THE CHARACTERISTICS OF A NEW SEMANTIC STANDARDS DEVELOPMENT APPROACH: THE PRESSURE COOKER METHOD

Master Thesis

UNIVERSITY OF TWENTE.

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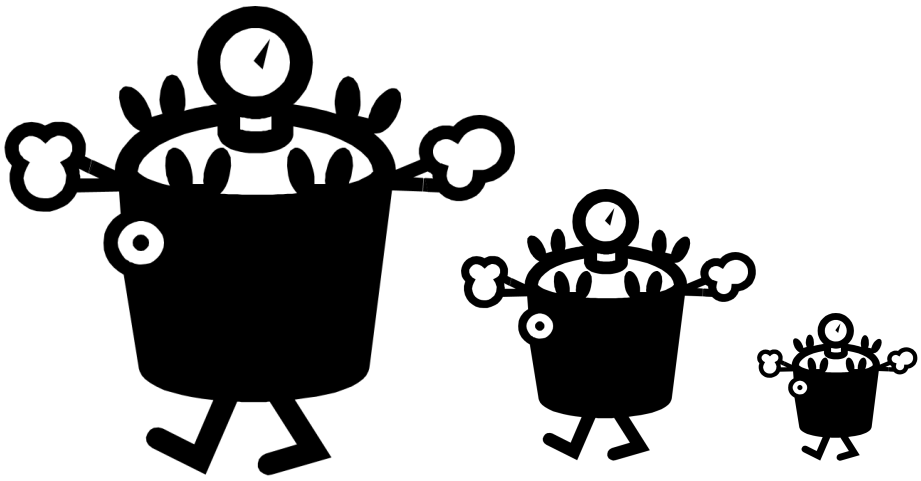

ISTVAN ZSOLT KULCSAR

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The characteristics of a new semantic standards development approach: the Pressure Cooker method

Author	Istvan Zsolt Kulcsar
Study programme	Master of Science in Business Information Technology School of Management and Governance University of Twente, Enschede, The Netherlands
Student number	S1192264
E-mail	kulcsaristvanzsolt@gmail.com

GRADUATION COMMITTEE

First supervisor	Dr. ir. E.J.A. Folmer School of Management and Governance University of Twente, Enschede, The Netherlands
Second supervisor	Dr. N. Sikkel Faculty of Electrical Engineering, Mathematics and Computer Science Information Systems and Software Engineering group University of Twente, Enschede, The Netherlands
TNO supervisor	Ir. J.B.M. Roes TNO, Enschede, The Netherlands

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2 Management summary

Semantic standards are important because they are able to connect different information systems by providing interoperability. It is estimated that the lack of interoperability costs billions of US dollars in different industries. Even if there is interest from the businesses, the current methods of standards development do not lead to solutions in a short time. Nowadays, the average standards development time can take up to 36 months. Among a wide range of projects, TNO also participates in semantic standardization projects, typically assisting in development efforts with standardization experts. A few years ago, based on a standardization expert's initiative, TNO applied a new approach called the Pressure Cooker that significantly reduced the development time compared to the time-extended method. Instead of following the traditional way of standardization, where the work sessions are separated by 4-5 weeks, the new method reduced the development time by organizing the originally separated work sessions within one week. Not only resulted the first try in an adopted standard (meaning the standard was adopted), also the development time was significantly reduced to 8 months.

After two more applications of the new approach, TNO wanted to identify the characteristics and the formalization of the results of the experimenting with the Pressure Cooker method. This study describes the approach and identified issues with the as-is Pressure Cooker method. The issues were identified by the analysis of the experiences in the three former applications. When the list of issues was finalized, a structured literature review was applied in order to address the challenges.

The structured literature review resulted in a list of improvement ideas that were discussed with standardization experts in the form of an expert session. The result of the session was used to select the most promising ideas in addressing the issues. In this thesis, the improved Pressure Cooker method is formalized and described. The method has advantages such as short development time and fixed costs but it must be emphasized that it cannot be the best choice in every situation. It is important to be able to judge whether a standard development request focusing on the characteristics of the project suits more to the Pressure Cooker method or to the time-extended process. Therefore the following characteristics are identified that can determine the successful application of the method:

- The number of the Steering Committee members should be below 10.
- The project has to follow a minimalist approach, and not a structuralist approach.
- The Co-pilot has to be familiar with the chosen technology and with the Pressure Cooker method too.
- The goal has to be an 80% standard. The Pressure Cooker can give a fast first step toward the final standard. The result of a Pressure Cooker can be best used for a pilot project and subsequently fine-tuned in the pilot.
- Without committed participation the Pressure Cooker is not applicable. There are cases when certain stakeholders cannot be left out even if the analysis does not suggests the involvement of them. In these situations, the time-extended method is the better choice.
- The larger complexity of standardization project has can undermine the common goal of the stakeholders and can make the decision making longer. If any of these occur, the Pressure Cooker method is not recommended.

- In the case of a mature standard, the goal is not an 80% standard anymore, but a 100% one. Therefore, if the size of the update does not allow 100% standard scope in the project management triangle with the given time and cost attributes, the Pressure Cooker method cannot be used. With small changes, the Pressure Cooker method can be applied, because the 100% target can be reached within the boundaries of the project.
- The Pressure Cooker method cannot be applied in the case of anticipatory standards development. A PC project needs clear scope and the development time is limited. None of these features beneficial for the development of anticipatory standards.
- If the Steering Committee does not unanimously agree on the development project then the Pressure Cooker should not be used because of lack of commitment and clear goal.

This research concludes that applying the proposed Pressure Cooker method in situations where it fits according to the characteristics, can result in significantly shorter development time than the time-extended standardization approach and it is more reliable than the as-is Pressure Cooker method. Research should validate the outcome in practice in the future.

Keyword: semantic IS standards, standards development, Pressure Cooker method, time-extended, standardization process

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6 Glossary

- 80% data standard: a standard that covers only the main process and does not include the possible exceptions. Besides, an 80% data standard usually includes many optional elements that would not be part of a 100% standard
- Chairman: a TNO expert, this person is responsible for coordination and management of the work in the group
- Co-pilot: a TNO expert, this person is responsible for capturing the information during the work sessions
- High pressure week: The development week of the semantic standard, where the Workgroup guided by the standardization experts (Chairman and Co-pilot), creates the Business Domain Model, the Information model and sets the technical requirements of the standard. The standard is developed in this week, but the documentation of it is finished later
- Pressure Cooker: a standardization method, which enables to significantly shorten the development time, and fosters adoption
- Semantic standard: Agreements on the meaning of data or information
- Steering Committee: the stakeholders of the standard, they manage and coordinate the development and management of the standard. Besides, they choose the Workgroup members too
- TNO: Acronym of the Dutch "Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek" (Netherlands Organisation for Applied Scientific Research TNO)
- Workgroup: A group within the standardization community with a demarcated sub-activity with a clearly defined end result as its objective. They develop the standard in the high pressure week.

7 List of Abbreviations

ANSI: American National Standards Institute

CEN: Comité Européen de Normalisation (European Committee for Standardization)

CM: Chairman

CP: Co-pilot

DTD: Document Type Definition

EBA: Elektronische Begeleidingsbrief Afval (e-Waybill for Waste Transport)

EDI: Electronic Data Interchange

ETSI: European Telecommunications Standards Institute

ICT: Information and Communication Technology

IEC: International Electrotechnical Commission

IOS: Inter-Organizational System

IS:	Information System
ISO:	International Organization for Standardization
IT:	Information Technology
MISMO:	Mortgage Industry Standards Maintenance Organization
NEN:	Nederlands Normalisatie-Instituut (Netherlands Standards Institute)
OASIS:	Organization for the Advancement of Structured Information Standards
OMG:	Object Management Group
PC:	Pressure Cooker
SC:	Steering Committee
SDO:	Standards Development Organization
SES:	The Society for Standards Professionals
SSO:	Standards Setting Organization
STOSAG:	De Stuurgroep Open Standaarden Afval- en Grondstoffen (The Steering Committee of Open standards in garbage and raw materials collection industry)
VISI:	the Dutch acronym for 'Terms & Conditions for the Implementation of Standardization in ICT in Civil Engineering', it is a standard for digital information exchange, broadly used in the Dutch construction industry
W3C:	World Wide Web Consortium
WG:	Workgroup
XML:	Extensible Markup Language

1 Introduction

Today´s businesses are in a dynamic and more and more connected environment. Organizations try to connect their business processes for the better productivity and higher efficiency (Harvey & Novicevic, 2006). Organizations need interoperability to align their processes. According to the European Commission, Information and Communication technology (ICT) is a major driver of competitiveness and represents one of the key industrial sectors of the 21st century (European Commission, 2009). Semantic standards support the achievement of interoperability by providing clear and straightforward definitions, layouts and processes for everyone who is willing to use it (Folmer and Verhoosel 2011). Data standards make sure that the different parties in the cooperation use the same names, measurements and way of doing the business during their inter-organizational work. The ability to connect devices and systems can increase their utility to end-users and the end–user can increase the utility of a product by connecting it to another one. Standards set specifications that enable the connection between different components (Wegberg, 2004). Standards ensure that users can enjoy the benefits of connected products. Standardization and interoperability are important in value-generating process.

When the organizations 'speak the same language' connecting their business processes is a much easier task and in the end interoperability is easier reachable. This is the reason that it is generally accepted that interoperability is supported by data standards. The importance of the standards in the achievement of interoperability explains that standardization is essential for organizations. Companies lose a lot not having the advantage of the interoperability. Almost $3.9 billion annual loss in the electronics industry and $5 billion annual loss are estimated in the automotive industry, just because of missing standards (Steinfield et al., 2011). In 1999, a study found much lower but still huge price of interoperability problems; Brunnermeier and Martin (1999) estimated that interoperability problems associated with sharing product and engineering data impose annual costs on the U.S. automotive supply chain totaling approximately $1 billion. Comparing the two results within 3 years can mean that the importance of interoperability is even increasing. Moreover, the lack of integration and data standardization is making health care services inefficient and costly. Hospitals have $29 billion cost yearly because of errors. Venkatraman et al. (2008) claim that three out of four errors can be eliminated by better use of information technology resources. It is expected that big part of these losses could be eliminated with appropriate level of interoperability. Standards make life easier by reducing the informational transaction costs, by being able to refer to them implicitly and explicitly (Egyedi, 2008). Transaction costs are costs like time and resources that are required in order to establish a common understanding. Using standards makes the actors' understanding easier and cheaper because it reduces the transaction costs of negotiation.

However, currently the Information Systems (IS) standards development processes are far from the desired maturity. One main concern is the average development time of the semantic standards. Wegberg (2004) claims that speeding up standardization will be valuable if the benefits from the standard are time-dependent. Currently, the average time of IS standards development is 36 months (European Commission, 2010). The importance of the problem is shown by the European

Commission too, who demands that before 2020, the average time of semantic standards should be reduced by 50%, down to 18 months (European Commission, 2011).

The need for fast solutions is especially important in the ICT field. Various actors from the same industry or actors from different industries work together and their productivity can be seriously hindered by the lack of appropriate connectivity of their IT systems. To fully realize the benefits of e-business, common standards are required to define the syntax and semantics of Web-based information sharing among firms (Kexin Zhao, Xia, & Shaw, 2005).

To have an even more complex situation, the companies are waiting for a solution in fast changing technology environment. During today's up-to 3 years long development times, many things can change such as technology and business needs. The (IS) standards are designed to promote communication and coordination among the organizations, and these standards may address product identification, data definitions, business document layout, and/or business process sequences (Markus, Steinfield, Wigand, & Minton, 2006a).

In the ICT domain, industry consortia set the vast majority of important standards, in contrast to formal standards organizations (e.g. ISO) (Rada and Ketchell 2000). Industry consortia are growing in number and importance; they cannot be neglected anymore in government policies (Kroes 2010; European Commission 2011). In the semantic standards area there is often one dedicated consortium that maintains one specific data standard for a specific domain. However both large industry consortia and formal bodies are aiming for the inclusion of more of these semantic standards. For instance Object Management Group (OMG), The Open Group and the World Wide Web Consortium (W3C), are all industry consortia involved in data standards for different domains, and currently W3C is offering a free online platform that can be used by semantic standards initiatives. The formal bodies bring their formal status into play, while the industry consortia offer their expertise and flexible processes (Folmer 2012).

This study makes key contributions in describing and improving a new standard development method to the research field of IS standards development. The Pressure Cooker method does not need 18 months of development time but it aims the shortest time to develop a good standard. What the minimal time for a standards development process is, and in which circumstances such a process is appropriate, remains to be seen.

The thesis is organized as follows. In the following part of the chapter, the research goals and methods are introduced and described. The next chapter discovers the work that has been done in the field of semantic standards development. The representation of the prior literature is structured in four topics in Chapter 2. In Chapter 3, the as-is Pressure Cooker method at TNO is formulated and presented. Figures help to understand the flow of the process and detailed definitions are provided for each activities. However the as-is Pressure Cooker method might be not perfect, therefore a survey and expert interview are used to investigate the presence of issues. Chapter 4 reveals the current issues in the as-is method and sets requirements for a new method. Chapter 5 consists of two parts. The first contains the discussion of standards on standards development pointing out what can be learnt from these. The second part addresses the earlier identified issues with the application of structured literature reviews in the topics. The findings were validated with an expert session. The improved Pressure Cooker method is presented in chapter 6 and chapter 7 investigates whether the requirements are met and the research objectives are achieved. Chapter 8 contains the

conclusions of the research, in which limitations and suggested topics for future research are included.

