

# Standardisation and Implementation of Information Technology

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## Abstract

*This paper looks at the mutual interplay between information technology (IT) and its environment. Exploring specifically the issues surrounding innovations in the field of corporate IT systems we show that a distinction has to be made between different categories of information technology (IT) systems regarding their introduction, subsequent diffusion, and particularly their corporate usage. We will show that strategic deployment of e-mail will only happen if and when it is no longer considered an infrastructural technology. However, apparently this has rarely happened thus far.*

*Strong relations and dependencies exist between standardiation, innovation and the subsequent implementation of IT systems. We argue that these activities must not be considered separately, especially as standards-based components are playing an increasingly important role in implementation processes. Consequently, the role of the users in, and their influence on, standards setting are addressed as well.*

## **1 Some Introductory Considerations**

Technological artefacts in general, and especially such powerful representatives as IT systems, will exert potentially strong impact on their environment. Complex interaction can be observed, where technology may assume both an active and a passive role; that is, technological artefacts and their environment are mutually interdependent. The environment within which technology is used and employed has, among others, social, cultural, societal, and organisational behaviours, rules and norms. It is clear that technology cannot emerge completely independent from such external influences. However, the impact IT may have on organisations, or indeed society as a whole, has thus far attracted considerably more attention than the powers that shape this technology in the first place. Especially the impact of IT within organisational settings (e.g. on a company's performance, or its role as an enabler of business process re-engineering) has been subject to a vast number of studies and analyses. Keywords such as 'organisational transformation' 'technology management', and 'management of change', can frequently be found in the literature, typically denoting studies on how the introduction and subsequent use of IT have changed a particular organisational

environment - for better or worse. Only recently has the reverse direction of impact been studied, i.e. the one exerted from organisational and societal conditions on technology.

## **1.1 The Social Shaping of Technology**

Two mutually exclusive schools have dominated research on technology and organisations until the early eighties (and are still in evidence). Proponents of the 'organisational choice' model consider technology as a vehicle to both reflect and foster the interests of particular groups; the process of change can be, and indeed is, shaped entirely by policy makers or organisation's managers; these actors have unlimited technological choices [Buch 85]. In contrast, 'technological determinism' in essence postulates that IT determines the behaviour of organisations, that the consequences of manipulating a given technology will always be the same, independent of who manipulates and within which context. It follows that, according to this view, organisations have little choice but to adapt to the requirements of technology; particular paths of technological development are inevitable; like organisations, society at large also has no other choice but to adapt.

Social shaping of technology (SST) adopts a middle course between the two older approaches, acknowledging that technology indeed has an impact on its environment, but that at the same time it is well framed through technical, but rather more through e.g. organisational, societal, cultural and economic factors. In particular, SST attempts to unveil the interactions between these technical and social factors. Abandoning the idea of inevitable technological developments implies that choices can be made regarding, for instance, the acquisition, the use and particularly the design of technological artefacts. There may be a broad variety of reasons upon which these choices may be based. In an organisational context this may include purely technical reasons, as e.g. the need to integrate legacy systems, but decisions may also take into account company particularities, as for instance organisational or reporting structures. These choices, in turn, may lead to different impacts on the respective social or organisational environments. Thus, studying what shaped the particular technology offers a chance to proactively manipulate that very impact expected to result from this particular choice. At the same time this capability should also contribute to the prediction - and thus prevention - of undesirable side effects potentially resulting from a new technology. Technology tends to have other effects besides those actually intended, these effects need to be explored as well. On the other hand, the respective environment shapes technical artefacts and systems during design and in use, i.e. at the site of the actual implementation. The overall process that comprises the first design stage (of an invention), its production and the final implementation can be referred to as 'innovation'. It is this process I will now look to.

## **1.2 Configurational Technology**

In today's networked environment technological systems are becoming increasingly complex. Some of these systems evolve into what has been called 'generic technological systems'; prominent examples include railroads, power supply and telecommunication networks. Such systems are not a coherent whole, rather, they have been established through the interconnection and interoperation of a large number of smaller systems, which are easier to handle, to manage and to modify. These smaller systems then need to be integrated into the

overall system; often they are interconnected through dedicated interworking units. Such environments typically involve different technologies from different vendors. Without standards it would be impossible to achieve interoperability at the required scale. The need for the individual components to interoperate also leads to ‘natural trajectories’ of development (as e.g. mechanisation or economies of scale, [Fleck 88]). Here, a technological bottleneck in a certain area can hamper the progress of the overall system. Thus, this bottleneck will attract the attention of a number of entities trying to solve the problem. This, in turn, will lead to progress in this particular field, possibly leaving behind others, on which interest and innovation efforts will subsequently concentrate. These gradual improvements are characteristic for generic systems, which typically exhibit their high degree of standardisation not least due to technological ‘path dependencies’.

