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Networked Organisations – Research into Standards and Standardisation

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Management Summary

This report is a sequel to the Report on 'The Dynamics of Standards I: Research Findings" of the NO-REST project (Deliverable 7). Where in the latter report we presented the research findings of an elaborate set of interrelated studies and a first analysis thereof, this report presents a meta-analysis of the material. Its aim is twofold, namely 1) to draw up a framework that synthesises the causes of standard dynamics, and 2) to model the evolution of standards in a heuristic manner.

In the introductory chapter background information is provided about the setting of the NO-REST project, and the methodology, which led to the findings presented in Deliverable 7 that are built upon in this report (chapter 1).

To start with, the notion of standard dynamics is refined (chapter 2). Three types of dynamics are distinguished: implementation dynamics, maintenance, and succession. This distinction eases the identification of causes of change and their consequences in chapter 4.

Standardisation is endogenous to technology and market development (Chapter 3). This means that cyclic patterns in innovation are also evident in standardisation. The cyclic patterns in standard dynamics are the bi-cycles of learning and novelty. They correspond to incremental and more radical forms of innovation.

Chapter 4 describes two complementary heuristic models that capture the main causes of standard dynamics. Regarding maintenance dynamics, seventeen more detailed causes of change are at work. These fall into four main clusters of causes, i.e.: technology development, regulatory change, market dynamics and characteristics of the standard development and implementation setting. Regarding implementation dynamics, 'benevolent' (i.e. unintentional, partly avoidable; or intentional but functional) deviations are distinguished from malevolent deviations (deviation as a market strategy). Twelve concrete causes of the former are identified. Some of these follow from decisions taken in the standard's design stage (conceptual idea), and are flawed answers to fundamental dilemmas. The majority, however, at least partly seems to follow from institutional features of the SDOs. Specific suggestions for improvement are made in the three areas of drafting standards, their pre-implementation and implementation process support. These promise to reduce implementation dynamics.

Chapter 5 addresses the applicability of the two models for both e-business and e-government. The two models are largely based on cases from these two areas (i.e. process integration standards, structured data exchange standards, infrastructure support standards). Indeed, general problems like the need for constant monitoring and updating also apply to e-business and e-government. However, there is one difference. The development environment for upper layer standards in e-government

differs from that of the SDOs. Governments are both standard users and key developers. Controlled dynamics may therefore be easier to achieve.

Chapter 6 concludes that the tension between stable and responsive standards will remain a problem, also for the fields of e-business and e-government. Several recommendations are made that address both aims, and intervene on the causes and consequences of standard dynamics. They contribute towards the design of robust *and* responsive e-business and e-government infrastructure, an infrastructure which can keep pace with innovation, without endangering interoperability.

1 Introduction

This report is the second of two consecutive reports on standard dynamics. It is a deliverable of the NO-REST project, an EU project carried out within the framework of the Information Society Technologies (IST) Work programme. IST aims to improve infrastructure interoperability for e-government and e-business *("networked organisations").* Standards, the theme which the NO-REST project addresses, are in this respect a sine qua non.

The problem. Stable standards enhance interoperability. However, although we usually assume otherwise, standards change.

> "Even in the most stable areas, like metrology or materials specification, change may be required – e.g. in response to new or improved scientific knowledge. Most technologies and/or their application environments change relatively more quickly. Some are characterised by rapid change which creates a particularly dynamic situation for standardisation. This has been especially true for intermediate technologies like ICT." (D1/D2, p.11)

They are revised, replaced, withdrawn, selectively implemented, etc.. This we refer to as *standard dynamics*, that is, the changes which standards undergo once they have been set or developed. Standard dynamics may create problems for implementers, as the primary users of standards. To anticipate on possible interoperability problems between products that comply with different standard versions, standard implementers must continuously monitor the changing stock of standards. Products that conform to the most recent version may not be Interoperable with ones own installed base of software or the installed base of others. Where standards change transparency diminishes. Interoperability is not self-evident anymore. This increases what economists term 'informational transaction costs'. Moreover, the costs of standard updates (including loss of investments) are largely born by standard implementers and IT consumers. Despite of these problems, little is known about why standards undergo changes, and how often changes occur (chapter 3, D7).

Methodology in Deliverable 7. The previous report, i.e. the report on the "Report on the Dynamics of Standards I: Research Findings", addresses these questions.[1] It provides insight in the causes of standard dynamics (*Why and how do standards change?*) and the scale thereof (*How often do changes occur?*). It describes the findings of a literature study, a feature study, nine case studies, two quantitative database analyses, and a survey. The case studies address the e-business and e-government area. Examined were standards for business integration and structured data exchange such as RosettaNet standards, RFID, e-GIF, SGML, and XML; standards for the underlying infrastructure such as Internet addressing standards (IPv4, IPv6, NAT), grid

[1] The two reports should, preferably, be read together.

standards (OGSI, WSRF), IEEE 802.11n, and mobile telecommunication standards (GSM, Parlay, Symbian). Because it presented itself as a highly informative case, the case of recordable DVD standards was added.

Aim. The purpose of this report is to develop a perspective on the evolution of standards based on the findings of Deliverable 7, and to support this perspective by modelling the causes of standard dynamics in a heuristic manner. Changing market demand and changes the standard development arena are integrated (NO-REST Deliverables 5/6; D5/6 for short).

The report is structured as follows. First the core concepts are defined. Three types of standard dynamics are introduced (chapter 2). Next, arguments that support modelling standard dynamics as endogenous to market and technology dynamics are discussed (chapter 3). In chapter 4 two complementary models are developed, one for maintenance and succession dynamics, and another for implementation dynamics. Their applicability to e-business and e-government is addressed in chapter 5. The final chapter draws conclusions and offers some recommendations (chapter 6).