1.1 Research aim and objectives

Semantic standards are agreements on the meaning of data or information. In the Information Systems (IS) field, semantic standards are typically used to describe data exchange related standards. In this master project a new standard development method will be validated and improved. This method aims to shorten the current development time and to fasten the solution providing for interoperability problems by allowing the adoption to start earlier. The research is focusing on a particular type of technical standards, on the semantic standards.

A simplified lifecycle of the IT semantic standards lifecycle is shown below.

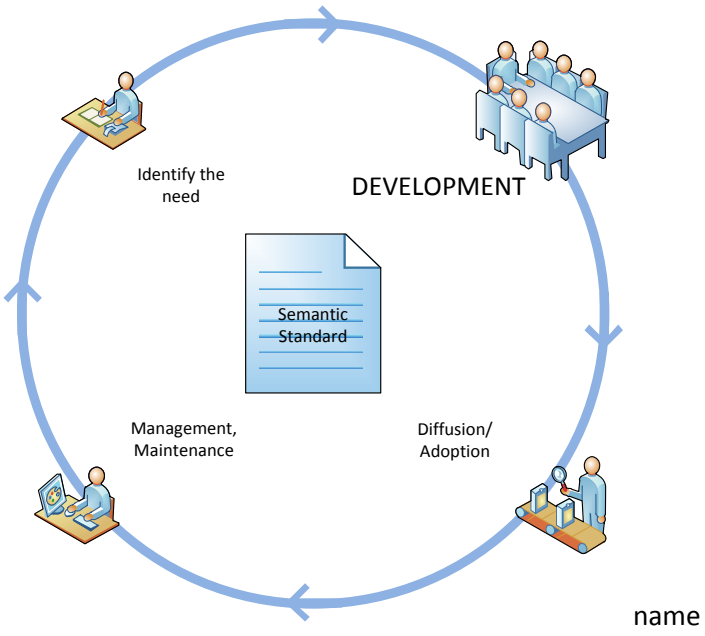

Figure 1. Simplified Standard Lifecycle

The visualization of the 'life' of a semantic standard is a cycle, because semantic standards are typically not finalized for good. These standards are managed through years and they have iterations to be modified and improved in order to fit the current business needs. Shorter life cycles are special for semantic standards compared to other technical standards. This research considers only one phase within a cycle and focuses only the development phase. The rest of the cycle is out of the scope of this research.

Of course the need identification and the adaption of the standard cannot be strictly separated from the development phase; therefore certain topics of these phases, where it is necessary, will be investigated too. The ultimate goal of the development is the successful adoption. This causes a close link between these phases. Although the development and the diffusion phases in the lifecycle of

standards are very connected, this research will concentrate on the development and questions regarding the adoption phase will be discussed when these are proven to be crucial for the method building.

The research starts with a comprehensive attempt to describe the semantic standards development process that has been used but never been documented before. This aims to guarantee the repeatability of the method and to identify the context in which it can be applied. Furthermore, the research aims to provide guidelines for the successful application in the future and to provide description of an improved method.

Considering the development period in a standards life, the main objective of this research can be formulated as a question.

How can the Pressure Cooker method be consolidated into a reliable method for the development of semantics ICT standards?

In the research, there are three main knowledge questions. Each knowledge problem consists of research questions. The table below represents the knowledge problems and the related research questions. For each research question, the research method is determined and the chapter, where it will be described, is stated.

Knowledge problem	Research Question	Research Methodologies	Chapter
A) What is the state of the art on semantic standards development?	What is the state of the art on semantic standards development in literature?	Literature review	2
	What are the characteristics of the current semantic standards development approach at TNO?	Documents, Semi-structured interviews*	3
	What are the current issues and challenges in standards development?	Semi-structured interviews*	4
B) What are potential improvements to the current standards development?	What are the expectations (requirements) for an improved development method?	Semi-structured interviews*, Survey	4

	What can be learned from the previous Pressure Cooker applications?	Content Analysis	4
	What are the potential improvements from literature that could be used for a new method in order to satisfy the requirements?	Structured literature review	5
	What should be the best length of a new method based on factors such as pure development time, group work and human factor?	Design research	7
C) How could an improved semantic standards development process look?	How should a new development method look like?	Design research	6
	Does the new development process meet the requirements?	Evaluation	7
	In what context is the new method applicable?	Analysis based on literature	5
	What are the areas for further research?		9

Table 1. Research objectives

*: the star indicates that the semi-structured interviews are the same ones.

1.2 Research methods

1.2.1 Overall methodology

We started with examining various scientific and commercial documents, which were published in printed and online forms, in order to get insight in the research field of standards development. This kind of preliminary literature overview made it clear that the current state of literature does not make it possible to create a semantic standards development process by combining the different documented approaches. Therefore, the research follows a different scenario, first focusing on the standards development process used by TNO in practice. TNO has already used the Pressure Cooker

method in three semantic standards development projects. The method that helped them to significantly fasten the development compared to the time-extended process, is called Pressure Cooker.

Based on the three aforementioned projects, we describe the Pressure Cooker method in practice. To do so, we used TNO documents and reports to identify the similarities and differences in the three different projects. Besides, for a deeper understanding, we conducted semi-structured interviews with TNO standardization experts, who were participating in these development projects. The result, model version 1, is capturing the practice of standardization when the as-is Pressure Cooker method is applied.

The figure below shows the design process. The design contains two iterations, result in two versions building on each other. Till Version 1, the method represents the standardization method in practice, Version 2 -the final product of the research- is an improved method.

The research is iterative which means that the final method is built through two rounds where the second was focusing on the refinement.

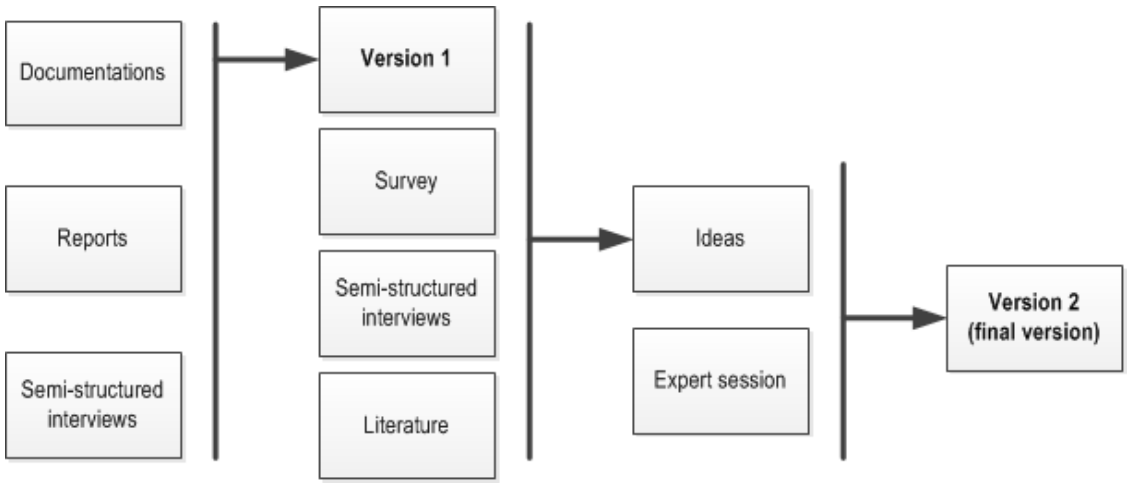

Figure 2. Method development

The starting point is the as-is method and then the research accumulates theoretical findings to improve the method. Focus shifts from practice more and more to theories in literature.

1.2.2 Literature review methodology

In the early stage of the research we came to realize that research on standards development, focusing on the development phase, is very limited. In research, the main interest is on the stakeholders` reasons in joining to a standardization approach. In order to gain as much insights as possible, the literature search has not been limited to often-cited peer-reviewed papers and often cited books strictly. Moreover, it has included publications of Standards Development Organizations (SDOs) too. This less formal method was used for exploring the prior literature.

After the current Pressure Cooker method had been described in a model and the issues with it had been identified, we aimed to find relevant theories and use these, in order to improve the method. To facilitate the theory search, a structured literature review method was chosen. The structured literature review was based on the 5 stage literature method proposed by Wolfswinkel, Furtmueller, and Wilderom (2013). From this method we executed the “Define”, “Search”, and “Select” stages.

The next chapter summarizes the most important finding in the literature of semantic standards development organized in four topics.

2 State of the art of literature on semantic standards development

In general a standard can be defined as a construct that is the result of reasoned, collective choice and agreement on solutions of recurrent problems (Tassey, 1999). More functionally, an industry standard is a set of specifications to which all elements of products, processes, formats, or procedures under its jurisdiction must conform. According to Tassey (1999), the process of standardization is the pursuit of this conformity, with the objective of increasing the efficiency of economic activity.

2.1 Semantic standards

A standard, in the simplest sense, is an agreed-upon way of doing something (Spivak & Brenner, 2001). Fomin et al. (2003) define a technical standard as an agreed-upon specification for a way of communicating or performing actions. The specifications usually progress through a series of drafts until they become the final standard (Nickerson & Muehlen, 2006). The most used definition of a standard is the one used by the ISO and IEC. This defines a standard as a document, established by consensus and approved by a recognized body that provides, for common and repeated use, rules, guidelines, or characteristics for activities or their results, aims at the achievement of the optimum degree of order in a given context (ISO/IEC, 2011). This definition can be disputed on the consensus and the approval by recognized body parts (Jakobs, 2006) because these points are not necessary valid in case of development by a consortium.

A company IT standard can be defined as a specification of an IT product or process to be repeatedly and consistently used in the company (Wessel, 2008). Standards at the presentation and application levels are often referred to as semantic standards, while standards below these levels are called syntactical standards (Löwer, 2005). Considering the OSI model, semantic standards reside at the presentation and application layer (Steinfield, Wigand, Markus, & Minton, 2007). Semantics deal with the meaning of signs, symbols, words and phrases (Brzezinski, 2010).

There are some different attempts to define semantic standards. According to Steinfield et al. (2007) semantic (Vertical-)IS standards are designed to promote communication and coordination among the organizations; these standards may address product identification, data definitions, business document layout, and/or business process sequences. Markus and Gelinas Jr. (2008) defines it as technical specifications designed to promote coordination among the organizations within (or across) vertical industry sectors. And Markus, Steinfield, and Wigand (2006) say that semantic standards

prescribe data structures and definitions, document formats, and business processes for particular industries.

As it can be seen, the definition of semantic standard differs in the different sources. In order to eliminate the existing terminological confusion, Otto, Folmer and Ebner (2011) proposed a comprehensive definition: “A Semantic IS Standard is an information model which is described by a language appropriate for the domain it is intended to be used in and the documentation of which is established by consensus of its addresses for common and repeated use. Being an information model, a Semantic IS Standard must specify the semantics of the objects which it contextualizes.”

2.2 Interoperability

Standards specify properties that a product must have in order to work (physically or functionally) with complementary products within a product or service system (Tassey, 1999). It was found that in the context of e-business, the lack of standards has caused difficulties for industry players in exploiting resources and coordinating activities (Choi, Raghu, & Vinze, 2004). Furthermore, the absence of standards made it difficult to build interoperable systems. The United States National Institute of Standards (NIST) estimates that, based on the results of a multi-method study conducted in 2002, insufficient interoperability among information technology tools costs the US capital facilities industry USD 15.8 billion annually, which is equivalent to 1-2% of the industry’s annual revenue (Gallaher, O´Connor, Dettbarn Jr., & Gilday, 2004). The majority of this cost was attributed to redundant data entry, redundant IT systems and IT staff, inefficient business processes, and delays indirectly resulting from these inefficiencies. Another US survey from 2007 suggested that software non-interoperability costs on average 3.1% of total project budgets (Young Jr., Jones, & Bernstein, 2007).

As it occurs with the definition of semantic standards, the literature provides various definitions for interoperability too. However these different definitions mostly describe the same phenomena.

The European Union defines interoperability in the European Interoperability Framework as the ability of disparate and diverse organizations to interact towards mutually beneficial and agreed common goals, involving the sharing of information and knowledge between the organizations, through the business processes they support, by means of the exchange of data between their respective ICT systems (European Commission, 2010). They define three aspects of need of interoperability: need of cooperation, information exchange and information sharing and reuse. For administrators in the public sector, businesses and citizens, interoperability results in improved service delivery and lower costs. Referring to any information that has direct meaning to the operational business of the organizations involved with the term enterprise information, enterprise interoperability is the ability of two or more organizations to share enterprise information in a meaningful and valuable manner (Oude Luttighuis & Folmer, 2011). (Inter-organizational) Interoperability means the ability of two or more organizational systems to exchange information, to interpret the information that has been exchanged and to act upon it in an appropriate and agreed upon manner (Rukanova, 2005). This research uses the interoperability term in the meaning defined by the European Union.

The ability to connect devices can increase their utility to end-users and the end–user can increase the utility of a product by connecting it to another one. Standards set specifications for components that make it possible to connect these components to each other (Wegberg, 2004). Standards ensure that users can enjoy of the benefits of connected products. There can be many examples from hardware-perspective to software-perspective. The existence of standards make it possible for a user to build a desktop computer from individual parts, for instance, to set up a computer with high performance. Besides, communication over internet using different devices such as PC, smartphone and tablets, would not be possible (or very difficult) without standards. The previous example shows communication between different electronic devices but obviously standards play essential role in linking the same kind of machines as well. Standardization and interoperability are important in value-generating process.

