Formulating a General Standards Life Cycle

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Abstract. Standards-related literature within business-to-business (B2B) covers many separate areas. Examples are enabling technology, development processes for standards in formal, semi-formal and informal fora, base standards (XML and EDI) extensions and evolvement, intellectual property rights, etc, etc. In computer science literature, the term life cycle is usually used to denote the previously mentioned phases for a product or process, from "birth to death". They are useful for understanding various phenomena and how these relate to their respective environments such as to stakeholders. However, the standards life cycles is only rarely discussed in literature. This paper examines seven existing life cycle models for standards and standardisation, and shows where extensions to the current approaches are needed. The result is a general standards life cycle model, which may serve as the basis for discussion and to identify perspectives for both standards research and standards practice to consider.

1 Introduction

This is not intended to be "yet another paper" describing how much e-business and Internet technology has changed the business world in terms of globality, competitiveness, and inter-operation. Instead, such utterances are an underlying foundation for the paper. The focus is instead placed on the use of standards in inter-organisational co-operation and communication, primarily within Business-to-Business (B2B). Using a general definition, a standard is a document that provides guidelines or characteristics for activities or their results [1]. Standards exist anywhere in our everyday life, in all kinds of products and processes. Often, we use them without paying much regard to them as being standards, e.g. electrical outlets. Since B2B is the scope for this paper, the general definition of a standard can be further detailed. A *B2B standard* includes guidelines for how communication and information sent between organisations should be structured and managed. This definition is two-fold, or rather comprises a range of possible standardisation roles in communication. Firstly, it concerns message content for documents sent and received during communication. Secondly, it concerns how the communication process should be structured (see Figure 1). One example of a document-centric standard is XML Common Business Library (xCBL[1]), which is a set of XML building blocks and a document framework for creating XML documents for e-commerce. Examples of

[1] The xCBL homepage is available at: www.xcbl.org

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more process-centric standards are RosettaNet[2] and electronic business XML (ebXML[3]), which aim at enabling exchange of electronic business information via global processes and an infrastructure respectively.

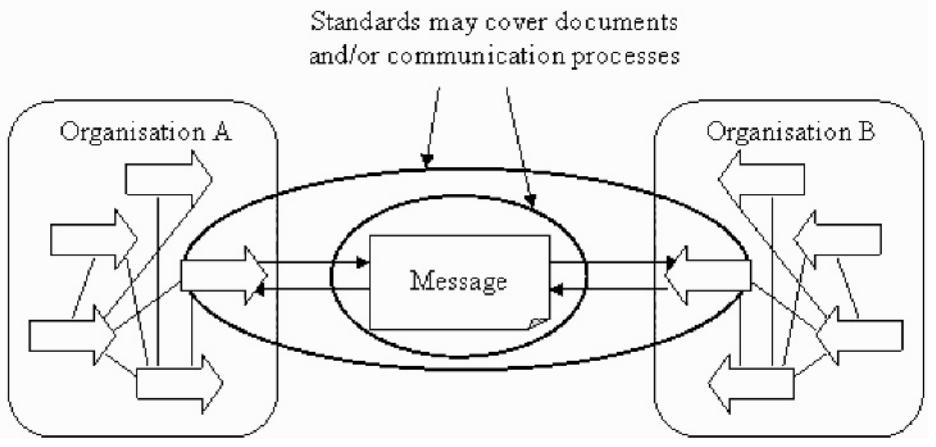

Fig. 1. The role of standards in organisational communication

Standards-related literature covers areas such as enabling technology, development processes for standards in formal, semi-formal and informal fora, base standards (XML and EDI), intellectual property rights, etc. B2B standards evolvement, however, is not as frequently discussed, i.e. what the different stages or phases in their life cycle are. Focus is instead placed on one or a few of the sub-phases such as development. The goal of this paper is to elevate the perspective to a more general level and to formulate a draft life cycle for B2B standards. Existing life cycles will be reviewed and merged into a general one. The merged life cycle model will be used to identify weaknesses in current approaches, to allow for extensions to be suggested.