2 Triple Dynamics

In the following the term 'standard dynamics' refers to changes which standards undergo once they have been developed or set. We distinguish three types of dynamics

- *standard maintenance.* At stake are standards' revisions by means of technical corrigenda, technical amendments, new editions, replacements, changes of document type, mergers between standards, split-ups, their formalisation[2] elsewhere, and standard withdrawals.
- *Standards' succession*, i.e. replacement by a next generation technology (i.e. usually developed by a different standards committee or organisation)
- adaptation of a standard specification during its *implementation*, e.g. by extending it or by its partial implementation.

In all three situations, changes occur after the standard is available. That is, the initial standards process is not included in this definition. See Figure 2.1.

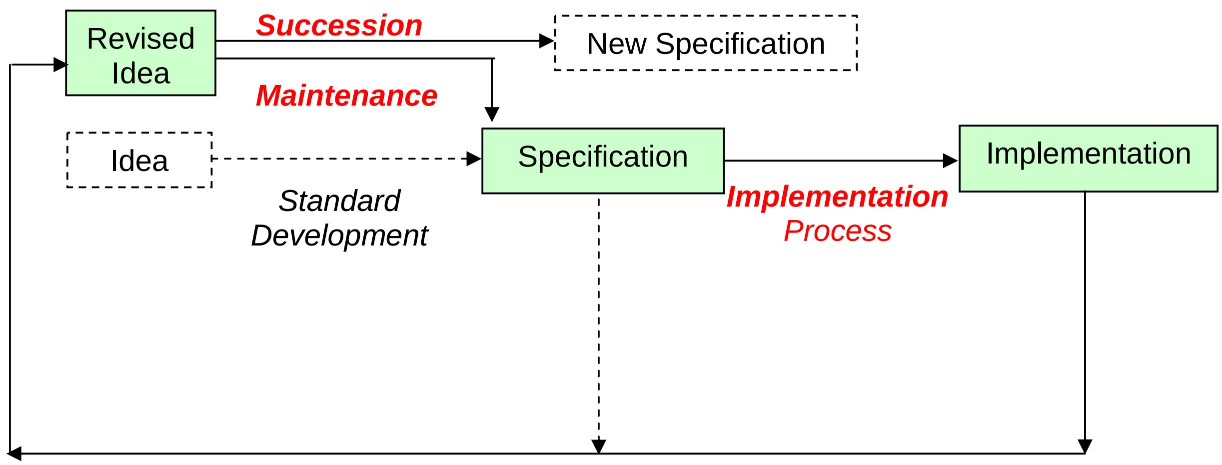

Figure 2.1: Triple dynamics of maintenance, implementation, and succession.

Compared to the incremental change common in standard maintenance, standards succession usually involves more radical technology change (see deliverable 7, section 3.1)

Figure 2.1 schematizes the cyclical and dynamic nature of standardisation. Once a standard has been developed, the first type of change which may occur is when the standard specification is 'translated' into an implementation. Where, for example,

[2] Because no new content is produced when a standard is formalised, formalisation of a standard in a different standards setting is treated here as a special type of maintenance (e.g. PAS procedure).

adverse experiences of implementers lead to new requirements[3], standard maintenance may be initiated. This may lead to a revised specification, or to a more radical change of technology, i.e. standard's succession. See Figure 2.1. The three categories ease the identification of distinct causes and their consequences. They form the basis for a discussion of causes of standard dynamics in chapter 4.

[3] NB: Implementers are seen here as primary standards users. Secondary users are the users of standard-compliant products and services.

3 Endogenous Standardisation

In the field of ICT, standard specifications are the substrate of ICT technologies. They define the technologies, and in everyday language they are often a *pars pro toto* for products. Thus, the GSM standard equals the GSM phone. An analysis of standard dynamics must therefore include the dynamics of the technology at stake. Standard dynamics is endogenous to technology dynamics, and as such also subject to market and other forces. (See figure 3.1.) For example, consumers may use standardised technologies in unexpected ways (*innofusion*) and come up with new requirements ; regulatory changes may take place which require a technical response (e.g. a change in radio frequency bandwidth); new technology developments may take place which offer new opportunities (e.g. web environment); existing technologies may be applied onto new application areas; etc. (Deliverable 7). All these new demands on technology also require adaptation of the standards concerned.

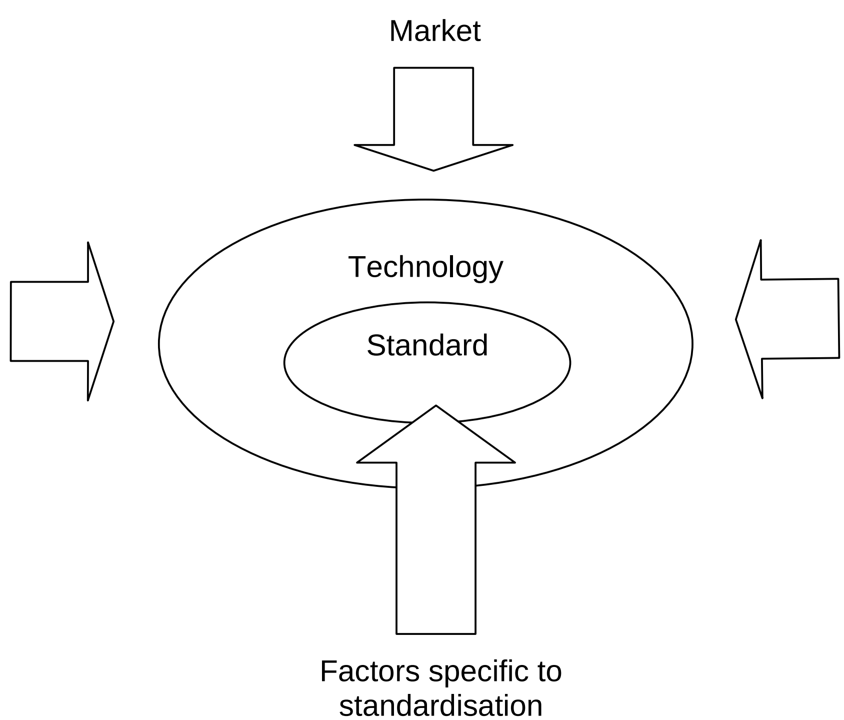

Figure 3.1: General and specific sources of standard dynamics.