Companies always looked for the possibilities how to use technology to implement efficient business transactions (Rukanova, 2005). In the 1970's a new technical standard had been developed for computers. The Electronic Data Interchange (EDI) made the communication between computer systems reality. The benefits such as reduced number of errors, increased speed of information exchange and a significant cut in the costs made the EDI popular, although it had its disadvantages too. The biggest concern about EDI was the technical solution focus instead of business oriented focus. Because of the strict technical restrictions of EDI, the technology was more difficult to be implemented. EDI required developers with high expertise, which raised the cost of the projects. Extensible Markup Language (XML) is highly versatile, it can serve for the definition of almost any kind of structured data. (Löwer, 2005) EDI is hard to read for humans without any further support and the order and position of all bytes have certain semantics, which are hard-coded. XML has tree structure and it is using tags to define data fields. The software does not derive semantics from the position of the data field, but rather from the combination of the place and the name of the tag, which makes it much more flexible than EDI.

Later in the age of internet, a new interoperability opportunity has been arisen. The new dominant technology of data exchange is the XML since internet became widespread. The lower costs than what EDI provided, allowed even the small- and medium-sized companies to connect their computer systems and exchange information via internet. The standards, used in business-to-business transactions, are all XML-based infrastructures lately. XML satisfies the needs both of the users and of IT vendors. Users do not want to pay for another expensive IT investment to be able to integrate systems, therefore the low cost of XML-based solution is favored. Besides IT vendors want to retain control over their applications (Markus et al., 2006). XML-based standards are business-oriented, therefore they have greater chance to ensure the business process and the IT alignment.

Söderström (2004) mentions that the importance of semantic standards is in the communication between organizations. Figure 2 points out the possible roles of semantic standards.

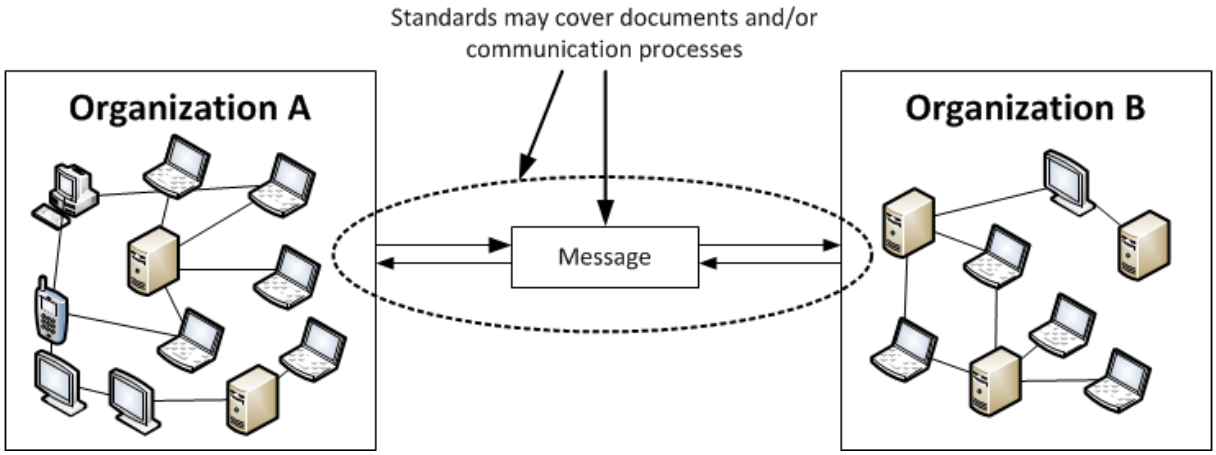

Figure 3 The role of standards in organizational communication (Source: Söderström, 2004)

Blind (2004) recognizes three functions of standards. First, standards provide information that reduces the transaction costs, corrects adverse selection and facilitates trades. The second function is fostering compatibility, which helps creating network externalities and avoiding lock-ins. Third, standards lead to variety reduction allowing economies of scale and build critical mass. The last point does not seem to be legit, because there is a large number of concurrent standards (Folmer & Verhoosel, 2011).

2.3 Development

The standards development processes can be classified as formal and informal standardization processes. Often the term Standards Developing Organization (SDO) is reserved for the formal development organizations, while Standards Setting Organization (SSO) includes all the organizations that develop standards (Spivak & Brenner, 2001). Standards are described as *de facto* standards when they are subject to proprietary technologies sponsored by a single firm or industry alliance (Pohlmann, 2012). Semantic standards developed by SDOs are *de jure* (Rada, 1993).

According to Choi, Kang, and Kim (2010), SDOs can be generally described as cooperative organizations that develop and/or approve standards based on formal agreements through communication, political negotiation and coordination among participants. Meanwhile organizations are called SSOs when they create standards only for a specific product field (Kexin Zhao et al., 2005). Especially in the IT field, SSOs are formed for each product technology and they create various standards. A disadvantage of the SSOs is that they can create different incompatible standards, and then some network externalities cannot be realized. As an advantage, SSOs can create standards in shorter time than SDOs. A larger number of members in the standardization is more likely to result a longer development time, because of the more difficult decision making. SDOs usually have more members than SSOs. SDOs must provide higher degree of compatibility to be attractive for companies, otherwise they cannot compensate the possibly longer development time (Wegberg,

2004). Traditionally, SDOs are considered more bureaucratic and SSOs are seemed to be more flexible.

The prior literature on the development of semantic standards is mainly concerned with the reasons for joining a standard development organization (Folmer and Verhoosel 2011) instead of the analysis of the standardization process. The research on development processes is still limited (Otto et al., 2011). One of the reasons of getting involved is to contribute and to orient the standard towards one`s own business practices (Zhao, Xia, & Shaw, 2007). According to the participation paradox, presented by Boh et al. (2007), the greater the number of stakeholders is, the more difficult it is to achieve consensus. The larger number of stakeholders slows down the process. On the other hand, involved stakeholders will be early adopters that makes the success of the standard more likely. Zhao et al. (2007) claim that the better and the faster a standard it is developed, the greater is the direct benefit for the developers. Being involved in the development of the standards helps to reduce future implementations costs, because it causes an increase in the understanding of the standard details. Backhouse et al. (2006) studied the stakeholders behavior after joining to a standards development; their work identifies how the participants' power and politics play a role in the standards development process.

De Vries (2003) defined standardization as the activity of establishing and recording a limited set of solutions to actual or potential matching problems directed at benefits for the party or parties involved balancing their needs and intending and expecting that these solutions will be repeatedly or continuously used during a certain period by a substantial number of the parties for whom they are meant. Rada (1993) states that the most important aim of standardization is to produce standards that are appreciated and applied. This statement is in alignment with the TNO experts' view. They consider a good a standard as a widely adopted standard.

Boh et al. (2007) described strategies used in the development of RosettaNet. RosettaNet is a standards consortium in the electro-technical domain. The RosettaNet's semantic standard solution allows trading partners of all sizes to connect electronically to process transactions and move information within their extended supply chains. The strategies are:

- Commitment of resources to the milestone program,
- Clear roles and restrictions,
- Validation beyond full implementation,
- Informal norms and social networks.

The lessons learnt from RosettaNet:

- Only involve the organizations that are committed to solving the problem,
- Use focused, quick, problem solving approach to standard setting,
- There is no one right approach for the standards development process, not even a full open approach.

In the MISMO case, Markus et al. (2006) pointed out a certain success factor for standard development. MISMO is a standard that was created to promote and support the common business interests of the commercial and residential mortgage markets. MISMO is a semantic standard for the financial domain. It is necessary to ensure participation of representative members of heterogeneous user groups, and avoid the natural tendency to splinter into rival homogeneous groups.

Werle and Iversen (2006) made four suggestions for the standard development process, based on observations:

- Openness to and direct representation (participation) of all actors interested in or potentially affected by a standard.
- Work in accordance to impartial and fair procedural rules.
- Decision-making should be based on consensus.
- All interests are considered in the standardization process.

Comparing nine different vertical standards, Nelson et al (2005) identified the key drivers, the differences and the similarities in the development processes of different vertical industries. The vertical industry term means that the semantic standard is developed for a certain industry-wide group by addressing their shared business problem. The Inter-organizational System (IOS) standards development methodology was set up to describe a universal process. Figure 3 presents the steps of the IOS development cycle.

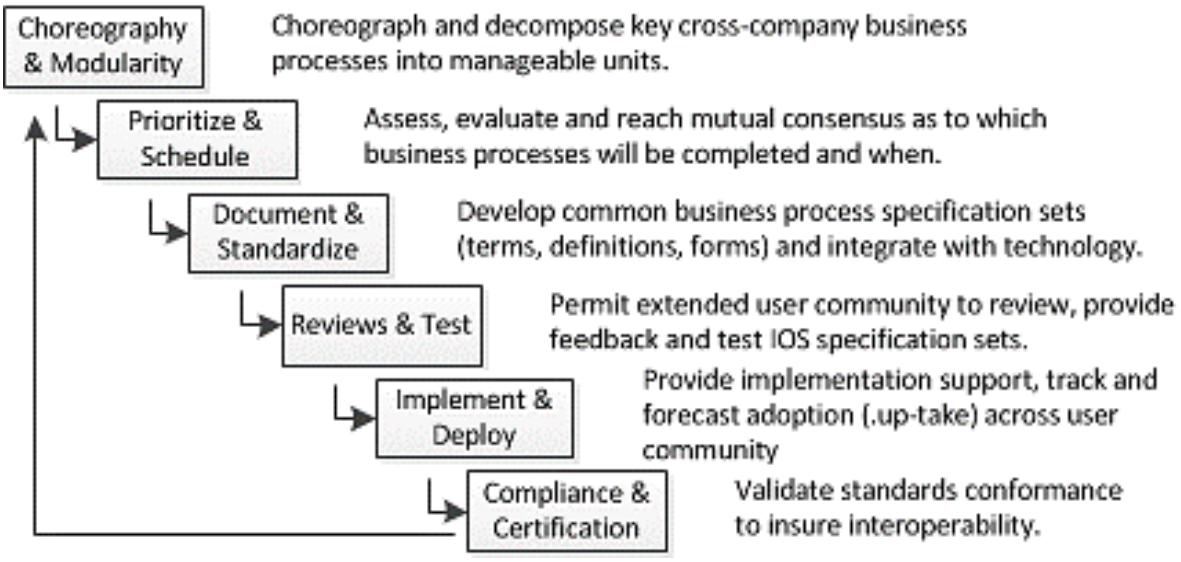

Figure 4 The IOS Standards Development Cycle (Source: Nelson et al., 2005)

The first two steps (Choreography & Modularity and Prioritize & Schedule) are meant to reach (1) the involvement of the important stakeholders, (2) the mutual consensus on the business processes that will be standardized and (3) the deadlines. There are two outputs of these steps. First, and overall project plan about the high-level business process flows that will be standardized. Second, there is a detailed project plan that determines the resource requirements, deadlines and sub-processes to be

standardized. The third step (Document & Standardize) in the cycle is the actual development of the standard. This step consists of the development and documentation of the result. The development is usually assigned to special work groups. As Nelson et al. (2005) describe, step 3 can be a laborious and time-consuming that lasts from weeks to months. The documentation typically includes version history, business process models and data flows, terminology, definitions, XML Schema, Document Type Definition (DTD) and sample XML messages. Step 4 (Reviews and Test) presents the reviewing and testing period of the draft version of the standard. Most of the consortia, which were compared in the building of the IOS Standards Development Cycle, provide extensive implementation and adoption support programmes (Step 5) and certifications (Step 6), therefore these steps are also included in the methodology.

Spivak and Brenner (2001) emphasize that the standard developing organization should keep in mind that the process they select must serve the industry and not the opposite. Löwer (2005) found another problem: Although there are many existing standards, still in a lot of standard development projects, the SSOs are reinventing the wheel and do not use each other`s results, which is clearly a waste of time and resources.

Considering that this research greatly deals with the development time of semantic standards, it is important to see what kind of findings are reported in the literature. The next part of the chapter summarizes these findings.

Table 2 shows the average development times at different standardization organizations.

ORGANIZATION	OASIS	OMG	W3C	CEN	ETSI	JTC1
TYPE	Industry Consortia	Industry Consortia	Industry Consortia	European Committee	Regional body	Regional body
AVERAGE TIME UNTIL FINALIZATION	16-24 months	12-15 months	Typically around 24 months	Varies, typically 1-2 years, the European Commission states 36 months in 2011 (European Commission, 2011)	Around 4 years	Up to 48 months

Table 2. Average development time at SDOs. Adopted from Jakobs & Kritzner (2009)

Van Wegberg (2004) explains the creation of consortia with the faster development time. According to him, when organisations are fed up with speed of formal standardization organizations, then one way to speed up the standard development process is forming a consortia Van Wegberg (2004) also adds that high level compatibility is not that important for a small community. These communities adopt a standard that is developed fast than a standard that provides full compatibility, therefore they do not mind to use a not widely adopted standard developed by a consortium. The value of compatibility is limited and the time-to-market feature has increasing importance.

In case of the alignment of interest established between technology providers and installed user base, a very speedy process of standards development in an informal standardization setting or a rapidly emergent de facto standardization may emerge (Choi et al., 2004). The traditional approaches tend to overestimate the universality of work practices, thus seeking order by simplification and abstraction and putting strong emphasis on design criteria such as consistency, completeness, and non-redundancy. In the case of IS standards-making, the closer the object of standardization is to local work practices, and the more knowledge-intensive the work practice, the less likely the traditional approach will succeed, possibly generating a reflexive self-destructive process (Hanseth, Jacucci, Grisot, & Aanestad, 2006).

2.4 Standards about semantic standards development

Currently, to our knowledge there are four standards on standards development. The ANSI/SES-1-2002 – Recommended Practice for the Designation and Organization of Standards, the SES 2:2006 – Model Procedure for the development of Standards developed by SES and the ISO/IEC Directives Part 1 and 2, Rules for the structure and drafting of International Standards provided by the ISO. Last, the British Standards Institution developed a standard for standards too. The following part will examine these standards aiming to recognize parts that could be used in the Pressure Cooker method.