Some large systems, however, may not follow such trajectories. Typically, each of them is particularly well integrated into its local environment, and closely follows this environment’s particular contingencies; that is, these systems are configured to optimally meet the respective local requirements. Such close adaptation to a local context is likely to lower the general interest in such systems, which implies that they will not generate any large-scale standardisation activity. Implementation of such systems requires considerable efforts, and would be next to impossible without far-ranging input from users, who are the only ones to know their environment sufficiently well. It is especially in those cases that the site of an implementation at the same time is a site of considerable innovation; in fact, the implementation itself becomes a source of innovation, as additional innovations become necessary for the adaptation to the local context. As a result, the distinction between innovation and implementation becomes meaningless in this environment, and the processes of invention, innovation and diffusion collapse into a process coined ‘innofusion’, with feedback occurring primarily through internal learning processes [Fleck 88]. Such systems are referred to as ‘configurational’; they have been configured from a wide range of components, from different vendors to optimally meet the need of their local environment.

Throughout the remainder of the paper we will first discuss the different characteristics and properties of two different classes of technology. Chapter two introduces the important distinction between generic and specific IT services. Subsequently, the importance of standardisation especially for the latter is discussed in chapter three. Finally, chapter four will give some brief conclusions.

## **2 ‘Infrastructural’ and ‘Business Relevant’ Technologies**

Neglecting the crucial enabling role of an adequate infrastructure has in many cases led to an environment where investment in infrastructure technology is given low priority [Ben 93]. In particular, a company’s internal communication system has in many cases been considered infrastructural technology [Jak 00].

This is a pretty short-sighted approach, though, as almost all applications depend on an underlying communication infrastructure. This holds not only for intra-organisational communication, but is becoming increasingly important for inter-organisational information

exchange as well. Ideally, an infrastructure supports common processes and business applications not only within a single corporation, but across organisational boundaries, where a company and its customers and suppliers share a common infrastructure upon which common applications can be built. Indeed, the need to quantify the corporate benefits to be gained in several cases hampered this attempt to upgrade e.g. a corporate e-mail system (considered part of the 'infrastructure'). Investments in this area are harder to justify as they will only result in intangible benefits, and are unlikely to yield an observable, or quantifiable, return on investment.

Which technological systems are actually considered 'business relevant' by a company very much depends on the respective organisation's commercial interests. A car manufacturer, for example, may look to robots or systems for Computer Integrated Manufacturing (CIM), a publisher may be interested in Desktop Publishing equipment. In the banking and retail sectors EDI has streamlined both intra- and inter-organisational processes to a considerable extent, a development which may be supposed to continue. In particular, a system considered as 'business relevant' by one company may well have 'infrastructural' status for another, a phenomenon that may, for example, be observed in the case of e-mail.

For each company technologies that relate to its core business - and its core competence - will naturally attract most interest, particularly if they hold the prospect of a quantifiable return on investment. Although demand for standard software has been growing faster than that for special customised software systems, tailor-made solutions are still preferred if the system is "*... affecting the primary business of firms, especially for areas closely linked to production and marketing ...*". It is primarily in these areas that companies are willing to invest most heavily. Yet, a company will only be able to implement new technology if adequate experience and expertise, both at engineering and managerial level are available locally [Bier 92].

Moreover, a company is likely to have developed very specific requirements and processes primarily in the areas of its core business interests, which, in turn, stand in the way of a straightforward installation of a system. It is here where long-standing, time-honoured traditions characterise the environment, and where technical systems as well as production and business processes have been designed to optimally meet the demands of their specific environment. A new system to be implemented here will have to be customised to a similar degree as have been the other artefacts in this environment. It is unlikely that standard components will provide the required functionality. Accordingly, it may be concluded that innovations are most likely to occur under these circumstances, i.e. when 'business relevant' technology is to be implemented. Indeed, recent research into innovations has almost exclusively focussed on what must be considered as 'business relevant' technologies].