The factors that affect the development of a certain technology also affect the dynamics of its standards. For example, in markets where companies use patents to fight off competitors, patents will also be used as a tool of competition in the narrower and wider standards arena (i.e. within standards committees and between standards bodies, respectively). In the case of DVD recordables (D7, Annex1), for example, IPR-based competition led to a standards race of competing updates and formalisation. Standard dynamics occurred as the devices of the competing company entered the market. In sum, their standards activities were very much part of company R&D and of a market strategy.

Cyclic or recursive patterns are not uncommon in innovation research. Kline and Rosenberg (1986) developed the so-called chain-linked innovation process, which in contrast to linear models of innovation, includes recursive feedback loops. According to them "innovation requires iterative fitting and trimming of […] necessary criteria and desiderata" (Kline & Rosenberg, 1986, p.286). The logic behind the feedback loops is the fall-backs in innovation development that are the result of a learning process. A loop can also include failures in the implementation of an innovation. Feedback is "part of the cooperation between the product specification, product development, production processes, marketing and service components" (Kline& Rosenberg, 1986, p. 289).

The recursive model is also evident in standard dynamics. Maintenance and succession are recursive cycles. They embed feedback which results first of all from learning during the standards process and the implementation process, in particular. Implementation feedback, which is a primary source of learning, usually leads to incremental improvements. The cycle of learning, as we may call it, is portrayed below as the inner circle. See Figure 3.2.

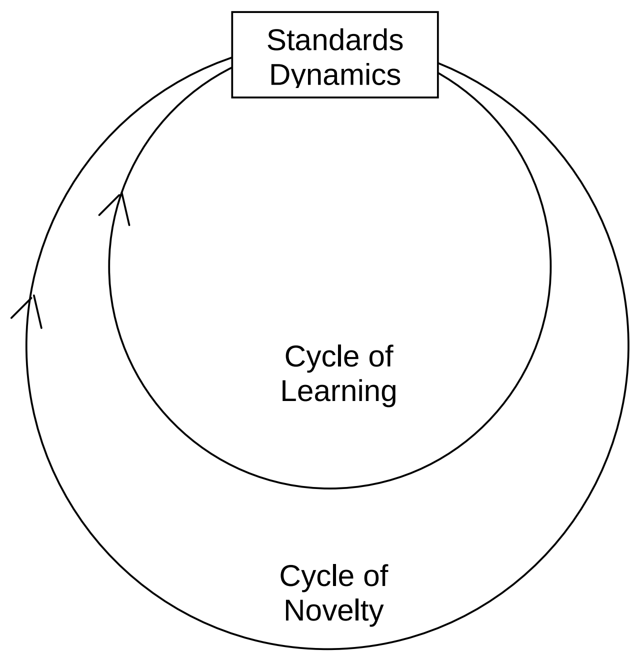

Figure 3.2: The bi-cycles of learning and novelty.

Second, some changes go beyond incremental learning. They embed novelty. The sources usually lie outside the immediate sphere of standardisation and stem from factors which impact technology (i.e. the outer circle of figure 3.2). The ‘feedback’ involved in the ‘cycle of novelty’ is more likely to lead to new standards trajectories and to standards substitution by a new generation of standards (standard succession).

Literature about technology dynamics indicates that most change is incremental rather than radical (D7, chapter 3). Indeed, concepts from technology studies such as path dependency, technological trajectory, technological paradigm, and entrenchment emphasise continuity in development. This also applies to standard dynamics (D7). Incremental maintenance is much more common than radical succession.

4 Modelling Standards' Evolution

Standard dynamics is not a fringe phenomenon. A large proportion of standards is revised or withdrawn (Deliverable 7, chapters 4 and 6). Indeed, increasingly standards bodies do standard maintenance work rather than develop standards. What causes can be identified that explain the occurrence and increase of standard dynamics?

Below, the evolution of standards is modelled for maintenance and succession dynamics, on the one hand, and for implementation dynamics, on the other. We address them separately to highlight the different causes in standard dynamics. (Note, however, that they are related, i.e. feedback from the learning cycle of implementation is one of the causes of maintenance dynamics.)

4.1 Maintenance and Succession: Causes of Change

As the endogenous nature of standards already implies, the degree of standard dynamics is technology–specific. Technical change as measured by number of patents decreases the expected lifetime of standards. For example, the expected average life of IT standards is significantly shorter than that of telecommunication standards. Standard dynamics is both technology–specific across sectors and within sectors (e.g. within IT OSI standards show a high rate of change).

Four main factors affect standard dynamics: technology development, regulatory change, market dynamics and characteristics of the standards setting. (See box 4.1 for more detail.) Technological factors affect standards in a direct way (i.e. improvement of the technology embedded in the standards) and in indirect ways (e.g. changes due to their application to new areas and platforms).

A second cluster of causes lies in the dynamics of the market. For example, a high interest from market players sooner leads to new standards requirements.

The third cluster of causes are the regulatory changes which beset technology use and concern standardisation (e.g. change in radio frequency bandwidth).