2 Standards-Related Life Cycles

Standards are becoming a natural part of organisations' daily lives. In B2B, there are numerous transactions occurring either between an organisation and its suppliers and/or an organisation and its customers [2]. Like any other system, process, or product, a standard passes through certain phases and activities during its "life", or existence. The life of something, in this case a standard, can be defined as:

> *"The term of existence, activity, or effectiveness of something inanimate"* [3]

Looking up the term "life cycle" in dictionaries, it is usually defined from a biological perspective as a (continuous) sequence of changes undergone by an organism

[2] The RosettaNet homepage is available at: www.rosettanet.org
[3] The ebXML homepage is available at: www.ebxml.org

[3; 4]. In computer science literature, the term life cycle is usually used to denote the previously mentioned phases for a product or process, from "birth to death". They are useful for understanding various phenomena and how these relate to their respective environments such as to stakeholders. Unfortunately, most life cycles in literature are not described in detail. In the remainder of this chapter, two different approaches to life cycles will be described and compared. The largest cluster concerns life cycles that directly relate to various parts of standards and standardisation (section 2.1). There are also similarities and comparisons made to the product life cycle (section 2.2).

2.1 Life Cycles with Direct Relation to Standardisation

In literature, seven versions of life cycles have been identified that directly relate to standards. Most of these focus on the first life cycle phases and on the activity of standards development.

The most referenced life cycle model was created by *Cargill* [5], and was also described in Burrows [6]. It is a five phase model consisting of: initial requirements, base standards development, profiles/product development, testing, and user implementation feedback. To our knowledge, this is the only life cycle model that explicitly relates phases and stakeholders: Initial requirements may come from sources like standards software organisations, various standards developers and from users. Both development phases may involve software organisations, developers, users and service providers. The fourth phase is performed by either software organisations or testing organisations (a kind of service provider). The final stage consists of feedback from users. The model's strength is its inclusion of stakeholders and an attempt to look beyond development. Its weakness is that it does not manage to broaden the horizon well enough. The focus is still on standards development.

The second model is described in *Köller et al* [7], and consists of four phases: definition, implementation, certification and installation and usage. The definition phase includes standards creation, and phase two is implementation of standards-compliant software. Step three refers to certification of that the software complies with the standard, and phase four means installation and usage of the software in question. Strengths with the model are firstly that it identifies the software certification activity, which not many life cycle models do. Secondly, it mentions the *use* of the standards-based software. However, the model may be confusing in the similarity between the implementation and installation and use phases. It seems that implementation refers to creation of software based on a standard, while installation refers to putting the software to use in real user organisations. However, this is not further described in the model, and is hence our interpretation.

The next model is described by *Ollner* [8], and focuses on standards development. The cycle is repetitive, with three main phases simply called pre-standardisation, standardisation and post-standardisation. In pre-standardisation, new developments and market requirements arise, which create a need and basis for standardisation. The standardisation phase includes all activities in creating a standard, e.g. co-ordination and adaptation of sizes and dimensions, specification of function requirements, variety reduction and development of unambiguous testing methods. There are three subphases here (see figure 2): preparation, publication and implementation of standards.

The resulting standard may in post-standardisation be the basis for developing, designing, producing, procuring and marketing products. Ollner does not explicitly relate the life cycle to stakeholders, but claims that standardisation experts should cooperate with users. One strength of the model is its elaboration of the development (or standardisation) phase. Another strength is the claim that existing standards must be revised when they no longer measure up to practical requirements, e.g. due to technical developments. The model's major weaknesses lie in its failure to capture phases beyond development.