'Infrastructural' artefacts may come from a wide range of items, their major common characteristic being the fact that they are not, or only to a very small extent, integrated into business processes. Typically, they are more or less equally useful for everyone, irrespective of his/her particular background or specific environment. Consequently, they are not normally subjected to well specified context-specific requirements. This, in turn, holds the prospect of a higher degree of freedom for the designers and implementors, possibly to the extent of

reducing implementation to a mere installation of components, without the need for any further innovation.

Our case studies have also shown that only those few companies which consider e-mail as a strategic tool, i.e. as 'business relevant', are prepared to implement a system that really meets their needs. In contrast to that, for companies which consider e-mail as 'infrastructural' it was a matter of buying off-the-shelf. Two conclusions may be drawn:

- **We must differentiate between different categories of technology.**

Technological artefacts may be either 'infrastructural' or 'business relevant'. Less specific requirements may be expected for the former, whereas the environment of the latter typically exhibits strong, specific particularities, and thus a need for local innovations.

- **Users are more prepared to invest in 'business relevant' technologies.**

This holds particularly when it comes to human resources and expertise, financial investments for infrastructure upgrades are hard to obtain, but are not completely unheard of. Requirements here are less specific in most cases, and may allow comparably straightforward installation.

Thus, irrespective of a company's core business it appears that the perceived strategic importance of an IT system is the yardstick by which a company's willingness to start its own development activities has to be measured - i.e. whether it is classified as 'business relevant' or 'infrastructural'. Accordingly, a dedicated e-mail strategy requires the recognition of e-mail as a strategic service in the first place. For a sufficient condition a user company also needs to be able to contribute its specific competence to the implementation process, i.e. primarily an in-depth knowledge of its particular needs and of the characteristics of its specific local environment.

### **3 Standards and Innovations**

In those cases where a suitable combination of standardised components meets the needs of a particular environment standards establish the sole framework within which an implementation takes place. This is most likely to happen in case of 'infrastructural' artefacts or systems, with only a small likelihood of, and indeed need for, innovations. Alternatively, especially if 'business relevant' systems are concerned, standards may be considered as contributors to a system implementation, and to potential innovations. Yet, time components will only play a minor role in the overall implementation, as the major efforts will (have to) go into the implementation of the overall system, that is, into the adaptation of the system to its environment.

To accept the proposition that future IT systems will to a considerable extent be based on international standards implies the need to look at the ways how standards are formed and established in order to understand what is going to shape future technology, and especially ICT. As a consequence we would suggest that the site of the user's implementation as the current major locus where innovations materialise, and where social shaping accordingly takes

place, will to some extent be complemented by activities of the standards committees, where the underlying groundwork upon which innovations will draw has to be done. In the case of electronic mail systems, for instance, much of the underlying transport system comprises exclusively of standardised components. Here, standards firmly establish the framework within which implementations take place (with little, if any, need for innovation). Regarding the more application-oriented parts of the overall system, i.e. the e-mail service itself, we note that implementation-specific particularities become more important; it is primarily at this level where the integration into the existing IT environment takes place.

In any case, it follows that standardisation processes are important for innovations, and that they must not be ignored when discussing implementation and innovation processes. Now I would like to go one step further and suggest that major similarities exist between innovation and standardisation processes. Indeed, it may well be possible that lessons learned from the well-researched field of innovation may be applied to standardisation processes, and vice versa. This proposition may appear to be a little far-fetched; after all, it could be claimed that there is a major, decisive distinction between the processes of standardisation and innovation - their respective scope. Whilst this is certainly true there are indeed also major similarities between the two processes as well.

For one, users have a considerable influence on innovations; a user may have commissioned a technological system the development of which requires innovations, or an innovation emerges on his premises as part of an implementation project, or he develops a genuine innovation in an attempt to overcome identified deficiencies of the available technology. Yet, it is frequently overlooked that users (could) have a similarly strong hold over the industry simply because of their purchasing power. It follows that they could establish themselves in a position to dominate innovation and standards setting processes alike. As it currently stands, however, users' different needs prevent them from playing the important role they could play - at least in standards setting.