The fourth and last cluster of causes is located in the standards and implementation setting. Dynamics may occur because the original standard was of low quality, because the standard is too difficult to implement, because cross-references to other standards oblige updating[4], etc. Notably, there are both positive and negative incentives for change. Lack of standards quality is clearly a negative incentive for changing a standard. However, a changing standard may also signal market interest.

[4] The influence of the number of cross references on the lifetime of standards is mixed. We would expect that if a standard has a cross reference to another standard, its expected lifetime would be lower because it would then seem to be embedded in a network of standards and sooner affected by external influences. However the evidence is not very clear. The mixed results could indicate that cross-references also signal entrenchment and therefore no change. (Deliverable 7, section 6.2)

(This is confirmed by the finding that amendments and replacements increase the expected lifetime of standards. They seem to stabilise and confirm the value of a standard, and thus reduce the likelihood of its withdrawal; D7, section 6.2)

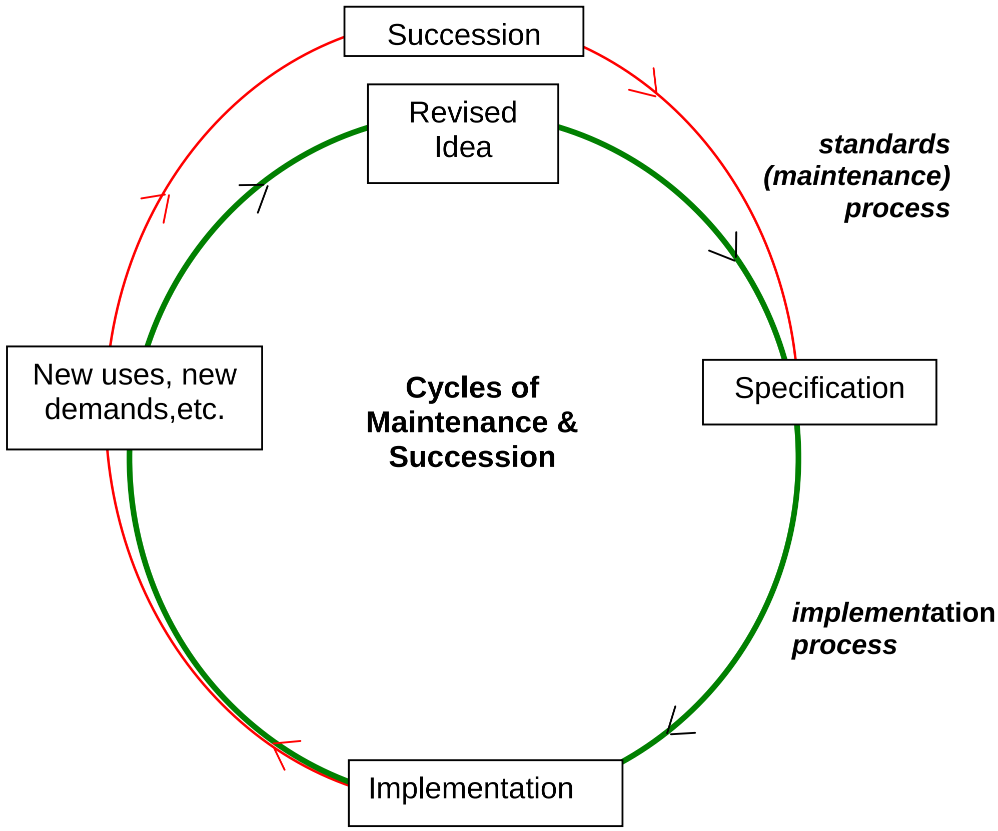

Figure 4.1: The cycles of standard maintenance and succession.

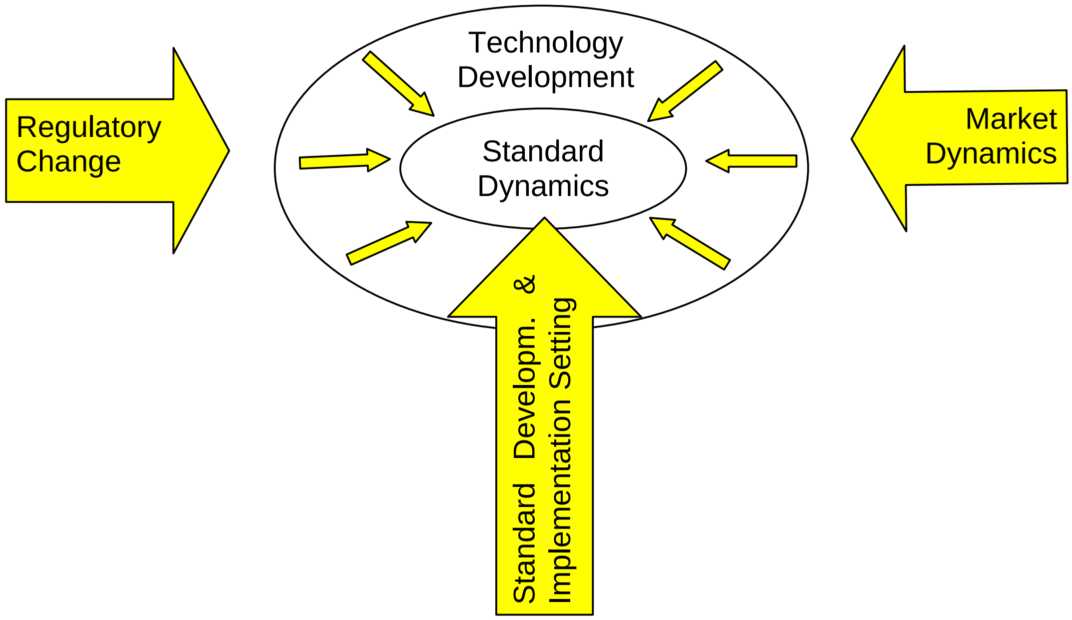

Figure 4.2: Clusters of causes for standard dynamics.