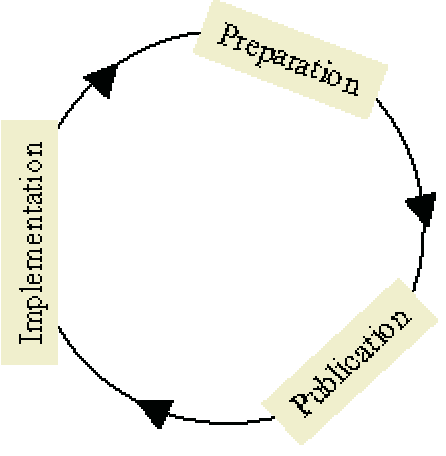

Fig. 2. Cycle for standardisation work (after [8], p.17)

Our next life cycle model is also focused on standards development, with particular reference to development within single companies. According to *de Vries* [9], input to life cycle processes is needs for a company standard. The phases (or processes) are: prioritising, standards development and revision, standards introduction, and standards distribution. The result is a company standard, which also is the focus of standards implementation. Feedback from e.g. implementation may result in new needs, which starts the cycle all over again. Besides the included phases, de Vries also identifies external factors that may have an influence on the development cycle: policy process, funding process, human relations management, and facility management. These are all part of the company as a whole, and constitute the strength of this model. The weakness is the same as for the previous model, i.e. failure to capture more that the standards development activities.

Weiss and Spring [10] provide the next life cycle model with three phases: development, distribution and implementation. During development, unambiguous and public specifications are created. The exact contents and requirements of this phase varies depending on whether the standard is anticipatory or responsive, i.e. preceeding or following technology developments (see also section 2.2). The distribution phase consists of getting the standard out to users and software organisations. This includes both making the standard known by name and enabling users and software organisations to acquire extensive knowledge about standards in order to use them effectively and efficiently. Finally, implementation involves creating products conforming to the standard, and testing the software's conformance to the same. However, implementa-

tion concerns product development and testing, not implementation in user organisations. The major strength of the model is the identification of the distribution aspect of standards development. The weaknesses are the same as with previous life cycle models, the standards development focus, but the naming of the implementation phase is unfortunate in not being descriptive for what the phase actually includes.

The "development weakness" applies to the next model as well. *Egyedi* [11] describes standardisation stages as being: planning, negotiation, and implementation. In planning, priorities for standardisation are determined. Negotiation concerns reaching consensus, e.g. as in formal committee standardisation. Implementation refers to how standards are implemented. Egyedi does not describe the phases in more detail, which is a weakness. It is furthermore noteworthy that Egyedi uses the term standardisation to refer to what we call standards development. Thus, the model's strength lies in its elaboration of the development phase, in particular in explicitly mentioning the negotiation activity.

Finally, *Hanseth and Braa* [12] provide us with a four-phase model: conception, definition, implementation, and use. Conception corresponds to identifying the need for a standard, while definition refers to creating the standard with its contents, scope etc. Implementation is creating products that are based on the standard, while use includes diffusion, adoption and actual use of the software. Hanseth and Braa mention the phases as part of describing a standardisation case study, and hence not specifically as being part of a life cycle. This is our interpretation. The strengths of the interpreted model are that it mentions activities like adoption, diffusion and use, meaning that it raises the horizon somewhat from development. Its weaknesses, like with some previously identified models, is that it does not successfully accomplishes the task.

2.2 Product Life Cycles

In the previous section, [10] touched upon relating life cycles for standards with life cycles of products. The authors mentioned standards that either precede or follow technology developments. In this field, [13] and [14] describe the product life cycle in a similar fashion (see figure 3). Standards can be anticipatory, participatory/enabling, and responsive. Anticipatory standards come before a product or technology has been widely accepted, or even before the product/technology exists. Participatory standards are developed, tested and used interactively with both developers and users. Responsive standards follow the emergence and acceptance of a product/technology, as a way to distill scientific information into useful products [13].