The ANSI/SES-1-2002 – Recommended Practice for the Designation and Organization of Standards and the ISO/IEC Directives Part 1 and 2

ISO/IEC Directives Part 1-2, Rules for the structure and drafting of International Standards does not contain information about the development process, it is a template and list of rules for organizing meetings and creating a standards' layout. The same is true for the Recommended Practice for the Designation and Organization of Standards document from ANSI/SES.

SES 2:2006 - Model Procedure for the development of Standards

This document includes more practical descriptions and suggestions than the standard from ANSI-SES and ISO/IEC. The group sizes (Steering Committee and workgroup) are aimed to be kept low, in order for the work to be carried out in an efficient and effective manner, and with the objective of including individuals representing all points of view. The balanced perspective representation is also mentioned. Four stakeholder categories are identified, whom should be included. These are

a) System Integrator / Rental and Staging
b) Independent Consultants / Independent Programmers
c) Manufacturers / Independent Manufacturers' Representatives / Distributor
d) Technology Manager / Presentations Professional / Student

But the number of the participants from each category should be balanced in such a way that no single interest category predominates.

The decision making during the development is done by voting with four possible options. The options are

a) Affirmative
b) Affirmative with comments
c) Negative with reasons
d) Abstain
e) Abstain with comment

The decision making is consensus based therefore in the case of “Abstain” or “Abstain with comment” votes the proposal is rejected. With proposal meaning design decisions in the workgroup. Furthermore the reviewing process is done with the same voting scale.

British Standards Institution (BSI) – Standard for standards

The BSI suggests to organize live meetings for the stakeholders only in those cases when the task cannot be done in other terms. For example, teleconferencing is encouraged. Working groups, each managed by a Chairman appointed by the parent committee, are expected to work on the principle of consensus. The principle of consensus has its origins in the desire to achieve the general acceptance and application of a standard within its intended sphere of influence. This entails trying to ensure that the interests of all those likely to be affected by it are taken into account, and that individual concerns are carefully and fairly balanced against the wider public interest. If any political or commercial dispute arises during the drafting process and cannot be solved, the dispute is expected to be referred to the parent committee for resolution, rather than impede the technical work.

Reviews may be instigated at any time, either at the discretion of BSI or of the responsible technical committee. Whilst the responsibility for reviewing a standard lies with the appropriate technical committee, a public consultation is always a feature of the process and the views of the committee will be informed by any responses to it. These responses are particularly important for assessing a standard’s continuing fitness for purpose and market relevance. A review usually results in a standard being confirmed for continued use, withdrawn, or revised. A thorough revision can be a large-scale undertaking that requires considerable resource and commitment. In some cases, small-scale changes can be introduced by amendment. In cases where it is not possible to undertake an adequate review (e.g. due to the lack of appropriate expertise), the standard is usually withdrawn.

Besides resolving disputes in the workgroup, the Chairman’s tasks are

a) leading the workgroup, with the objective of establishing consensus on all matters brought to it for a decision
b) ensuring that a UK standpoint is established on international and European standardization matters
c) contributing actively to strategic planning of the committee’s activities
d) communicate with BSI
e) judgment without bias
f) ensuring that all those participating in the workgroup are encouraged and able to have their views heard and respected
g) in consultation and conjunction with the secretary

The secretaries are responsible for ensuring that all necessary administrative arrangements are made in order for a committee to function efficiently and effectively.

The role of members of a Steering Committee is to:

a) contribute their expertise and experience to the standardization project
b) represent the interests, aspirations and concerns of their respective nominating organizations

Table 3 summarizes the key findings from the BSI standard.

ELEMENT	PRINCIPLE
THE MEETING	Organize live meetings just when it is unavoidable
DECISION MAKING	Based on consensus In the case of unsolvable dispute in the workgroup, the parent committee is responsible to decide
STEERING COMMITTEE MEMBERS	Contribute their expertise and experience Represent their nominating organizations
CHAIRMAN	Resolving disputes in the workgroup Leading the workgroup Keeping contact with the Steering Committee Keeping contact with BSI
ASSISTANT/SECRETARY	Responsible for the administrative agreements
REVIEW	Considerable resource and commitment are needed. Small-scale changes can be introduced by amendment.

Table 3 Summary of the BSI standard

Learnt from the standards on standards development

Although the topic of all the examined standards is the semantic standards development, only two out of the four went beyond providing a list of terms and a suggested template to represent the standard. Therefore, in the lack of focus on the development process itself, the standards developed by ANSI-SES and ISO/IEC did not contain parts that could be used in this research. The standards provided by SES and BSI formed the base for the findings shown in the following list:

- Keep the workgroup size low.
- Make sure that wide variety of perspectives is present.
- Limit the number of live meetings.
- Use consensus in decision making.
- Make the Steering Committee responsible for the unsolvable workgroup questions.
- Allow small-scale changes without consensus
- Base the reviewing on consensus
- The Chairman's task: resolve disputes, lead, keep contact with Steering Committee
- The Assistant's task: administrative tasks

The Assistant's task is focused on communication with the workgroup members but the standards do not describe the tasks during the working sessions.

As it was mentioned and as this chapter found, the development of semantic standards is a barely investigated area in the literature. Instead of pointing out the development processes of the standard, the prior literature tends to focus on the involvement, preparation and adoption of the standards (Backhouse et al., 2006; Boh et al., 2007; Markus et al., 2006; Steinfield et al., 2007; Zhao et al., 2007).

2.5 Overall result

The following list points out the key advices of the prior literature regarding participation in a standard development effort. The list is adopted from Folmer (2012) and extended with additional findings.

- Involve the organizations that are committed to solving the problem (Boh et al., 2007),
- Involve the user-groups that have the greatest ability to influence adoption (Markus et al., 2006),
- Involve all stakeholder groups and assure that they do not drift apart during the development project (Markus et al., 2006),
- Create a social group of the participants (Charles W. Steinfield et al., 2007),
- Promote actively the further participation (Charles W. Steinfield et al., 2007),
- Increase the perceived benefits from consortia participation activities (Zhao, Xia, & Shaw, 2011),
- Keep the group size low ("BSI Standards Publication A standard for standards – Principles of standardization," 2011),
- Use consensus in decision making (ANSI & SES, 2002),
- Make the Steering Committee responsible for the unsolvable workgroup questions ("BSI Standards Publication A standard for standards – Principles of standardization," 2011).

As the list shows, the participation in the development has been extensively examined but there is a lack of research about other aspects of the development. Practical advices are rare, the recommendations are usually abstract.

3 The characteristics of the TNO standardization methods

This chapter describes two semantic standards development methods applied at TNO: the time-extended method and the Pressure Cooker method, which is used to reduce the development time. We investigated and modelled both methods to be able to identify the key differences. First, it is described how the models were created, then the methods are described separately. In the end of the chapter the two different approaches are compared.

3.1 Development of the as-is Pressure Cooker model

TNO applied the Pressure Cooker method in three projects until the spring of 2013. In order to describe the characteristics of the current Pressure Cooker semantic standards development approach, these projects served as the base of the first model.

There were three semantic standards development projects using the Pressure Cooker method when the research was in progress:

- STOSAG (garbage collection),
- EBA (waste transport) and
- Digitale Rotonde (ground cables).

Information sources

The available written documentations from the projects were project plans, scope documents, preparation information, planning of the high pressure weeks, presentation slides, working documents, drafts, draft versions with feedback, and final reports. However, the different written information sources usually covered slightly different parts of the projects, therefore semi-structured interviews were conducted to fill in the gaps and clarify the upcoming questions. The information gathering from the written sources are represented in Table 2.

	STOSAG	**EBA**	**Digitale Rotonde**
Project plan	Interview	Documentation	Documentation
Scope document	Interview	Documentation	Documentation
Preparation information for the high pressure week	Documentation and Interview	Documentation and Interview	Interview
Planning of the high pressure week	Documentation	Documentation	Documentation
Presentation slides	Documentation	Documentation	Interview
Working documents	Interview	Documentation and Interview	Interview
Draft	Interview	Documentation	Interview
Draft version with feedback	Interview	Documentation	Interview
Final report	Report	Report	Report

Table 4 Sources for the Model 1.

A design decision was made at this point of the research. Some experts used the Pressure Cooker term to cover the whole standard development process, others referred to the term as the working week. To avoid misunderstanding about the Pressure Cooker term, the model refers to the working week as the high pressure week. Meanwhile, the Pressure Cooker method means a broader part of the development process. In our work, we will consistently use the Pressure Cooker and the high pressure week terms as it has been just described.

For the representation of the current method of semantic standards development, we chose to create a process model. Humphrey (1989) claims that repeatable software development process is a key component in the development of high quality software. The author continues, ''implementing a repeatable process ensures that all of the necessary development tasks get completed, and in the correct sequence''. According to the author, in order to make a process repeatable, it needs to be documented so that project stakeholders can adhere to the process. Humphrey (1989) adds that in the field of software engineering, it is common to document a process by means of a process model. To ensure the repeatability of the Pressure Cooker concept, we decided to represent it with a workflow of processes.

Besides filling the information gaps, the interviews aimed to gain information from the practical perspective. For the interviews, the selection criterion was that an interviewee had to be a standardization expert who was involved in at least one Pressure Cooker project. This requirement resulted in a list of five names. Because interviews are costly time-wise, three face-to-face interviews were conducted. The semi-structured format was chosen to foster the interviewees sharing their opinions and thoughts about the Pressure Cooker method without boundaries. After identifying the role of the expert in the projects, the interviews, which took place between December 2012 and March 2013, started. The first couple of questions were open-ended questions about what the interviewed experts' reasoning were on the current form of the method and the future possibilities. When interviewees could not come up with any more own thoughts, we asked them to discuss the questions, we had prepared beforehand. The interviews last around 60 minutes. We were continuously taking notes during the sessions and extended the notes into text right after the interviews to capture the overall context. The interviews were not recorded and therefore transcript was not written, but to validate the text written down after the session, the interviewees received these documents for reviewing. Interviews 3, 4, 5 were actively used in the refinement of the first Pressure Cooker model.

The written documentations and reports of the projects and semi-structured interviews with the standardization experts who were participating in these projects, were used in order to build the 'as-is' model. The written sources helped to recognize the processes, the stakeholders, the events, and the input-output of the processes and more generally to get most of the picture of standards development. In cases, where the written sources did not provide sufficient information or proved to be inconsistent, the interviews came into the picture. The interviews with standardization experts clarified the missing or conflicting parts of the Pressure Cooker model. This model is called version 1, expressing that is describing the current process without proposing improvements.

3.2 The Pressure Cooker

The idea behind the Pressure Cooker is 'why can't we develop a standard in one week? We then put the experts together for a full week and with good preparation and afterwards some decent reviewing we should be able to achieve a standard with 80% quality'. An **80% data standard** can be defined as a standard that covers only the main process and does not include the possible exceptions. Besides, an 80% data standard usually includes many optional elements that would not be part of a 100% standard. This second feature is the result of the harmonizing process during the short development time. If someone wants to include an element that is not refused by the others during the high pressure week and the reviewing process, then it gets included in the standard. So no quest for the perfect standard, but delivering a standard that is good enough to test in pilot settings and improve afterwards. Key is the quality and commitment of the workgroup who gets the responsibility of achieving results within the week. Although time-extended approaches also work with workgroups, the intensity within the Pressure Cooker is key, just as the separation of concerns between the Steering Committee, workgroup members, and the standardization experts (Chairman and Co-pilot) who guide and lead the Pressure Cooker.

The Pressure Cooker model contains 13 activities and is depicted in Figure 4. The following part will state the actors involved, their respective task, as well as the input and the output of the all the activities. One should bear in mind that the Pressure Cooker method was applied in informal standardization processes so far.

There are four actor roles recognized in the standard development. Obviously, there is an organization that combines the interest of the stakeholders who have a shared business problem. The different possible forms of this organization are out of the scope of this paper. The organization, whatever the form of it is, is called Steering Committee in the model later on. The standard development is traditionally done by a workgroup. This group is also included in the model, and their task is the same, but they work under special conditions compared to the time-extended standards development. They have to develop the standard in one week. The third and fourth actor roles in the model are standardization experts. They guide the Steering Committee, manage and coordinate the work of the workgroup and finalize the documentation of the standard. Two experts participate in the Pressure Cooker projects. Their tasks differ during the high pressure week. The Chairman moderates the discussions and manages the work to make sure that the process goes as planned. The Chairman is also responsible to ask questions that help the group`s work. The second expert, the Co-pilot, continuously captures the information discussed during the high pressure week and records them in models. Ultimately, the standardization experts are responsible for the delivered standard after the high pressure week.

In a Pressure Cooker project, the development and maintenance of the standard is under a Steering Committee`s control. The Committee manages and coordinates the development and management of the standard and they choose the Workgroup members as well. The Committee members are the stakeholders of the standards; originally the different parties have a shared business problem that calls for the development of a standard. The members want to use standards to make their business easier, simpler and more effective by achieving interoperability.

The three projects, which we investigated to build the Pressure Cooker model, all started without an existing Steering Committee. This means that first a Steering Committee had to be set up, therefore we included the most important steps in the model from the beginning of the standardization effort. The standard development process with Pressure Cooker method is shown on Figure 5.

1. Setting up Steering Committee

Actors	Different stakeholders who are connected by a shared business problem
Task	Responsible for the development and management of the standard
Output	Operational and financial plan of the committee

The first activity determines four important aspects, the form of the organization, the members, the operational plan and the financial plan. The organizational form can be foundation, association or government organization and it does not influence the Pressure Cooker method. The Committee has to agree on the operational and financial plan in the beginning. The operational plan describes the way of doing their work including regulations of decision making, administrative work, and control type. The latter needs decisions on the financial support of the organization. Typical topics are membership fee, estimated costs, and price of the standard.

