increases exponentially, not linearly. So three years from now, the PDM user population may not have increased 10-20% from today, but rather 100-200%.

9.4. Assess desired degree of standardisation

The question underlying the assessment of the desired degree of standardisation is: What is the nature of the process that is being supported by the technology? Is it closer to the flow of formal authority or regulated activity, or are ad hoc processes being supported and rapidly changing work constellations? If the latter, then standardisation is best limited to output specifications. If the former is the case, then standardisation may well have to include process standardisation to
some degree as well. For regulated activities, full standard process standardisation may be required.

It is important to note that very different kinds of business processes, and hence different standardisation requirements, may be relevant within a single field. In the case of PDM, the assignment of unique article codes tends to be a very formal activity, which proceeds according to precisely formulated steps. On the other extreme there is informal communication between designers and marketers regarding specs for a certain new product, possibly in the form of some workgroup operating from multiple geographic locations. Then there are regulated activities as creating product specifications and writing product documentation, and updating this information whenever the need arises.

Obviously, the degree of standardisation and especially IT standardisation will be different for all of these processes. Ad hoc, informal communication needs E-mail and workgroups can be supported by collaborative work support software, but in both cases the contents of the outputs need not be standardised, leave alone the processes that generate these outputs. The degree of standardisation will be considerably higher for the transactional processes such as product documentation and should be very strict for a formal authority-type of activity such as central article code assignment. Each of these IT standardisation requirements will have their own associated costs, benefits and time horizons.

9.5. Determine standardisation mechanism(s)

If we have now determined the desired level of IT infrastructure standardisation for the different processes involved, then how will this standardisation be achieved? In the networked firm, coercive standardisation will be the exception rather than the rule, since there is no single central formal authority to enforce a single standard. In these cases, the hierarchically ordered version of collaborative standardisation is the closest that one can get to. For Electroco, that would mean that corporate and or BU general management would prescribe that representatives from the different BUs would a committee or working group that developed company-wide PDM IT infrastructure standards.

At the other extreme lies the wait-and-see approach, which for a networked firm means letting competitive standardisation processes from the external market place play out internally. As we have seen in the example of E-mail, this may be a valid alternative if this passive stance changes into a very forceful one once it becomes clear that stronger central control is needed (Nolan’s stages 3 and 4). However, let us not forget that in the case of E-mail, which supports informal communication, only the format of the information to be exchanged needs to be standardised, not its contents, leave alone the processes that created the information in question. Therefore, at Electroco, even with some twenty E-mail systems, internal communication may have been cumbersome but did not break down. This would probably be very different in the case of PDM.

A more promising approach in this concrete example might be to use a mix of various degrees of collaborative standardisation. For instance, one could start up several local projects to learn from and to create multiple de facto emerging standards (i.e. market-driven collaboration). Findings from these projects could be shared between business unit representatives (i.e. voluntary collaboration) These informal network meetings could be formalised, endorsed, financed and supported with specialist expertise by central management. Once sufficient maturity in both processes and technology had been achieved, this standard-setting body could recommend one or two common standards for the whole or a part of Electroco, which decision would be approved by senior management. In this way, early lock-in into a losing technology would be prevented, and yet convergence towards company-wide standardisation would be speeded up. The initial stage could proceed quietly and in an evolutionary manner; rolling out the final standard could be much more intense, in line with the organisational growth concept of punctuated equilibrium (Gresnick 1991).
9.6. Apply and remain adaptive

Any managerial activity requires assumptions about the future. These are usually wrong, especially in turbulent high-tech environments like the electronics industry. This means that constant monitoring of the present state of affairs and frequent analysis of gaps between what was expected and what turned out will remain required. Management should continue to bear in mind that, in implementation, “standards never create order — in the way usually assumed. Order can only be created locally or as seen from one perspective. Therefore, managing dis-order as disorder is just as important” (Monteiro and Hanseth 1999). Being adaptive to ever-changing developments will remain essential. There may come an important customer who enforces standardisation, or a certain core technology may become obsolete. So if bets are to be made on specific standards, either one should make multiple bets simultaneously or make the bet as late in the game as possible.

10. Concluding remarks

This article has investigated the topic of managing standardisation of IT infrastructure in the decentralised, networked firm of the 21st century. Regarding this topic, it has stressed two basic messages. The first one is that, in such a networked firm, standardisation is more important than ever for business success, not less, as one might think at first. The second one is that, although the classical hierarchical command-and-control type of standardisation mechanism will be difficult to operate for management in networked firms, there are a whole variety of other mechanisms that management can utilise to achieve rapid and successful standardisation.

With regard to the first message, one could say that this paradox, i.e. that more freedom means more underlying rules, is a very broad one which is not limited to the field of IT or even to business organisation. For instance, political thinker Geoff Mulgan writes: “A society which too loudly proclaims individual independence soon becomes an unpleasant one to live in. In a densely populated society it is hard to enjoy freedom if you can have no certainties about how others will behave. Freedom to walk the streets, happiness in a relationship, contentment in a job, all of these depend on confidence — that the streets will be safe, your partner will not suddenly walk out, you will not be suddenly sacked. For the same reasons, free markets rest on rules guaranteeing property rights and enforcing contracts, and policing against fraud.” (Mulgan 1997, p.47)

With regard to the second message, one can argue how new these non-hierarchical standardisation mechanisms really are. We have seen that most of the theories that form the basis of these mechanisms have been around for several decades. Transaction cost theory goes back to the 1930s. Product life cycles are a concept of the 1960s. Organisational growth stages date back to at least the 1970s. Galbraith’s organisational design guidelines were published in 1976. Mintzberg’s classification schemes are from the 1980s. One could even argue that the recently-published material on network economics has roots much older than the 1990s. From a practical perspective, managers are invited to look back at successful standardisation efforts they witnessed in the past, and see to what extent these were achieved solely by strong command-and-control and not at least partly by some of the collaborative and market-driven mechanisms discussed. Moreover, how many of the abjectly failed attempts at standardisation that they recall weren’t pushed by authoritarian management? Therefore, we feel that the conceptual framework that we have presented in this is not a radical departure from established business imperatives, but much more an intensification of them. The past continues to contain important lessons for today and tomorrow, for those willing to learn from it.
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