This description merely shows if standards come in before or after a technology/product has been produced. The product life cycle as such can be described in two ways. The first consists of five phases [15]: design, production, operation, support, and disposal. The second consists of five different phases [16]: innovation, improvement, maturity, substitution and obsolescence. [16] elaborates his division of life cycle phases by illustrating them in conjunction with market penetration. Market penetration grows the most during the improvement phase, is generally high during maturity, and decreases the most during the substitution phase. Merging the explanation of the product/technology life cycle with how standards relate to the cycle, we can show a more detailed picture of how standards fit into the product/technology life cycle (see figure 4).

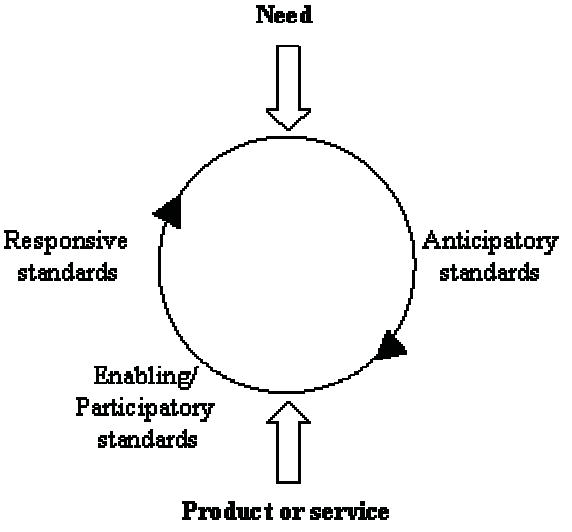

Fig. 3. Standardisation position in the product cycle (from [13], fig. 4 and [14], fig. 1)

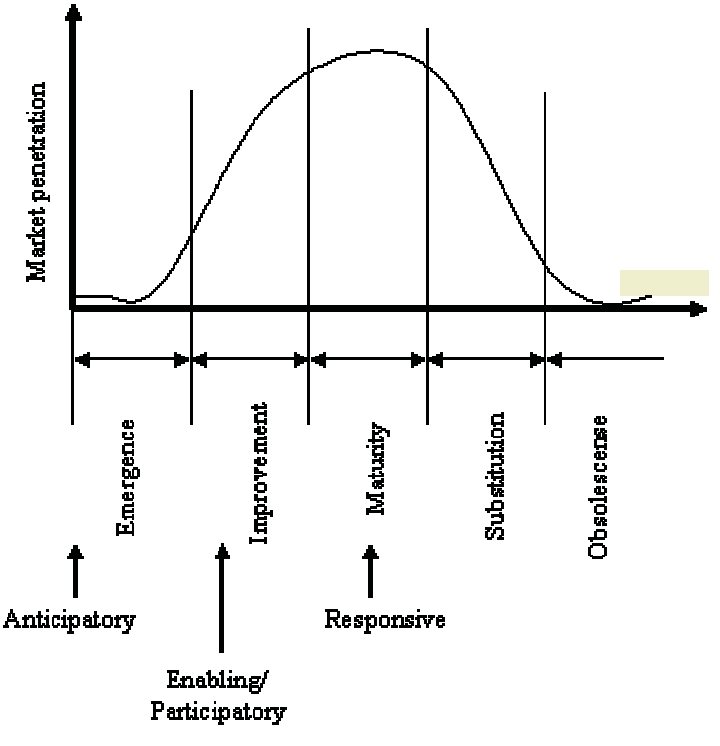

Fig. 4. Detailing how standards relate to the product/technology life cycle

Anticipatory standards precede the first phase, emergence, since they do come before the actual technology. Enabling/participatory standards are developed in parallel to technology developments, placing them during the improvement phase. Finally, responsive standards come into play during the maturity phase, since they emerge after the technology has been developed, but before its substitution and obsolescence.

3 Comparing the Standards-Related Life Cycles

Having presented and described existing standards-related life cycles, this chapter will compare the life cycles, and extract a general model from the descriptions. The merger is made firstly to illustrate the differences and similarities between the approaches, and secondly use the model as a basis to point out where further additions are needed (see chapter 4). The comparison in table 1 shows that there are both significant differences and significant similarities between the current life cycle approaches. All approaches have one phase in common, the development phase. The naming differs for this phase, though: develop, define, standardise, and negotiate. Depending on how [10] is interpreted, distribute can also be used. Regardless of the name, the phase includes the creation of the standards specifications, which are the essence of standards.