The Committee manages and coordinates the development and management of the standard and chooses the Workgroup members too.

2. Decide on scope, set up planning, select the members of the Workgroup

Actors	Steering Committee members
Task	Common goal
Output	Scope document version 1, Schedule, List of Workgroup members

At this point, the Steering Committee has to decide whether they want to use the Pressure Cooker method for the development of the standard or not. Moreover, the Committee has to define the scope of the standard they want to be developed. The agreement on the scope ensures that all the stakeholders know what the problem is and what the business process, where the standard should provide interoperability, is. When the scope is determined, the Steering Committee has a signing event, where they express their commitment to the project. The scope document makes the list of requirements clear and shows what the solution does not have to cover.

After the scope has been clarified, the Committee sets up the planning for the development. They decide on the starting time and the dates of milestones. The milestones are the date of the draft version, the date of review, the date of delivery to the Committee and the date of the final standard.

The planning is the key to be able to provide the standard for the pilot or adoption in time. The period for the high pressure week is also selected by the Steering Committee, but this can be slightly changed later.

Finally, the Steering Committee, with the active involvement of the Chairman, selects the members of the workgroup. In the selection process, the Committee aims to put a group with diverse knowledge together. In the end, they choose, 10-15 participants with business and/or technical knowledge. If the Committee finds the set of knowledge in the group not sufficient, they invite other participants to meet the needs.

The working group is a group within the standardization community with a demarcated sub-activity with a clearly defined end result as its objective. The members of the workgroup are selected by the Steering Committee and the workgroup develops the standard for the Committee.

The second activity of the model normally takes around 1 month, but this period highly depends on the Steering Committee members. If they see the crystal clear goal and can agree on it easily, than the agreement and plans can be done in shorter time.

3. Information meeting with the standardization experts

Actors	Steering Committee representatives and standardization experts
Task	The Steering Committee has to collect documents with information that is essential for the standard, Scope document
Output	Better understanding on and sufficient information sources for the development

As preparation for the information meeting, the Chairman asks the Steering Committee to collect all the available information about the standard and the business environment, where it would be implemented. Besides the aforementioned documents, the Steering Committee representatives also present the scope document, which they defined for the standard.

Obviously, the experts do not know the business environment in details, therefore they use the information from the Steering Committee to get known the environment and the business processes that might play an important role in the standard development.

In total this activity can take up to two weeks, including the preparation and the information meeting, which takes one day.

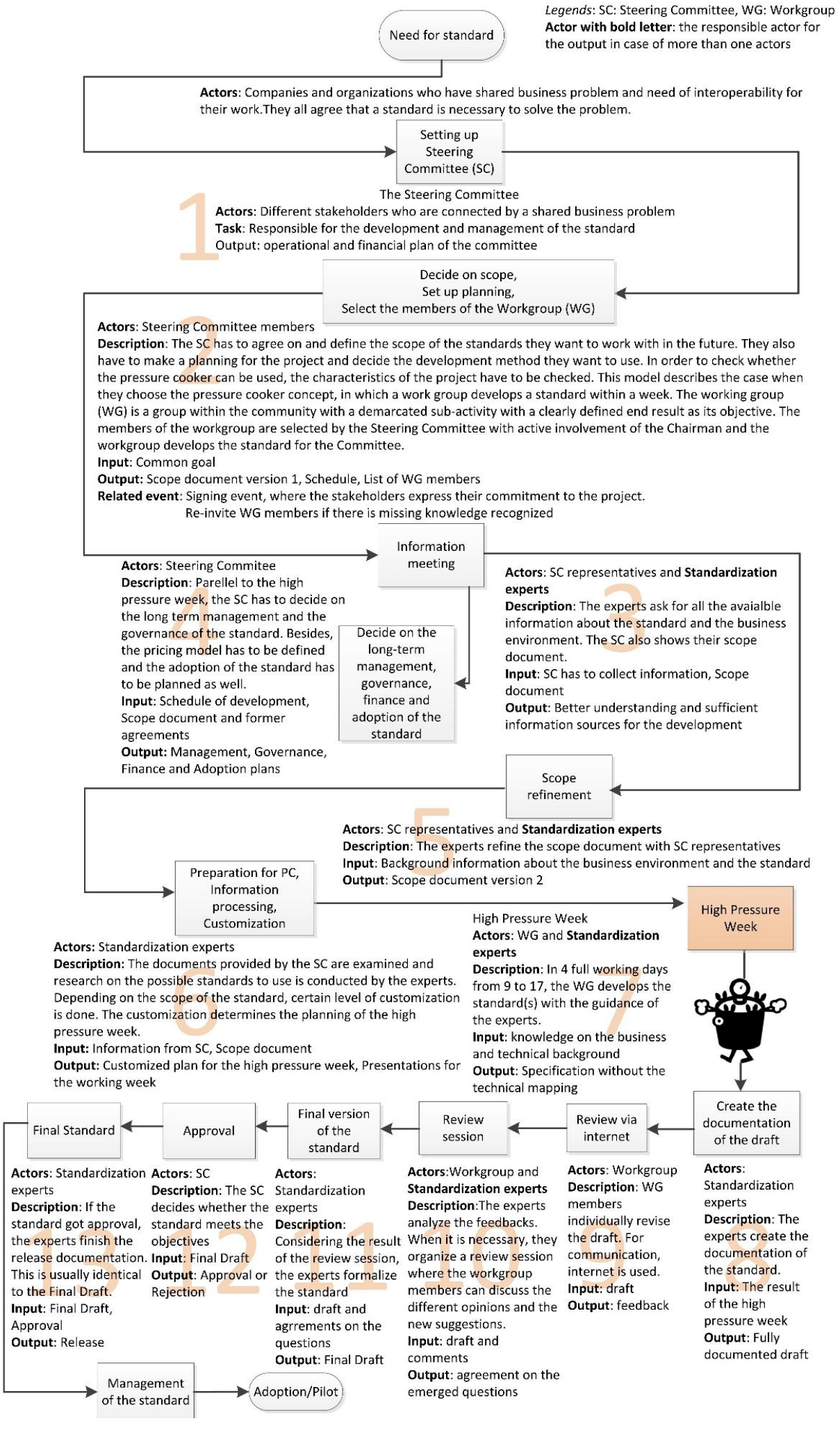

Figure 5 The Pressure Cooker

4. Decide on the long-term management, governance, finance and adoption of the standard

Actors	Steering Committee
Task	Schedule of development, Scope document and former agreements of the Steering Committee
Output	Management, Governance, Finance and Adoption plans of the standard

This activity occurs parallel with the high pressure week in time. The Steering Committee has to finalize their plans with the standard. They have to decide on the long term management and the governance of the standard. Besides, the pricing model has to be set up and the adoption of the standard has to be planned as well. The questions, they have to decide on, can be summarized as:

Management: Who, how and what will do with the standard?

Government: Who and how can decide on the future of the standard?

Finance: Who, when and how much have to pay for the standard?

Adoption: Who, when and how will start the diffusion of the standard. Consider the use of a pilot project.

The Management and Development Model for Open Standards (BOMOS) model (Folmer and Punter 2011) is used for inspiration to answer these questions.

In ideal case, the Steering Committee should be done with these decisions by the end of the high pressure week in order to provide seamless process for the standard in the future. Previous practice showed that a delay in the deadline would lead to delays in the standard diffusion. Uncertainty does not help, the Steering Committee has to try to mitigate it by reaching consensus in time.

In order to agree on the management, governance, finance and adoption of the standard, the Steering Committee can start the discussions a week before the high pressure week. This also means that they have two weeks to produce the output of this activity.

5. Scope refinement

Actors	Steering Committee representatives and standardization experts
Task	Background information related to the standard and the business environment, Scope document
Output	Scope document version 2

By this step, the experts checked the information and scope provided by the Committee. Two Steering Committee representatives and the standardization experts refine the scope together. This

refinement makes sure that the standard development is feasible with the Pressure Cooker method and it is possible to develop it within the high pressure week. The scope document has to clearly state the boundaries, and the parts of the business process that must be included in the standard. In practice it was experienced that it is good to point out processes that are not in the interest of the standardization as well. This decreases the likelihood of getting out of the scope during the discussions of the high pressure week with the workgroup.

Without the preparation time, the meeting takes only one day. With the preparation, it takes 1 week.

6. Preparation for the high pressure week, information processing and customization

Actors	Standardization experts
Task	Information provided by Steering Committee, Scope document version 2
Output	Customized plan and presentations for the high pressure week

The Chairman and the Co-pilot read and analyze the information provided by the Steering Committee in details. Based on the scope and their understanding on the needs and background, they make the planning for the high pressure week. The planning gives opportunity for some sort of customization. The type of standard can influence the time needed for the Business Domain Model or for the Information Model. The experts decide on this question and schedule the week according to that.

Furthermore, the experts do their preparation for the working week too. They prepare presentations and supporting tools. The experts need one week to get ready to the high pressure week.

7. High pressure week

Actors	Workgroup and standardization experts
Task	Knowledge on the business and technical background, prepared materials for the work
Output	A standard draft without technical mapping

Activity 7, the high pressure week, is the core of the Pressure Cooker method. This week gives a quick first step in the standard`s life by decreasing the development time to one single week.

Figure 6 represents the activities in the high pressure week. The dashed stroke in the figure shows the activities within a week. The high pressure week consists of four main steps.

First, there is the Kick-off. The Kick-off covers the welcoming and the introduction presentations. The first presentation introduces the Chairman, the Co-pilot, and the workgroup members. Later a Steering Committee representative presents the background and the goals of the whole project. This

presentation places the upcoming work of the group into a broader context. Afterwards, the Chairman presents the goal and the schedule of the following days and explains the game rules for the work. The rules, shown in Table 5, are simple, but necessary for success.

Strive for consensus
Everyone has to be ready compromise
The time is limited, the participants must restrict themselves
The issues that cannot be solved immediately are written down and discussed later, this is the so-called "Parking lot"
The Steering Committee is available in case of 'emergency'
Everyone is expected to focus on this project during the week

Table 5 Game rules for the high pressure week

Second, the workgroup has to identify the roles in the business environment. The tasks and activities have to be determined for each role. If the process is relatively straightforward and there are not too many different scenarios, then the workgroup builds the process model too. Afterwards, the information exchange points and the exchanged messages are identified. Creating the Business Domain model starts on the first day, and depending on the customization, can be continued on the second day of the high pressure week.

Third, on day 2-3-4 depending on the customization, the workgroup creates the Information model. The terms and definitions for each message element and the business rules are defined during these days. Fourth, the workgroup agrees on the Technical requirements on the last day.

The high pressure week does not include technical mapping. Those issues, which emerged during the past days and are still valid, are discussed here.

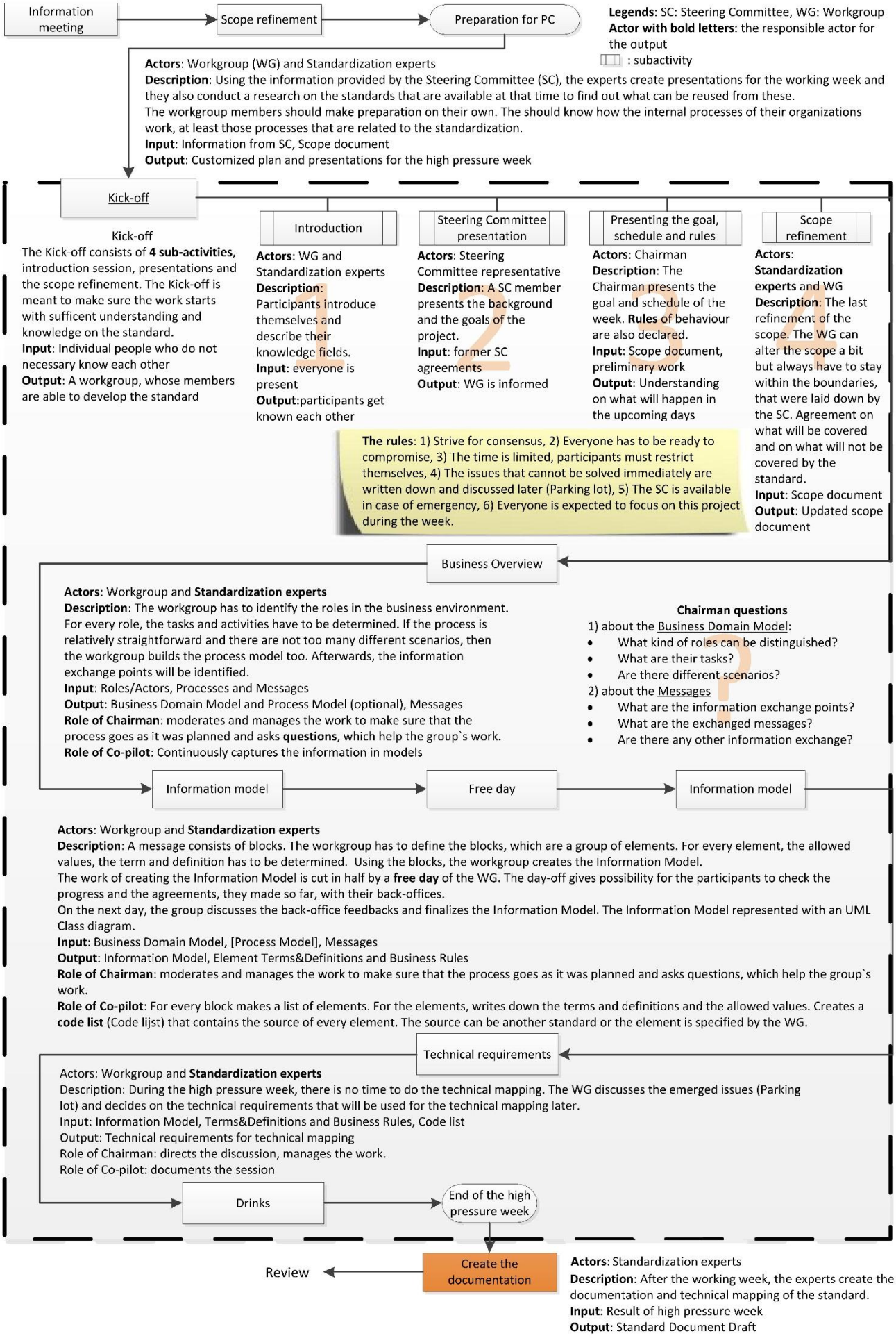

Figure 6 High pressure week

8. Create the documentation of the draft

Actors	Standardization experts
Task	The result of the high pressure week
Output	Fully documented draft

After the high pressure week, the experts create the documentation and technical mapping of the standard. Right after the high pressure week, the experts finish the documentation in 2 weeks. In this step, additional experts can be involved in the project to fasten the work.