Figure 4.2 portrays the clusters of causes evidenced in the case studies. Note that incentives for change that stem from the standards and implementation setting primarily constitute feedback for the learning cycle.

The case studies in D7 also indicate *when* standard dynamics occurs. In many cases, feedback from early implementation experience explains its timing, namely soon after the standard is launched. Once the core set of specifications is usable enough to implement, and the commercial interest of companies start taking over the shared interest in a standard, the feedback from implementers to standardisers drops off.

But also, in the situation of a war between competing standards, the most intense battles occur when the competitor's devices enter the market. In order not to lag behind, a company or a consortium seeks public reconfirmation of its standard's legitimacy and prowess by fast-tracking the standard through an internationally recognised standards body.

Competing standards races are likely to persist if users apply multiple implementations (multi-protocol stacks). They prolong dynamics between competitors and stabilise the standards race.

Box 4.1: Causes of standard dynamics (D7, chapter 4):

Technology development

- changes due to new or improved functionality (e.g. speed and capacity)
- changes due to related new technology developments (e.g. new platforms)
- changes that reflect converging technology or application environments

Regulatory change (affects both technology and market)

- changes that take account of new rules and regulation (e.g. change in radio frequency bandwidth)
- changes that exploit new opportunities when regulatory conditions change

Market dynamics

- lack of interoperability
- competition
- changes due to high market interest (e.g. a shift towards new application domains)
- changes due to market fragmentation; this may lead to a concerted standards effort
- changes due to IPR-based standards competition (standards race)
- changes due to changes in business models
- changes due to the desire to increase a standard's status

Standards and implementation setting

- changes due to high standard maintenance efforts
- institutional changes towards fast-track procedures (PAS, CWA, etc.)
- competition between standards bodies
- changes due to a low quality standards process (e.g. no testing and implementation experience included in the process)
- changes due to editorial, corrective reasons
- changes due to implementation problems (see next section)
- changes due to changes in related standards (cross-references to other standards)

4.2 'Benevolent' Causes of Implementation Dynamics

In many cases deviant standard implementations, that is, changes introduced to standard specifications during implementation, lead to incompatibilities. Partly, these deviations are a result of intentional standards corruption (embrace-and-extend market strategy). Companies may introduce incompatibilities, frequently disguised as improvements, in order to lock consumers into a vendor-specific version of a standard implementation (D5/6, p.71).

Partly, deviations occur for functional reasons. Typical motives to deviate from or partially implement a standard are to better suit the local context (localisation, e.g. reduce unnecessary complexity) and to reduce the costs of implementing a standard.

Partly deviations may be unintentional or for 'valid' functional reasons (i.e. 'benevolent'). This is the category we focus on in the following. Here, the source of change may lie in a flaw or a weakness in the idea behind the standard, the standard process, the standard specification, or the implementation process (D7, chapter 5). (See figure 2.1.)

Conceptual idea of standard. For example, the conceptual idea that underlies a standard may not work satisfactorily when implemented (e.g. OSI's comprehensiveness).

Standards process. For example, the formal bodies' ideal of consensus decision-making and implementation-independence affect the standards process and indirectly the implementability of standards. Consensus and a pressure to deliver quick results may sooner lead to political compromises that are technically ambiguous.

Standard Specification. For example, different use of terminology may lead to problems of interpretation, implementation and interoperability.

Implementation process. For example, modest user requirements and cost-constraints may lead to partial standards compliance. This creates incompatibility among implementations.

The causes of implementation problems may be located in any of the above states and processes. Which problems are at stake? (D7, chapter 5):

- Errors, ambiguities, inconsistencies
- Ambiguity of natural language
- Missing details, monopoly on tacit knowledge
- Ill-structured standards
- Unclear how to handle options
- Uncertain compatibility of non-binding recommendations
- Unclear 'official' status of standards companion books
- Complexity of comprehensive, ambitious standards

- Too many options and parameters
- Overload of standards within a technology 'family'
- 'Bugward compatibility'
- Interference between standards

Box 4.2: Dilemmas on the Implementability of Standards

Some incompatibilities derive from a set of fundamental dilemmas, choices regarding the standard's design and use that can be summed up as four questions.

Standard's design:

- Comprehensive or simple standards?
- Implementation-independent or implementable standards?
- Consensus on a compromise or implementable standards?

Standard's use:

- Adapt a standard to ones simpler needs or aim for interoperability with other standard-compliant products?

These deliberations have to be faced by standardisers and implementers, respectively. The choice they make affects the implementability of standards.

All but the last problem are connected to the standard specification. Some are a flaw in the design (conceptual idea) of a standard (see Box 4.2 for the dilemmas at stake). Some result from a flaw in drafting the standard (standards engineering process). Although there are constraints of time and cost, the standards setting can to a large degree determine whether the above problems are likely to occur. Some standards bodies - and standards committees - place more emphasis on standards quality than others.[5] (We refer here to 'quality' pragmatically, namely in the sense of addressing the above-listed problems.) In this respect, a standard's origin is relevant.