Before development starts, there must be an initiation phase, during which the idea of the standard is born based on needs or estimations. This applies whether the standard-to-be is anticipatory, participative/enabling or responsive. As with standards development, there are different names for the phase, e.g. initiate, pre-standardise, need, plan and conception. The common denominator suggests that the phase includes preparations for the standards development process. Needs may stem from market requirements, technology developments or from the organisation itself. It may also include setting the standard's scope and defining how the following development process should be performed. Five out of the seven life cycles in table 1, include an initial phase. Thus, the first phase is regarded as rather important. It is possible that the two life cycle models that do not include the initial phase implicitly include them in their standards development phase, or regard it as in input to standardisation activities. We believe it is important to distinguish initiation from development for several reasons. Firstly, a first look into the claimed standardisation need may not result in any further actions, if the need is determined to cost more than the return of the investment would be. Secondly, the preparations made set the conditions for coming standards development activities, and thus clearly affect the standard's final structure, content and application area.

Three out of the seven life cycle models include a sub-phase where products are created based on one or more standards. Two of them [5/6 and Weiss & Spring] include testing of the products before they are implemented in user organisations (denoted by a * in table 1). Weiss and Spring's [10] implementation phase was placed in the product development column since it by its own definition deals with product creation and not user implementation. Product development may be viewed as part of the remaining four life cycles as well, in either standards development or in implementation. However, we believe it should be a separate phase since it not necessarily is the way in which organisations implement standards. In other words, software products are not a necessary requirement for standards implementations, even though it is the most common approach.

Table 1. Comparing standards-related life cycles

Cargill/ Burrows	Initiate	Develop standards	Develop products*	Implement		Feedback
Köller et al		Define		Implement*/ install	Use	
Ollner	Prestand.	Stand.	Poststand.			
De Vries	Need	Develop		Implement		Feedback
Weiss & Spring		Develop/ distribute	Implement*			
Egyedi	Plan	Negotiate		Implement		
Hanseth & Braa	Conception	Define		Implement	Use	

Five out of seven life cycles include an implementation phase, where standards and/or standards-based products are implemented in organisations. The explanation for the phase's absence in the two remaining life cycles may be that these are only focused on standards development, with its preparation and conclusion. For example, [8] describes how standards may be used for a variety of things once they are created. This phase still ended up in the product development column since one example is that products may be created. Still, it is evident that this particular life cycle does not focus on anything but standardisation. As with two of the product development phases, there is an asterix in the implementation column as well. Testing can this be done in two ways here, one for testing products when they are developed, and one for testing actual implementations of standards and/or products in organisations. Since testing can be a part of different activities, we chose not to include it as a separate activity in the table. We will, however, get back to testing in section 4.1 when discussing extensions to the life cycle model.

When moving one column to the right, the number of life cycle models covering use decreases sharply. Only two models include the actual use of standards and related products. However, neither of the two proceeds to describe what "use" actually includes. [7] only specify it by use of standards-based software, which as we described earlier is no definite pre-requisite for using standards. Clearly, further research is needed into how standards are used in practice, and not just how they ought to be used in theory.

The situation is the same when moving to the right-most column of table 1. Here, feedback refers to users giving feedback to developers of products or standards of what they think about the standard: what works, what does not, which problems have been experienced and so on. The feedback creates one of the possible inputs for evolving standards, and is thus an important separate phase. Today, most standards development organisations are open to, and even encourage, user participation in their

development activities. However, open participation does not mean free participation, and few users therefore have the financial resources required, nor the time for that matter.