As committee members (including those from user companies) tend to see themselves as company representatives (as opposed to e.g. representatives of the user community), they only contribute specific requirements that originated from their respective environments [Jak 00]. That is, we can observe here that the single local environments already have a major - albeit implicit - impact on the standards setting process in that they heavily influence the user requirements that are actually fed into the process. This impact in fact represents another correspondence between standards setting and innovation.

Moreover, both standardisation and innovations are major platforms for cooperation between vendors and users. Without this cooperation the outcome of the processes would most likely be far from satisfactory, due to the complementing roles users and vendors play, which are equivalent in both processes: it is the vendors' task to provide for the technical knowledge and expertise. Users, in turn, contribute their specific knowledge about their requirements and environments, respectively.

These complementing roles imply that communication between the two parties is crucial in both processes. The 'technology-centric' view of the vendors needs to be aligned with the

organisational and technical requirements of the users, a process that has to happen during implementation and standardisation, albeit with somewhat different foci. During implementation vendors need to gain a good understanding of the particularities of the context within which an innovation is to be implemented. Consequently, an active learning process has to take place on the side of the vendor. In standardisation users need to generalise and align their specific requirements which can then contribute to the process. This is rather more a teaching process with the users assuming the active role. Still, the underlying common need for communication remains.

Another aspect of standardisation should not be forgotten either: not only will technological specifications be done in the committees, but other factors that may shape technology will be channelled into the work groups of the international standards setting bodies as well. The respective corporate environments of the committee members' employers, for instance, will play a major role in this context. The different visions of how a technology should be used, and the ideas how this can be achieved are both formed by these local environments. They will exert a significant impact on the work of the committees, thus preceding, and possibly complementing the local implementation context as a major source of influence. This holds especially in the case of anticipatory standards, which specify new services from scratch, and thus offer the opportunity to incorporate the particular characteristics of the originating committee to some degree. In a more extreme case, work within the committees may even anticipate innovations that would otherwise result from a local implementation. This may, for instance, happen if a strong user representative succeeds in promoting the particularities of his local environment as the basis for a standard. Yet, reactive standards will likewise transpose the environment from which they emerged; this will typically be the corporate environment of the inventor who specified the system upon which the standard will be based. Thus, his visions will implicitly be embodied in the standard specification. Again, the correspondence between implementation and standardisation is obvious, only in this case it is the vendor's environment that shapes the standard. It therefore comes as a surprise that this close relation between standardisation processes and innovations has so far been largely ignored.

Related to these observations, although on a personal rather than organisational level, we note that the processes leading to both, technical design and technical standards are typically developed by engineers, who in many cases lack an understanding of the non-technical components that need to be considered for both, designs and standards. The accordingly rather 'technology-centric' outcome of both processes has frequently been criticised.

We can now identify two distinct activities which have a major impact on innovations, namely the work done within the standards committees and the actual implementation itself. As we have seen, these activities are not unrelated; even implementations of individual, customised systems are likely to include standards-based components. Thus, standardisation will always influence innovations, either:

- directly, e.g. if an implementation is done via integration and configuration of standards-based components, or

- indirectly, in case of a customised solution comprising some standard elements being implemented, or
- as the actual locus of innovations.

In fact, given the large number of standardised components available, every innovation in the IT sector will in part be influenced by standardisation. This, in turn, suggests that a meaningful user representation on the standards setting bodies is essential, particularly to convey requirements.

#### **4 Users and Standardisation - Some Concluding(?) Remarks**

'Requirements' is a very broad term, that not only refers to the technical domain, but is also closely linked to the particularities of the respective local environment. Accordingly, providing only functional and technical requirements does not suffice. Rather, organisational and other non-technical needs have to be considered, and user representatives need to be in a position to identify these needs. Thus, it would not make too much sense if only technical people were sent to the committees to represent users. Rather, corporate strategists and managers also need to get involved, to make sure that the non-technical issues are adequately covered as well.

If a user actually does participate, assuming the role of a user representative, as opposed to representing only a single company, survey findings show s/he will face credibility and communication problems. First, many respondents said they would need to be convinced of a proper mandate, to show that not just a particular company's special requirements are brought into the process, but more widely identified needs.