As D5/6 notes, the question of standard's origin should go beyond an oppositional characterisation of formal SDOs and consortia. For one, their standards procedures

[5] Whether or not quality should be the first priority is a matter for discussion. Experience seems to suggest that it is essential to acquire market share first. Speed is more important than standards quality (i.e. maturity). Standards quality should come second. This would explain why a qualitatively high Hyperlan standard (ETSI) lost its market to the WLAN standards of IEEE 802.11. Indeed, also in the case of Parlay, the strategy was to quickly develop a standard in order to secure early market share. Speed was more important than quality. Implementation feedback was used to improve the standard. In a later phase more 'controlled dynamics' took place. (lectures by Jørgen Friis (ETSI) and Zygmunt A Lozinski (Parlay) "Impact of Standards?! - New Insights", NO-REST conference, 27 May 2005, ETSI, Sophia Antipolis, France)

are converging in many ways. Moreover, as the case studies in D7 show, some consortia closely cooperate with formal standards bodies and systematically formalise their standards, revisions included, as a side-step of their maintenance process. A more fine-grained basis for classification should be adopted, one that focuses on characteristics of the standards setting process like the overall time frame for standardisation, the degree of consensus aimed for, the degree of transparency offered, etc. These strongly determine the quality of the 'translation process' between 'concept of a standard' and the 'standard specification' (see figure 2.1). A sketchy translation may cause implementation problems.

The source of the above listed problems lies primarily in the institutional setting. Possible solutions are listed in table 4.1. They assume that the causes of these problems lie in the realms of drafting standards, usability and reality checks before issuing standards (pre-implementation), and implementation process support (e.g. standard integrity measures). See table 4.1.

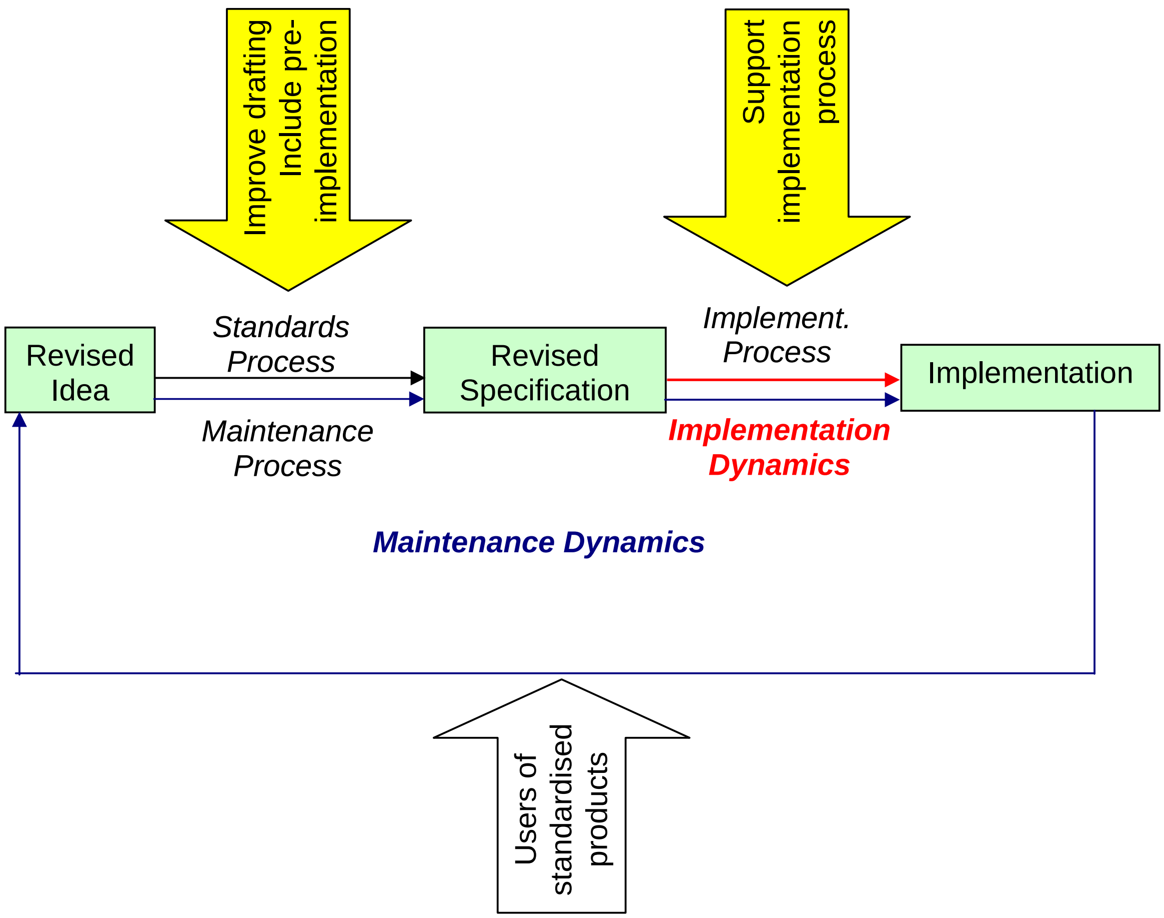

Figure 4.3: The relation between the maintenance cycle and institutional solutions to standard dynamics.

Figure 4.3 summarises the main line of argument. It depicts the maintenance cycle, and locates implementation dynamics (from specification to implementation) and maintenance dynamics (from specification via implementation and revised idea to revised specification). The measures of 'improving the drafting of the standard' and 'including pre-implementation' impact the standards process (or standard maintenance process) – and in its wake also the standard specification and its implementation. It reduces both implementation dynamics and maintenance dynamics. 'Support for the implementation process' directly affects implementation dynamics.

The unintentional 'benevolent' causes of implementation dynamics in Table 4.1 have an institutional background and need to be addressed in the 'standard development setting'. The solution to other interoperability problems such as the 'benevolent' functional deviation and 'malevolent' problems due to embrace an extend strategies lie in the 'implementation setting'. The third setting of relevance is the 'setting of use of standardised products'. Users may use standardised products in new and unexpected ways. This is a consequence of what technology literature calls 'the interpretative flexibility of artefacts'. Its relevance for standard dynamics is that unexpected uses sooner uncover the limitations of a product – and of the standards embedded. This may lead to new requirements and start up a new standard maintenance cycle. See figure 4.3.