Looking at table 1, each column makes up a phase in standards life cycles. Figure 5 provides a graphical model of a result. To summarise, the process starts by an initiation phase where the idea is born and general conditions for coming activities are set. Based on conditions from the initial phase, the actual work with developing standards specification is started. After completion of the specifications, the cycle can proceed in two ways: by product development before implementation, or directly to implementation. After implementation, the standard and/or standards-based products are used in organisations' daily work, and feedback may be sent back to developer organisations as a basis for improvement.

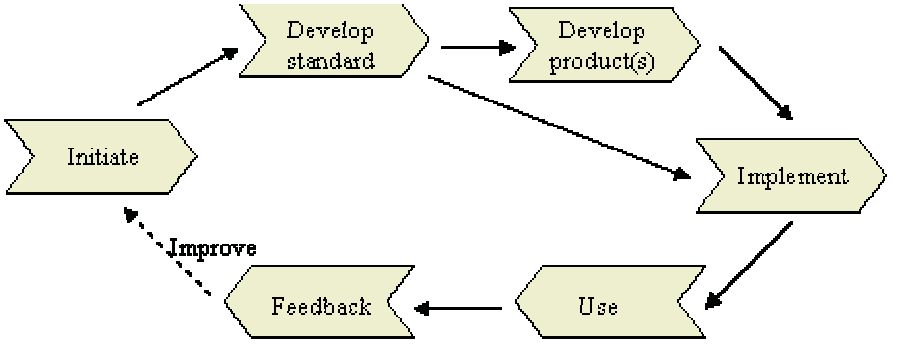

Fig. 5. Generalised life cycle model for standards

In standards-related literature, life cycles for the most part concern the standards development process alone. This means that the life cycle focus stops after implementation. As figure 6 shows, there is more to the life cycle than development, its prerequisites and consequences. As Cargill [5] puts it, issues that are important to other stakeholders, primarily users are not taken into consideration. Hence, there is also more to the life cycle than figure 5 shows. The next chapter will discuss possible extensions to this model.

4 Adding Phases to the Standards Life Cycle

The previous chapter presented and compared a number of life cycle models for standards and standardisation. The resulting generalised model of the standards life cycle does, however, have weaknesses. There are several activities that should be an explicit part of the model, namely: testing, education, maintenance and termination (figure 6).

Each additional phase will be motivated and described in sub-sections of this chapter, with facts and motivations.

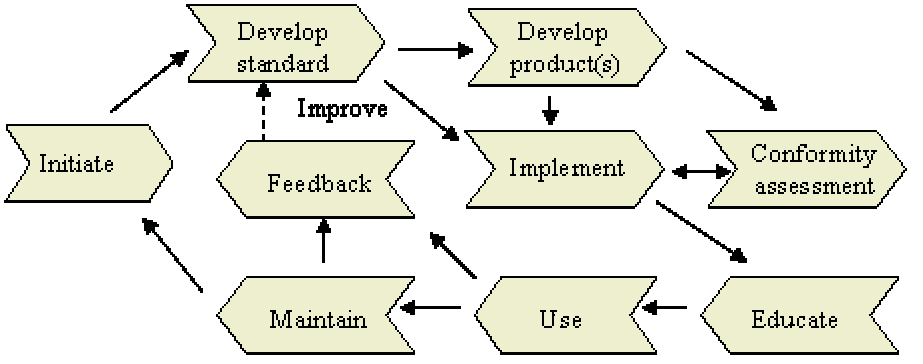

Fig. 6. The general standards life cycle model extended

4.1 Conformity Assessment

The first phase, conformity assessment (CA), has partly been mentioned by a couple of life cycle models in the terms of testing. Since there are different occasions where CA can be applied, e.g. after completion of a standards-based product or after implementing a standard or a standards-based product, we did not include it in the generalised life cycle model. Another reason was that besides differences in occasions, there are also differing techniques for performing CA. Examples are [18]:

- *Testing*: may consist of activities such as calibration and measurement, and is the basic technique for product certification.
- *Inspection*: examination of products, materials, installations, plants, processes, work procedures and services, for e.g. quality and fitness for use.
- *Certification*: a first, second or third party gives written assurance that a product, service, system, process or material conforms to specific requirements.
- *Accreditation*: how an authoritative body gives formal recognition that a body or person is competent to carry out specific tasks.