It is worth noting here that apparently no such mandates are necessary for representatives of vendors and service providers. This may again be interpreted as an expression of the predominantly 'techno-centric' attitude of standards setting committees, whose vast majority of members is representing vendors or service providers. Their roles have never been questioned, although they obviously include the representation of the respective employers' commercial interests (which may or may not be in line with the overall best interest).

Typically, companies are sending their engineers to standards committees, and their views tend to be somewhat 'techno-centric'. Thus, it is not too surprising that committee members have named technical sophistication on the side of the user representatives as a major prerequisite for meaningful participation. Thus, it would be necessary to convince them that representing a user in a standards committee does not necessarily require technical expertise, and that there are more aspects to standards than just purely technical functionality. Failing on the users' side to adequately address these issues will invariably weaken their position in the committee.

A major underlying obstacle here is rooted in a communication problem, and in the differences in views and perceptions of technology that can be identified between engineers and

managers. Such problems in 'cross-profession' communication are not uncommon, to solve them requires learning by all sides; engineers need to gain some understanding of the necessary organisational and managerial considerations, and managers need to get an understanding of at least the technological basics. This may sound trivial, but the reported major credibility and acceptance problems from which ITU-T's Study Group I, and its ISO sister group, suffered finally contributed to the abandoning of these groups.

As a consequence of the typical history of corporate deployment of e-mail, and of its perception as being primarily infrastructural, users will not only be unable to contribute initial requirements to a new standards setting initiative (others than very general ones), but they will also be unable to provide useful input for quite some time afterwards. This situation can only change if and when the status of e-mail (and of other IT systems with a similar corporate history) switches from 'infrastructural' to 'business relevant'. Even if this happens, it will subsequently take a considerable period of time to actually identify new, more advanced requirements. Although some are likely to emerge during implementation, others will only surface once the system has been adapted to, and especially integrated into, the local environment and experiences have been gained through its use, a process which may well take years.

If users are not (yet) in the position to contribute requirements, the standards setting process will not benefit very much from their participation. Therefore, we may conclude that in this case it will make little, if any, difference whether or not user representatives participate in the process, since they can only assume the role of technical experts - rather than that of a contributor of requirements - many of whom will be on the committee anyway (representing vendors). It follows from the above that this situation may easily occur in case of 'infrastructural' technologies, where users do not see any business incentive to contribute to standards setting. This additional lack of incentive comes on top of the reluctance caused by the general perception of the standardisation process as slow, inefficient, costly and yielding uncertain results.

The generally accepted principal role for user representatives in standards setting is to provide real-world requirements (see e.g. [Naem 95]). However, in most cases specific functional requirements are not normally available at the beginning of a standardisation project. Moreover, we have seen that unconditional user participation in standardisation is not a desirable goal per se, thanks to the largely context-specific - and thus very diverse - requirements that are to be expected. Instead, ways need to be found to achieve meaningful user representation.

Given the huge variety of business sectors, organisational forms and business philosophies, the many different intra- and inter-organisational interdependencies, and all the differences that come with varying company sizes, not to mention regional or national differences in culture and legislation it is most unlikely that coherent requirements will ever materialise, apart from some very generic ones. Moreover, representatives of user companies do not necessarily see themselves as user envoys in general; rather, they are representing their respective employers. Therefore, there is a need for a mechanism to align the various requirements.

These considerations suggest that users should seek representation through a dedicated body (a 'user coalition'), responsible for voicing its stakeholders' needs and concerns in the appropriate standards committees. Great care needs to be taken to ensure that such a body actually represents as broad a variety of users as possible, of all sizes and from all sectors, rather than acting as something similar to, say, a trade association representing only a single market sector. This broad market coverage is crucial for several reasons. For example, even basic requirements will differ between SMEs and large enterprises.

There is also an economic dimension to this way of user representation, in that it offers the almost only realistic chance for those user companies which cannot afford direct participation to have their requirements filed with standards committees. Again, this holds particularly for SMEs, almost all of which currently stay clear of any standardisation-related activities. Finally, it will serve to reassure other committee members (i.e. representatives from vendor companies) that indeed a broad base of users is represented. Clearly, the alignment of requirements has to take place prior to actual standardisation to enable the user community to file an agreed set of requirements, and to speak with one voice, rather than engage in turf-wars during the actual standards setting process.

The observations above should trigger some further thoughts regarding the general desirability of direct user participation in standards setting, and indeed on the overall structure of this process.

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