Table 4.1: Measures of standards organisations that address (benevolent) sources of implementation dynamics, and maintenance in its wake.

Measures that address implementation and maintenance problems
Drafting of standard • institutional support for editors and rapporteurs on standards engineering • technical editors (other than those who developed the standards) • focused use of pseudo-code or formal languages (also eases generation of test suites) • unified naming convention • clarify type of option (optional/mandatory, orthogonal/equivalent) • specify how to deal with options (e.g. sets of minimum requirements in different contexts, i.e. profiles) • specify consequences of (not) implementing options (i.e. of a pick and mix in real products) • make explicit the rationale behind the specification • add a reference guide as part of standard • wider scrutiny of standard • translate international standard • coordination between standards bodies (compatibility among interrelated standards)
Pre-implementation • validate standards before implemented in products ("walk throughs") • reference implementation, pre-implementations • reference environment • testing (standard conformance & interoperability testing)
Implementation process support • interoperability events with products from different vendors (e.g. plug tests) • dialogue between standard developers and implementers communities • improve consistent use & standard integrity by certification program: e.g. compliance & interoperability conformance statements, standard-compatibility logo • supply test suites

5 E-business and e-government

E-business poses challenges to standardisation. It requires an infrastructure which can cope with business models that may change over time.[6] *"E-business is ... about using technology to redefine your business. To succeed, you'll need an infrastructure flexible enough to absorb new technologies, maximize efficiency across your organization, and support business model changes*". (European Commission, 2004)

The same applies to e-government services. Their evolution may also involve changes in service concept, changes which require a robust infrastructure.

The two heuristic models of standard dynamics presented in Chapter 4, are they applicable to e-government and e-business? On the aggregated level of the models no distinction is made between the different type of standards relevant to e-government and e-business. The standards which we researched were of three categories: lower level infrastructure standards, standards for structured data exchange, and standards for process integration. See Figure 5.1. Although most companies in transition prioritise the development of the supporting infrastructure layer (e.g. mobile solutions and VPN; European Commission, 2004, pp.32-36)), the two upper layers (e.g. XML standards) are at least as important to both e-areas.

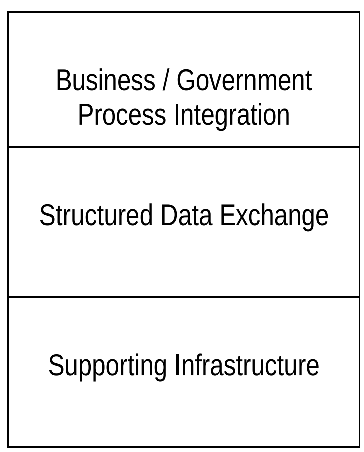

Figure 5.1: Levels of standardisation relevant to E-government and E-business (adaptation of the RosettaNet case, D7, Annex 1, figure 1).

[6] Business models determine which partners and network of organizations are most relevant (e.g. which actors participate, how much influence can be exerted, etc.) and influence a company's choice of standards forum. Business model characteristics are embedded in standards specifications (e.g. value creation mechanism, externalities, supplier dependencies). A change of business model reflects on the technology chosen and on the standards involved (D5/6). The new business model poses new requirements, and will trigger standard maintenance or succession.

Most businesses and governments are still making the transition to e-business and e-government (D 5/6). That is, standard *development and implementation* is still a key issue in the upper layer, more so than standard maintenance.[7] At the middle layer, data exchange standards such as EDI, XML and STEP are being used, but mostly by large companies and in high tech sectors (European Commission, 2004).[8]

Lower layer standards are widely used, also by businesses which have not yet made the transition to e-business data exchange and process integration. Much more is known about the dynamics of these – not e-business specific -standards. However, there are indications that the findings on which the models are based are also very relevant for the higher layer e-government and e-business standards. The E-business W@tch report, a report which monitors the field of e-business (European Commission, 2004) notes the same problems for standard dynamics in e-business as for standard dynamics overall, i.e. the problem of lack of transparency in a dynamic standards environment, and the need for constant monitoring and updating of standards, respectively:

- "The variety of standards, developments and requirements (…) pose strategic challenges in the choice for standards, especially for SMEs" (p.64)
- "Doing business electronically, (…), is about to become a "must" to stay in business. However, the underlying concepts are still changing fast, which translates into a constant 'adopt and adapt' for many firms." (p.9)

The need for constant monitoring and updating also applies to e-government. The coming decade new 'user side' requirements will put much pressure on the stock of emerging standards– if the UK e-government case is anything to go by (e-GIF; Deliverable 7, Annex 1).

In one respect the models would seem to be less applicable to e-government. Needless to say, governments play a key role in e-government standardisation. In such standards efforts the public interest is likely to preside over other, commercial interests. That is, the 'business model' (incentives) of governments differ from those of companies in general. Or, worded differently, the market factor in figure 4.2 and 4.3 refers to a more select type of demand in e-government. The standards setting will usually be a government internal project setting rather than a formal SDO or a consortium, since E-government standards are much more an intra- than an inter-organisational matter, if you consider government as one organisational unit. Under this assumption, a more deliberate and controlled form of dynamics will be easier to achieve. However, the multi-level structure of most governments in the European

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[7] For businesses the shift from business to e-business is in many cases accompanied by a change of business model. Deliverable 5/6 argues that a company's standards strategy is based on its business model. Two strategic choices are relevant, i.e.: choice of standards forum and preference for type of standards product, be it a standard, a guideline, etc. For more information please consult Deliverable 5/6.