9. **Review via internet**

Actors	Workgroup members
Task	The draft version of the standard
Output	Feedback on the draft

The workgroup members individually revise the draft. Internet is used for communication. This makes the information gathering easier and decreases the response time compared to reviewing of printed documents. The workgroup members have 2 weeks to do the review and send their comments.

10. Review session

Actors	Workgroup and standardization experts
Task	Draft and comments
Output	Agreement on the emerged questions

The standardization experts analyze the workgroup's feedback on the standard. They organize a review session where the workgroup members can discuss the different opinions and the new suggestions. The meeting takes place on one day, but with the preparation, the activity takes a week.

11. Final version of the standard

Actors	Standardization experts
Task	Result of the review session
Output	Final Draft

Using the result of the review session, the standardization experts finalize the standard and its documentation. This process takes up to 1 week.

12. Approval

Actors	Steering Committee
Task	Evaluation of the Final Draft
Output	Approval or Refusal

When the standardization experts finish the work on the standard, they deliver the final draft to the Steering Committee for approval.

The Steering Committee usually makes the decision in a week.

13. Final standard

Actors	Standardization experts
Task	Make minor changes and finish the standard
Output	Release

In the case, the final draft has been accepted, the standardization experts put the documentation of the standard in the final form. If minor changes without the need of another approval are suggested by the SC, these are done in this activity.

The model does not include the case, when the SC refuses the final draft, because that event could be followed by a few different scenarios depending on the cause of the refusal.

Management of the standard

This final standard (called Release) is usually used for pilot projects first. From now on, the Steering Committee has the responsibility to decide what to do with the standard. If step 4 has been successfully done, then there are no open questions about the management at this point.

3.3 The time-extended standards development method

This chapter will describe the time-extended method (Figure 7 and 8) to be able to point out the unique parts of the Pressure Cooker method. The model was created with an intense work session with a standardization expert. After the first sketch had been visualized, three iterations were rolled out. In every iteration, the standardization expert investigated the model and gave feedback on the work. The method behind the model of the time-extended standardization process has been applied in several cases at TNO.

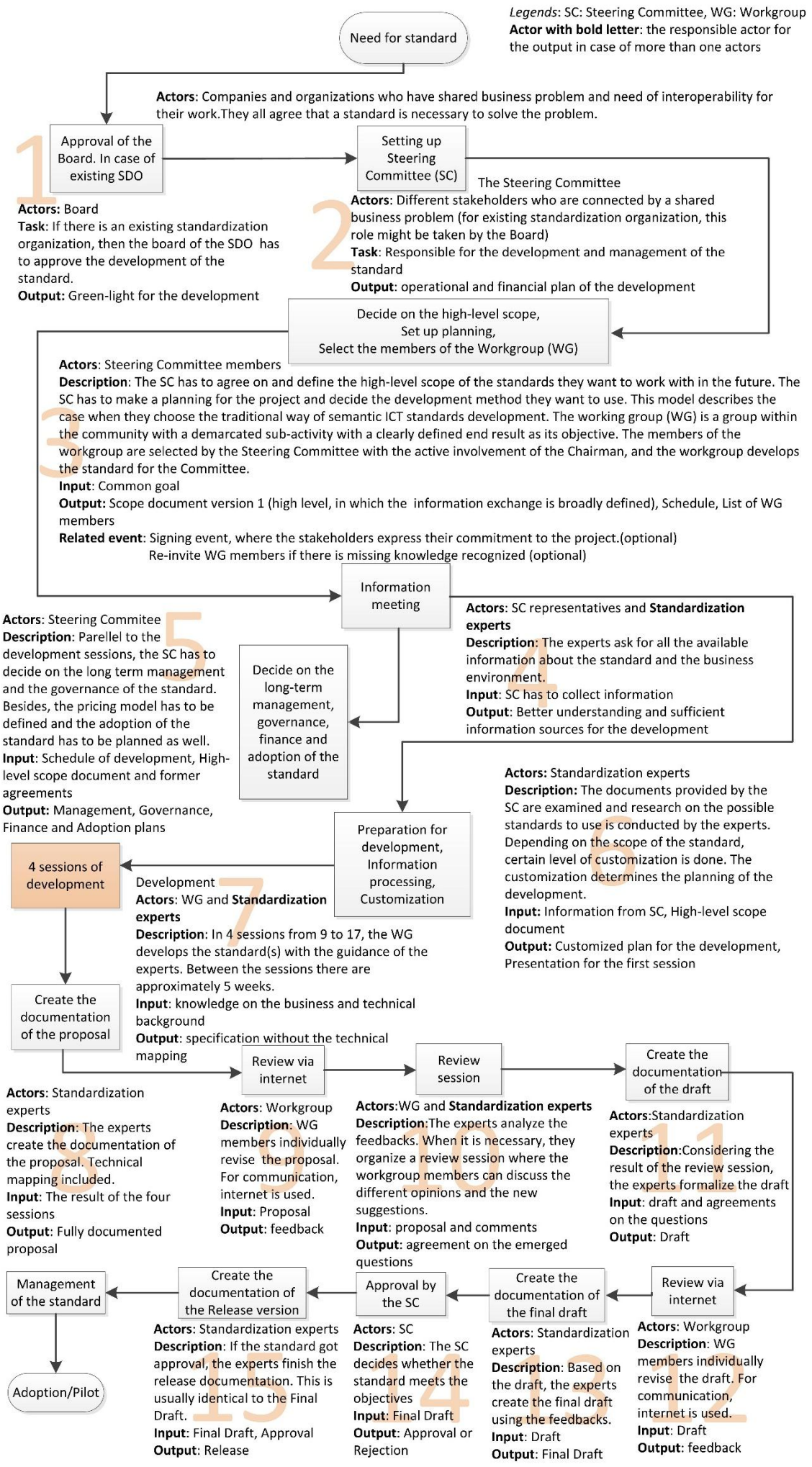

Figure 7 The time-extended standardization process

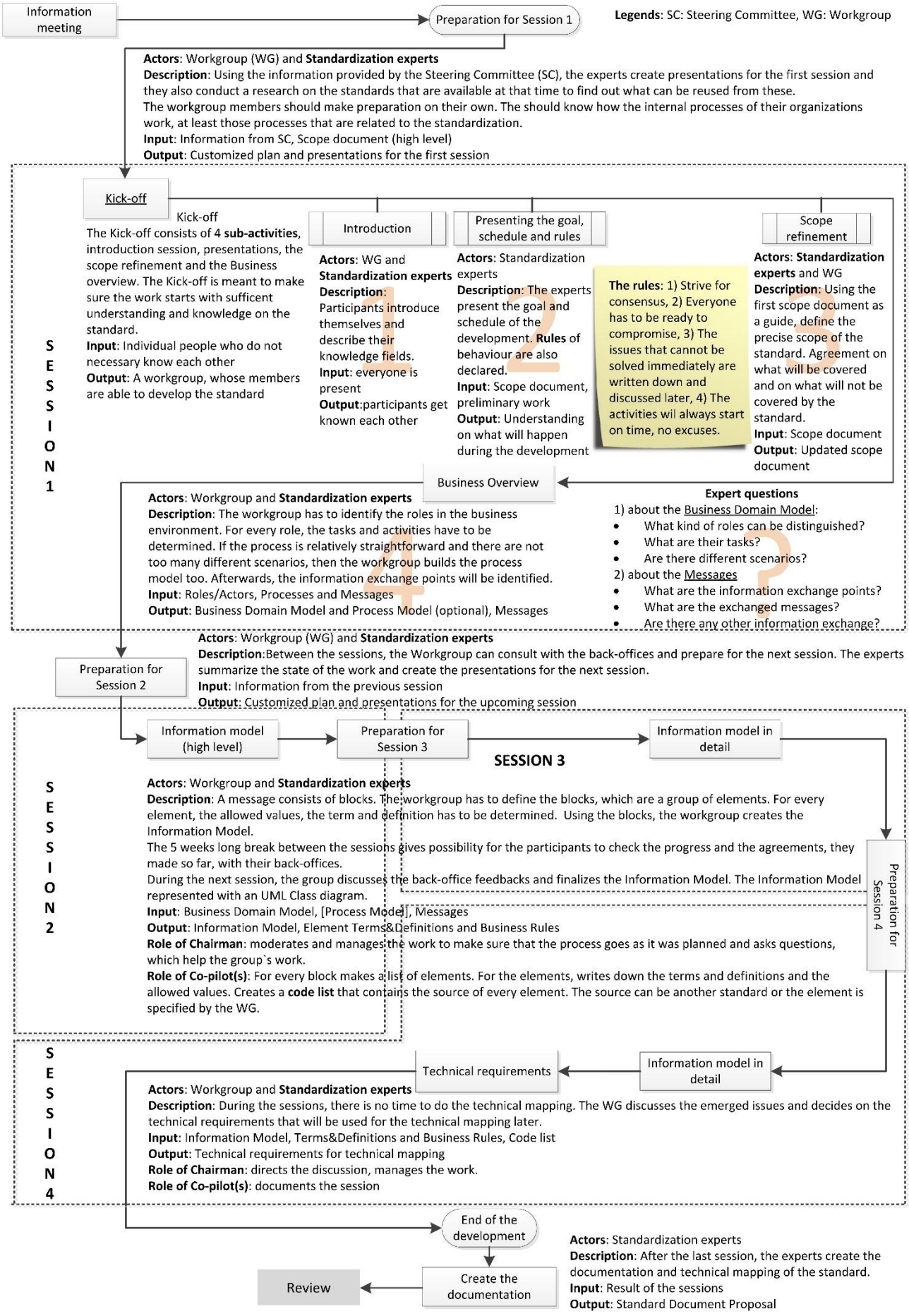

Figure 8 The time-extended standardization process - work sessions

3.4 The comparison of the as-is standardization methods

Carefully comparing the two methods, it can be slightly surprising that the activities and the order they are following are more or less the same in the different models. And still, the time-extended method takes long months to be finished, meanwhile the Pressure Cooker can be finished in 15 weeks without taking planning buffers into account. In the reality, the 15 weeks are not achievable as the Pressure Cooker has to include extra buffer time between the activities. However, even if it is just in theory, in 4 months the standardization could be finished. In the real applications, the Pressure Cooker took 6-8 months, which is still at least 10 months faster than the EU's directive (European Commission, 2011).

A question can come up then "But what makes the difference then?".

The largest difference is between activity 7 from the Pressure Cooker and activity 6 from the time-extended method. Activity 7 takes only a week, 4 full working days, activity 6 in the other model has a timeframe of months. In this case, 4-5 weeks of break occurs in-between each work sessions. So compared to the time-extended method, the uniqueness of the Pressure Cooker is the very intensive working week, the high pressure week.

Further differences appear to be always related to the different work sessions in the models. These differences are:

- **Activity 1** is different in the two models, but actually the activity shown in the time-extended model could be part of both models. However to keep the process easy to understand, it was left out from the Pressure Cooker model.
- The first real difference occurs at Activity 3 in the time-extended and at Activity 2 in the as-is Pressure Cooker models. The Pressure Cooker method includes a way **shorter development work**, therefore the scope is defined in a more detailed level before the workgroup starts the work. In the time-extended method, there is **more time to refine the scope** even in the first work session. Besides, in order to achieve the more detailed scope definition before the development starts, the Pressure Cooker method includes **an additional activity, the scope refinement**.
- In Activity 6 (both models) the difference is that in the case of Pressure Cooker the standardization experts **prepare the presentations** and the **schedule** for the entire development week, and in the other case, they work these out in details only for the first session.
- During the time-extended standards development process, the Steering Committee has 3-4 months **more time to deliver the output of the Activity 5**. Meanwhile applying the Pressure Cooker method, the deliverables (Activity 4) should be finished latest in 2-3 weeks.
- The largest difference between the two methods is **the length of the workgroup's work**. The Pressure Cooker method has **1 week** for it and in the time-extended method, the workgroup finishes the development after **4-5 months**. The steps of the development processes do not differ too much. The Pressure Cooker does not include 4-5 week long breaks between the work sessions, but the activities in the two development processes are very similar. Additional small changes are:

- **The Kick-off** involves 4 activities in the Pressure Cooker. The time-extended method does not include a presentation of a Steering Committee representative.
- Besides, there are four **rules for the development sessions** instead of 6. The Pressure Cooker has two more rules to foster the work under pressure.
- In the Pressure Cooker, **the sessions are following each other**, the development is finished within a week. In the time-extended method, **there are 4-5 week long breaks between the sessions** and the preparation for these does not happen upfront the first session, but always before the particular session.
- The Pressure Cooker method includes **one free day during the week**. The time-extended approach has **each session separated**.