First, second and third parties refer to by whom the assessment is made, and applies to CA as a whole. First-party is performed by the supplier, second-party by the customer of the supplier, and third-party by an independent assessment body. There is a fourth alternative, the supplier itself giving some written assurance of meeting the standard. CA is an important phase, since it helps guide e.g. users in determining whether or not their product/implementation meets the set requirements, and software organisations in determining that their products work as specified in the standard and that they are inter-operable with other standards-based products.

4.2 Education

In a previous study, the lack of knowledge in user organisations has been recognised by standards developers as a problem [2]. Users do not know how standards work, what they can do for them, or how they work. Instead, they outsource their standards

management to e.g. consultancy firms. This may be a problem if the consultancy firms cancels the contract or goes out of business. Furthermore, without knowledge about standards, users have fewer chances of affecting the standards development process. It should be noted that users are willing to learn. The Korean Integrated Forum on Electronic Commerce (ECIF) conducted a study in year 2002, where they concluded that 64,5% of their study respondents were willing to learn more about standards [19]. In particular, the subjects for education were said to be application methodology, implementation and application case studies, benefits for adopting standards, standards specifications and information about support solutions. According to de Vries, standardisation education should disclose the standardisation phenomenon to students in a way that students can get accustomed with standardisation, get knowledge about it and be equipped to use this knowledge in practice [9]. What, how, why and who are four important questions to ask. Education is an important matter if standards and their related products should be used efficiently and effectively. It should therefore be part of the life cycle.

4.3 Maintenance

Maintenance in the standards community is a forgotten subject. Nevertheless, it is important. Often, technology for using standards, particularly with the early technology such as Electronic Data Interchange – EDI, has required substantial financial investments. Therefore, when new standards or versions of them, as well as new technology, are introduced, many organisations cannot afford to simply throw their existing systems out. As any other technology or system investment, maintenance is needed to keep the standard/system operating as intended, e.g. to monitor and improve quality and productivity [19]. This phase should therefore be made explicit, in particular since it for so long has been neglected. In the end, it is the standards users that pay for changes in the standard.

4.4 Termination

The fourth and final extension suggestion is to explicitly include a phase for termination of standards. There are occasions when standards are determined to be obsolete, and are taken out of use. Such occasions should be explicitly noted, in particular if the decision to terminate them has international consequences. By consequences, we here mean if standards that are international are terminated, the phase must be co-ordinated and communicated world-wide. If not, there is a risk that some use the standard while others, perhaps their partners, have ceased to use them. Standards may also be put out of use by a single company or group of companies that may not be on an international level. Still, there may be consequences for the company environment. For example, if we speak of communication standards, any connection a company has with suppliers and/or customers will be affected by a change in or removal of a standard.

5 Conclusions

The focus of this paper was to cover the existing gap in standards literature and sketch out a first general life cycle model for standards, with particular focus on B2B stan-

dards. However, much of what is discussed applies on a more general standards level as well. We lifted the focus from standards development to a more general view of how standards evolve during their existence. Seven existing models for standards life cycles were examined and compared. The resulting general model showed weaknesses in current approaches. Four additional phases were suggested and merged into an extended life cycle model. Life cycle models are useful for understanding standards and how they relate to their environments. One example is how activities in one phase may affect activities in other phases. How education is performed may for example affect how standards are used. Different stakeholders may also have varying interests in different phases. Standards users may have an interest in affecting the contents of a standard, and which kind of education they may have access to in subsequent phases, as well as how standards and systems should be maintained. A life cycle view may thus serve as a basis for discussion. As an example, maintenance has so far been a missing perspective in standards research and perhaps also in practice. The life cycle model can therefore point to important aspects of standards to consider, both for standards users, developers, software organisations and so on.

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