[8] E.g. the costs of implementing RosettaNet standards are high (European Commission, 2004, p. 34), and therefore largely restricted to the bigger companies.

Union is a large challenge. The challenge is to implement e-government solutions in governmental institutions at and within various levels. Taking the complex structure of governments into account, even more problems may be expected to arise regarding standardisation in general and standard dynamics, specifically.

6 Towards Robust and Responsive Dynamics

There is a dilemma between the value of stable and , what we might call, *responsive* standards. Stable standards create market stability and support technical continuity, while responsive standards are associated with progress and innovation. It is a dilemma which cannot be resolved satisfactorily. On the one hand, a certain degree of standard dynamics is inherent to system evolution (e.g. the evolution of an IT application area, a technology or a market).[9] On the other hand, standard dynamics is in many ways problematic. It may lead to incompatibility, lack of market transparency, loss of investments, etc.. In deliberating whether novelty (standard updates) should be preferred to stability, the switching costs between consecutive revisions and successors play a significant role. (For example, standards' legacy has hindered companies to switch from EDI to XML standards; European Commission, 2004, p.32)

Before turning to recommendations about how to lessen the negative impact of standard dynamics, we need to recall that there are different kinds of standard dynamics, and that any recommendation should take these differences into account. For our purpose here, we distinguish two types of dynamics.

1. *'Unnecessary' dynamics.* The previous analyses indicate that much can still be done to avoid unnecessary change, namely improvement of the standards process. The higher the quality of the standards process, the more stable the standard.[10] Improving the quality of the process means intervening in the causes of dynamics. See Box 6.1. Because the dilemma of 'stable versus responsive standards' is shared by all standard bodies, we assess that the recommendations listed in Box 6.1 are generalisable to other formal standards bodies and to consortia as well. However, comparative quantitative research is needed to ascertain this assessment.

[9] It requires that standardisers actively monitor of change in the IT environment and pursue an active maintenance strategy.

[10] NB: The standards strategy also affects standards dynamics. Quick and dirty standardisation allows standardisers to make an early claim to market. This pragmatic approach later leads to revisions. Whereas high quality standards take longer to develop, but are more stable and less disruptive. The quick and dirty alternative is not typical for European standardisation, (Private communication with Jørgen Friis (ETSI), "Impact of Standards?! - New Insights", NO-REST conference, 27 May 2005, ETSI, Sophia Antipolis, France)

Box 6.1: Recommendations for the Maintenance Policy of Standards Bodies

Research on the scale of standard dynamics in JTC1 suggests, firstly, that some maintenance measures are systematically used *post hoc* for correcting errors which might have been prevented (i.e. a two-step development process which leads to avoidable maintenance).

Secondly, the use of new editions seems to be overtaking the use of supplements. Does a change in the balance of maintenance measures matter? Are new editions or supplements the lesser problem of standard dynamics?

Since maintenance activities are increasingly becoming the defining activity of standards bodies, we recommend that standards bodies

1. Review their maintenance strategy, and in particular
- the current *balance* between *maintenance instruments,*
- their current use and suitability for different problems
2. Acquire further insight into the impact of different maintenance instruments
- assess whether their impact differs
- review current means to address their impact (in-house[11] and elsewhere)
3. Monitor standard dynamics (diagnostics)

2. 'Desirable' change. In response to continuous pressure for change, two complementary, responsive strategies can be followed:
   - Design robust standards *ex ante* (i.e. 'future-proof', flexible standards in answer to uncertain future needs). This is easier said than done, as a study on the flexibility characteristics of standards shows (Egyedi & Verwater-Lukszo, 2005). Further research is needed before situation-specific suggestions can be made.
   - Prioritise downward compatibility when revising standards. See Box 6.2. This involves intervening on the consequences of dynamics.

[11]NB: A discussion at a JTC1 SC22 meeting indicated that the document status of Technical Report (TR) is sometimes used to gain experience with a standard without it having the full status of a formal standard. This route is an alternative to one where a full standard is started out with, and experience then leads to a maintenance action. That is, it may be relevant for standards bodies to weigh the use of TRs, namely as a stepping stone for an International Standards, against the use of maintenance instruments in the light of their impact on standards adoption and implementation problems. (Mont Tremblant, Canada, September 2005; JTC1 SC22 is sincerely thanked for the opportunity to attend their meeting and for the discussion.)

Box 6.2: Importance of compatible change for impact assessment

The impact of standard dynamics depends to a large degree on whether or not standard versions are compatible. Downward compatibility (grafting) is a key issue for assessing the consequences of standard dynamics (e.g. technology disruption and market fragmentation). Most changes are of an incremental rather than of a radical kind. The incremental nature of most changes makes grafting a viable option and the negative impact of change to a certain extent manageable.

Grafting also partly alleviates the problem that standards are not stand-alone artefacts. They are part of a web of interrelated standards. Usually updates must be made to keep abreast with changes in the 'core' standard. Grafting lessens the pressure on the interrelated standards.

The course of maintaining downward compatibility is a familiar and challenging one to many standardisers. However, it cannot but be a secondary issue. As the SGML/XML case study showed, even where grafting has high priority, it cannot compete with the primary motive for change. As a follow-up, we recommend that an inventory of barriers for downward compatibility be made based on the experience of standardisers. Such an overview might to throw new light on interoperability design for future networking.

Finally, a European standards policy is needed which not only positions European businesses in new markets – a static standards approach, one which stops at standard *development*, would suffice here – but also one that consolidates and enlarges existing markets. The latter requires a dynamic standards approach and must include a maintenance strategy. Temporary interoperability is not enough. A responsive and interoperable e-business infrastructure is needed.

7 References

To keep this report lean, we refer to Deliverable 7 for an overall reference list. Only references specific for this report are included below.

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