- The high pressure week **results in a Draft** and the time-extended work sessions **result in a Proposal.** This difference influences the follow-up reviewing process. Applying time-extended method includes an **additional reviewing round** that is left out of the Pressure Cooker. It is left out because the objective of the Pressure Cooker can be reached without one more reviewing activity.

4 Current issues, challenges, expectation and requirements for a new method

4.1 Issues and challenges in the as-is model

In order to identify existing issues in the as-is Pressure Cooker, the practical experience of the workgroup participants and the standardization experts were examined. An online survey was deployed to capture the perception of the workgroup members and semi-structured interviews were applied for the expert interview. The following subchapters describe the way of information collection and the findings for both sources. Afterwards, the combined results are grouped and represented as major and minor issues.

4.1.1 Survey

The questionnaire was designed to survey the workgroup members' impressions and experiences of the high pressure week mainly focusing on group setting, satisfaction, and work related questions. The questionnaire was administered online on the 1st of March in 2013 to a population of 50 persons, who were participating in one of the three Pressure Cooker projects. Because the initial list of participants included a little involvement error, seven recipients have been removed and the size of the final population became 43 later. The root of the error was that the original list also included a few experts and Steering Committee members, who were not the target group of the survey. In the end, twenty-seven valid responses were received. This is 27 out of 43, 63% of response rate.

In order to make the survey capable to gain valuable insight from the former workgroup members, we decided to create a model with variables (Appendix C) that cover the important aspects of the

high pressure week. To do so, the survey drafting principles were followed from Blumberg, Cooper, and Schindler (2011). Survey questions addressing the variables have been formulated based on the model. Research on communication (Louhiala-Salminen & Kankaanranta, 2012) showed the role of the language in enhancing knowledge sharing and in the development of trust between communicators. It was found that the aforementioned factors can be addressed better by using native language instead of English in the response collection. Based on this finding, the survey prepared for the Workgroup, has been translated to Dutch, in order to eliminate the language barriers. The translation was done by the secretary of the TNO Enschede office and to make sure that the field-specific terms are formulated without losing the researcher's meaning, a standardization expert from TNO proofread the translated list of questions.

The invitation for the survey were sent out to the workgroup members via email and the responses were collected in an online survey system. The invited parties had time to fill in the survey between the 1st of March and the 21st of March in 2013. The sample size was 43 and 27 responded till the closing time. This means 63% response rate. Although the sample size seems small, one should keep it in mind that the Pressure Cooker projects did not have a large number of participants. The original survey and the results in Dutch can be found in Appendix D. Although the survey was sent out in Dutch, the results were translated back to English for the research.

4.1.1.1 Results

Group setting:

33% of the respondents claimed that they are business-oriented, 22% of them claimed to be technical-oriented and 45% considered themselves to have knowledge in both sides. This shows that a bit more business knowledge was represented in the workgroups. Although this does not seem to be a problem, because most of the respondents (74%) agreed that the mix of knowledge was good and it is also clearly shown that the necessary knowledge was present in the workgroup (70% agreed). Roughly half of the people thinks that the size of the group was good (48%) and the other half thinks it was too big (52%). The STOSAG group was the only one, where more members felt the group size right than too large. This is interesting, because there were no significant difference between the group sizes in the three different projects. Although the STOSAG was the first Pressure Cooker project ever and the time could influence the respondents more than the other two groups.

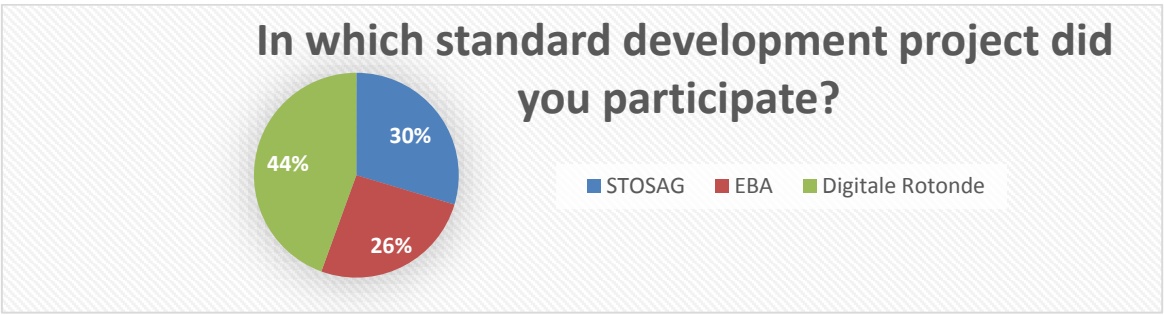

Figure 9. Respondents from the three projects

Figure 10. The background of participants

Scope document:

The scope document provided by the Steering Committee was found to be helpful or extremely helpful by the majority (67%) and roughly the rest (26%) considered it being all right.

Planning:

According to the respondents, the planning of the week is sufficient (78%). Most (70%) found it easy to keep track of the actual status of the work during the week. Neglecting the technical mapping in the high pressure week proved to be supported by the workgroup members (63%). There was only one participant with business background who did not agree at least partly with the lack of technical mapping. This was a Digitale Rotonde workgroup member, who strongly disagreed with the statement. This might be not that surprising, considering that this project used VISI instead of XML technology. VISI has many special rules and restrictions, which made the technical requirement setting more difficult than in the other projects. 33% of the business representatives agreed and another 33% of them strongly agreed that the technical mapping is not necessary in the high pressure week. The result is a bit different among technical representatives of the workgroup. Till three out of six did not mind the absence of technical mapping at all, there was one respondent, who partly accepted it, and two members, who missed it. The last group of the workgroup members, those who are representatives of the technical and business sides too, did not miss the technical mapping from the work. The majority (67%) absolutely and the rest (33%) partly agreed on not to include it. The 4 work-day length of the high pressure week was generally considered as right by the majority (70%).

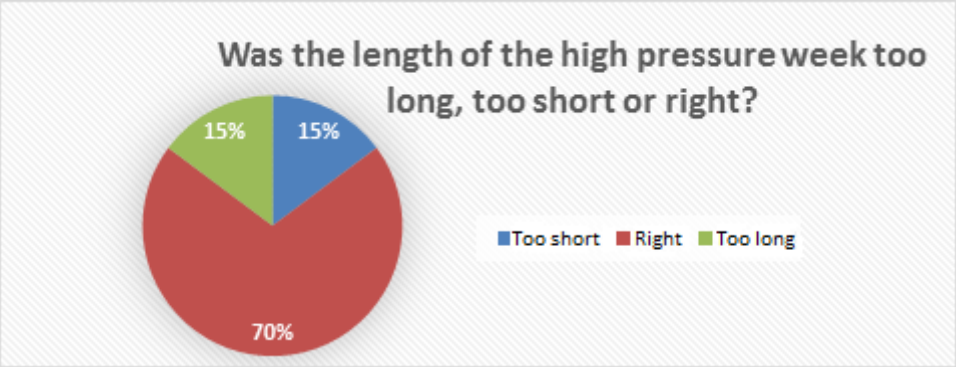

Figure 11. Opinion on the length of the high pressure week

The last day of the working week was considered sufficient and good. Those who call it productive, are referring to the reviewing of what had been done in the previous days. One person said that it was especially useful for those, who did not feel comfortable with thinking in abstract level, to see the result together. This person was indicating that he was in general not that good in abstract thinking. The majority of the respondents think that the free day was useful and good. For this statement the responses from the participants of the EBA project were not considered, because their project did not include a free day. Most common responses are outlining that this time was used to consult with the back-office and it was good to give some time to the already achieved status to settle down and to be able to reflect on it. Some used it for rest. Four respondents were not absolutely happy with the free day. One of them reported that he got out of the flow but two of them found it useful in another way. They used this day to be able to devote attention to other projects.

Work during the high pressure week:

70% of the participants considered the information representation good during the work sessions. Except 3 respondents, the rest found the information presentation way (mix of flipchart, Excel, Word and Powerpoint documents) at least sufficient. The remaining three workgroup members mentioned that it was messy and not transparent. Their opinion cannot be generalized to a project, because each of these comments arrived from different workgroups. In the following two statements the responses of the EBA group were not considered, because the high pressure week did not include a free day there. The big majority (85%) more or less agreed that there were enough opportunities to consult with the back-office next to the free day. 50% agreed or strongly agreed with this statement. Considering all the responses, 85% felt it easy to work in the high pressure week, but 4 respondents (15%) not. Nevertheless one of them had difficulties because he had to squeeze the high pressure week into his busy agenda. The remaining three respondents did not explain the cause of the difficulty. The time pressure was helpful in the development of the standard according to 78%. The majority (70%) agrees that the objectives of the high pressure week were satisfied. 3 respondents disagreed and one strongly disagreed with the previous statement. The open questions revealed that two of the disagreeing workgroup members did not agree with the scope and the third expected more iterations during the high pressure week. They all had technical background. Two of these participants were involved in the Digitale Rotonde project, which proved to be technically the most challenging according to the standardization experts because of the usage of VISI technology instead

of XML. Two people who felt the time pressure not helpful, also think that the objectives of the high pressure week were not satisfied. Most of the respondents (78%) were satisfied with the result of the high pressure week. Four out of the six, who were not satisfied, are from the Digitale Rotonde project. In average, these six respondents had problems following the current status of the work and found the mix of knowledge not sufficient. Half of them felt the work in the high pressure week difficult. Most of those who filled in the survey (67%) think that the Chairman let the right amount of time for discussions. However significant amount (22%) felt it a bit too little. These people were involved either in the STOSAG or in the Digitale Rotonde projects (3-3 members). These results do not seem to be a huge surprise since the STOSAG was the first test run of the Pressure Cooker method and the Digitale Rotonde project had the largest number of participants. Both aforementioned factors can explain the possibly less time provided by the Chairman.

What the group liked:

The workgroup members emphasized three things they especially liked in the Pressure Cooker. First, most of them reflected on the great collaborative work of the group. According to them, the fact that the members were enthusiastic and motivated resulted in a great group effort. This might be correlated with another group of responses. Most respondents appreciated (1) the chance to share and discuss ideas and visions; (2) the discussions, which always ended with consensus; (3) and in general, the decisiveness of the group. Second, the members liked the pressure too. They felt that the pressure helped to focus and fastened the work speed. The result (standard) in a short time is appreciated. Third, some participants from the Digitale Rotonde project explicitly mentioned the satisfaction with the location and environment of the high pressure week.

What the group did not like:

Eight respondents (2-2 from the EBA and STOSAG projects and 4 from the Digitale Rotonde project) did not find any specific problem with the current method. However, most of the people (7) were complaining about the repeated discussions. The complaints almost follow a linear distribution through the projects. Three complaints from the STOSAG, two from the EBA and the Digitale Rotonde. A STOSAG workgroup member added, that the discussions took a lot of time because of the lack of understanding or misunderstanding between business and technical representatives. Two workgroup members, one from the STOSAG and another from the Digitale Rotonde project, did not find the available time sufficient for the decision making. Some respondents emphasized that the group size was too large, but they did not suggest a better size. Two Digitale Rotonde workgroup members pointed out that they did not like the lack of a real application of the standard. They wanted more tangible and practical result after the high pressure week. One respondent from the STOSAG project found the environment not appropriate.

Result of the high pressure week:

Regarding the result, the feedback from different groups gets more emphasis. However, when the results from each group are very close, we use the combined result.
Half of the STOSAG workgroup feels that the provided available time for reviewing the documentation of the draft. Interestingly, 38% think the opposite, they think the provided time was

too long. 50% of the STOSAG participants partly agree and partly disagree that the high pressure week resulted in a good standard, but 37% thinks the result is definitely a good standard. 88% satisfied with the result of the high pressure week and 63% also satisfied with the final standard. One of those who are disappointed, did not agree with the scope at all. The two other basically liked the result when it was delivered. They are referring to missing parts and errors that became visible later.

In the EBA project, the majority (57%) found the provided time for reviewing not enough. 29% was more or less satisfied with it, but it shows clearly that the members would not mind to have longer reviewing timeframe. Similar to the STOSAG project that 43% partly agrees and partly disagrees and 29% agrees that the high pressure week resulted a good standard. The group is almost unanimously (86%, only 1 person disagrees) satisfied with the result of the high pressure week. The one person, who was not satisfied, and another are not satisfied with the final standard. They both have problems with the scope and consequently with the standard. However 71% of the survey participants from the EBA workgroup is satisfied with the standard they delivered to the Steering Committee. In the EBA group, all the negative evaluations rooted in the disagreement with the scope.

The third workgroup, from the Digitale Rotonde project, would have liked more time for the reviewing. 42% clearly indicated this and another 42% just partly agreed and partly disagreed with the provided time. 4 people (34%) thinks that the result of the high pressure week is not a good standard. 33% is neutral and 33% thinks it is good. 7 persons (58%) were not satisfied with the final standard, but 4 of these people claimed that the result of the high pressure week was good. This can indicate that the standard failed to reach the members' expectation after the documentation and reviewing processes. The respondents, who were not satisfied with the final standard, had problems with the less technical and practical focus of the high pressure week. They expected more practical, demo-oriented solution during the work sessions. One expressed his disappointment with the scope and therefore with the result. Another says, that he wanted to spend more time on the development. Answering the regarding question of the survey as well, he indicated the same.

Most respondents (78%) at least partly agreed that the high pressure week resulted a good standard. Although, 11% (3 respondents) disagreed with this and another 11% strongly disagreed. In total, 22% of the workgroup members do not consider the standard as a good result. 4 out of the 6 respondents, who felt the result of the high pressure week was not good, were in the Digitale Rotonde project involved. The remaining two Workgroup members are distributed between STOSAG and EBA equally with 1-1 respondents. 56% of the survey respondents were satisfied and 44% were not satisfied with the final standard of the standardization. Most (7 people) of those who were disappointed (12 people), were workgroup members in the Digitale Rotonde case. In the STOSAG, 3 and in the EBA project 2 participants were unsatisfied. The expertise areas of these people are shown in Table 4.

Expertise/Project	**STOSAG**	**EBA**	**Digitale Rotonde**
Business	0	0	2
Technical	0	1	3
Both	3	1	2

Table 6. Amount of participants per project who were unsatisfied with the final standard

There are two factors that alter the result represented in the Table 6. First, there are two respondents from the STOSAG project, who said that they are not satisfied with the final standard, but their explanations reveal that they found the core standard appropriate as the result of this short development time. Besides, one respondent with business and technical expertise from the Digitale Rotonde project did not write any explanation, therefore his reasoning is unknown.

Chronologically reading the results, we can conclude that the workgroups perceived better results in the EBA project after the STOSAG, which had good evaluation too. The last Pressure Cooker application, the Digitale Rotonde, was the least successful according to the experts and this is supported by the survey. 58% was not satisfied with the final standard. However it is a bit difficult to compare the Digitale Rotonde result to the other two project, because of its special condition. As it was mentioned before, VISI standard was used instead of XML, which caused much more difficulties for the standardization experts, who did not have a lot of practical experience with it. Still, the majority of this group (67%) thinks that the result of the high pressure week was good. Considering the survey responses from the three projects, there is obviously room for improvement, but it is visible that the workgroup is usually satisfied with the results.

4.1.2 Semi-structured interviews

Semi-structured interviews were chosen to collect input from the experts. There were four main reasons behind this choice. First, the sampling size was not large at all, it was relatively easy to conduct the interviews and handle the results. In total, there were five TNO standardization experts involved in Pressure Cooker projects. We managed to conduct interviews with four of them. All these experts had an active role during the high pressure week in the different projects. The expert, who was not interviewed, had only a small role during the high pressure week.

Second, the depth of information about the Pressure Cooker method did not suit with other research methods such as a survey or a structured interview. The semi-structured interviews paved the path for the first model and helped to establish a solid base of knowledge on the process, which was used for the analysis of the survey results as well.

Third, since there were already three Pressure Cooker projects finished at the sampling time and these were the first three applications, it was not a surprising to find out, that they differed in some small aspects. The interviews helped to resolve the seemingly conflicting information found in the documentations.

Fourth, the knowledge and expertise of the experts helped to identify challenges and to gather ideas for improvement. The interviews made it possible to determine relative emphasis on issues.

The semi-structured interviews allowed to gather:

- opinions, perceptions and attitudes of the standardization experts,
- background information about the Pressure Cooker method extracting expert knowledge, facts, and descriptions of the process.

The interviews followed an incremental scheme in the sense that certain questions were added or opted out based on the previous interview. In the beginning, the interviews were mostly used to get an overview of the Pressure Cooker method to be able to visualize the standardization process in a model. Later, the emphasis moved to the details and improving suggestions of the current process. The interviews followed a guide with questions and topics that must have been covered. Some discretion was applied about the order in which the questions were asked. In general, the interviews followed conversational style lead by the guide. This conversation based style proved to be useful for discovering new issues, ideas, topics that the interviewer missed earlier. Besides, we managed to delve deeply into the Pressure Cooker projects and to understand thoroughly the answers provided by the interviewees.

Key findings of the interviews

The interview summaries can be found in Appendix B.

1. In the scope document, the business problem has to be addressed.
2. There are different expertise with different objectives in the workgroup. How to deal with this?
3. 15 people form a too large workgroup.
4. The place and objective of the Pressure Cooker should be clear to the stakeholders.
5. Standardization experts have to face hard workload during the high pressure week.
6. The price of the Pressure Cooker is an important factor for the customers and therefore limits the changes to the method.
7. In case of a semantic standard, the maintenance and governance are crucial.
8. In an optimal scenario, the Steering Committee also has some technical expertise.
9. The limitation of the standard should be clearly communicated.
10. Unanswered question: In which situations can the Pressure Cooker successfully be used?
11. The used tools information capturing and recording tools (Visio, PowerPoint, Excel, Word, Flipchart) need improvement.
12. In the current practice, reviewing is a very time consuming process.
13. The Chairman should always stay neutral.
14. The high pressure week follows top-down approach.
15. Parking lot of rising ideas for later discussion.

4.1.3 Major and minor issues

Based on the interview- and the survey results, it was possible to make a list of issues in the current Pressure Cooker practice. Soon, it became clear that this list is lengthy and not all the points are equally essential to be taken care of. In order to narrow down the focus of the research and put the emphasis on the important issues, the points of the initial list are weighted. One can argue how biased the weighting process is. Of course, we cannot claim that it is not biased at all, however the importance of the issues was determined by some rules. The rules helped to determine whether the particular issue should get more or less importance. More information about the weighting rules and the scores can be seen in the Appendix F.

Major issues

1.	**In which situations (what context) can the Pressure Cooker method be successfully used?**
2.	**Conflicting interest of business- and technical representatives and the too large group size**
3.	**The expectations of the participants are not realistic in many cases, and therefore they are not satisfied with the delivered standard**
4.	**The reviewing process is very time consuming**
5.	**Planning related issues: preparation for the high pressure week is not good enough, work on the last day is less effective than the rest.**

1) **In which situations (what context) can the Pressure Cooker method be successfully used?** Based on the interviewees' opinion, it can be stated that the Pressure Cooker method does work. Although it does not fit to every situation. As the interviews revealed, it is still not transparent when a Pressure Cooker can be successful and when it is better to use the time-extended standards development process. Generally, in the scope document a business problem is addressed, but this is often the root of critique in the survey results. To sum up, there is need to investigate the possible scope of a Pressure Cooker project and there is need to be able to explain under what conditions the Pressure Cooker is a good alternative for the development of the semantic standard.
2) **Conflicting interest of business- and technical representatives and the too large group size.** In the workgroup, the participants can have three kind of backgrounds. They can be business-, technical representatives or they can have expertise in both fields. Both the interviewees and the survey respondents spotted out the conflict between the different interests in the group. Besides, lack of understanding can also appear and generate repeated discussions, which irritates some workgroup members. Additionally, the interviewees and the workgroup members agree that the current group size is too big. Question arises, ''What is a better group size?''.
3) **The expectations of the participants are not realistic in many cases, and therefore they are not satisfied with the delivered standard.**
   The survey identified that while the respondents were satisfied with the work in the high pressure week, they were not that delighted with the final standard delivered to the Steering Committee. Although the Steering Committees are not disappointed with those standards, the Workgroup members fail to meet their own expectations. The interviews showed that the experts have the feeling, that the objective, the start and end of the high pressure week is not always clear for the workgroup members.
4) **The reviewing process is very time consuming.**
   The reviewing process is very important for the end result. The experts feel that considering the received feedbacks, too much time is spent on the reviewing. On the other hand, the workgroup members reported to spend average more than 10 man-hours on the reviewing. Furthermore, almost half of the survey respondents think that the available time for reviewing was not too much. This raises a question, "With what solution could both parties be more satisfied? ".

5) **Planning related issues: preparation for the high pressure week is not good enough, work on the last day is less effective than the rest.**
The survey showed that some workgroup members are not satisfied with the amount of information they received before the high pressure week. Although most of the survey respondents found the last day not different compared to the rest, the experts unanimously agreed that the last day is less productive. Besides, there can be some tension observable on the last day, therefore the work to be done at this time should be carefully chosen. Questions arise: What can be the goal for the last day to get the most out of it? How can it be achieved?

Minor issues

1. **The high pressure week has special work conditions and high workload. To whom does this kind of work fit?**
2. **Absence of technical mapping.**
3. **Information capturing is too difficult and have a messy result.**

1) **The high pressure week has special work conditions and high workload. To whom does this kind of work fit?**
The issue with the large amount of work in a short time was sometimes considered somewhat overwhelming by the interviewed experts. The workload proved to be not an issue for the workgroup members. The most natural ways to change the workload of the experts would be either make the high pressure week, its preparation period, and the following activities longer or increase the number of experts during the high pressure week. Both solution would challenge the current prerequisite requirements of the method. The Pressure Cooker should be short and not more expensive than it is now. One can argue that the benefits could outperform the extra costs. Within the research, it was not feasible to test and decide in this question.
2) **Absence of technical mapping.**
The technical mapping was seriously missed by a few workgroup members, specifically by the technical representatives. However, neither most of the respondents nor the standardization experts found it wrong to leave out the technical mapping from the program of the high pressure week. Moreover, a properly executed technical mapping would take a lot of time and is irrelevant in the business perspective.
3) **Information capturing is too difficult and have a messy result.**
Some experts were concerned that the way of capturing the information is not sufficient. They were also worried about the presentation of the information, but the survey revealed that the workgroup members are satisfied with the current way. The information recording is difficult, because the process includes a lot of brainstorming and discussions. So far, the best solution for the recording of the elements of the Information Model is found to be the use of Excel documents. It is possible to store the information in a structured way, but at the same time, Excel provides high flexibility to make changes. Considering this solution in the chronological order of the projects, it still seems to work well. In the very first try, there was extra difficulty because two standards out of four were very technical standards. Listing the

elements of this needs special expertise. In the second Pressure Cooker, the information capturing solution (Excel) worked without remarks. And finally, in the third project, there was extra difficulty because the standard was not based on XML. So the only Pressure Cooker application, where there was no special circumstance, was the second project. To sum up, in this research this issue is not investigated further in order to keep the number of significant modifications lower.

4.2 Requirements for a new semantic standards development method

The research goal is to create a method that shortens the standards development time. This goal is aimed to be achieved by using the currently used innovative method (the Pressure Cooker) and improve it with using different theories from literature, in order to make the current process easier applicable and implementable. The following part lists the requirement that have to be met by the improved method.

We distinguish three kinds of requirements. There are prerequisites that represent common sense or general business rules. The general requirements target the improvement of the current process. And finally, there are the issue related requirements that are created to drive the research in solving the identified issues. These requirements are derived from the issues. The following requirement elicitation techniques were used: interviewing, brainstorming, and survey.

Prerequisites

P1) The Pressure Cooker should not be more expensive than it is now.
P2) If the current length of the high pressure week is to be changed, care should be taken that there is no negative impact on other characteristics of the method.
P3) The quality of the standard developed with the Pressure Cooker method should not be lower than it is now (80% standard, described in Chapter 3.2).

General requirements

GR1) The final standard of the Pressure Cooker has to achieve the objectives set by the Steering Committee.
GR2) The standards development time with buffer-time included has to be less than 18 months. Additionally, the theoretically shortest standardization time has to be clearly stated.
GR3) To foster the repeatability of the Pressure Cooker method, the process must be documented and supported with a guide.

Issue-related requirements

IR1) It has to be identified, in which context the method can be used successfully, and the characteristics of such a context have to be listed. Additionally, characteristics have to be identified and listed that make the method not applicable.

IR2) The method has to propose a guideline for the workgroup size and the composition.

IR3) The method has to pay attention to managing the expectations of the participants according to what the Pressure Cooker is able to and supposed to do.

IR4) The reviewing process has to become less work-intensive for the workgroup members and the experts by eliminating unproductive activities from the current method. To do so, the unproductive activities have to be identified first.

IR5) There should be a tool to support the preparation for the high pressure week.

IR6) The tasks to be done on the last day, in order to get the most out of the high pressure week, should be described.

4.3 The requirements and the as-is Pressure Cooker method

The prerequisites are requirements that can be evaluated by comparing a method to the as-is Pressure Cooker method. Therefore, the fit to these requirements cannot be checked. Table 7 contains a short overview of the as-is Pressure Cooker method regarding the specified requirements. The evaluation is indicated with a symbol. The tick symbol (✓) means that the requirement is satisfied, and the cross symbol (X) shows that it is not satisfied. In the case, where the negative symbol (–) was used, the requirement was partly satisfied.

Requirement	As-is Pressure Cooker	
The final standard of the Pressure Cooker has to achieve the objectives set by the Steering Committee.	All the three Pressure Cooker projects are considered successful. The Steering Committees received the standard they were expecting.	
The standards development time with buffer-time included has to be less than 18 months. Additionally, the theoretically shortest standardization time has to be clearly stated.	The standardization process takes 6-8 months with the as-is Pressure Cooker method. The theoretical shortest Pressure Cooker process takes 15 weeks.	
To foster the repeatability of the Pressure Cooker method, the process must be documented and supported with a guide.	The model is not designed and written guidance does not exist.	
It has to be identified, in which context the method can be used successfully, and the characteristics of such a context have to be listed. Additionally, characteristics have to be identified and listed that make the method not applicable.	These characteristics are not known.	

The method has to propose a guideline for the workgroup size and the composition.	Optimal workgroup size is not defined. The method uses a diverse composition of the group. Both technical and business representatives are chosen.	
The method has to pay attention to managing the expectations of the participants according to what the Pressure Cooker is able to and supposed to do.	The requirement is related to an identified major issue.	
The reviewing process has to become less work-intensive for the workgroup members and the experts by eliminating unproductive activities from the current method. To do so, the unproductive activities have to be identified first.	The requirement is related to an identified major issue.	
There should be a tool to support the preparation for the high pressure week.	The requirement is related to an identified major issue.	
The tasks to be done on the last day, in order to get the most out of the high pressure week, should be described.	The requirement is related to an identified major issue.	

Table 7 The requirements and the as-is Pressure Cooker

The next chapter aims to address the major issues and identifies possible solutions.

5 Potential improvements ideas

This chapter lays the theoretical ground to answer the research question:

What are the potential improvements from literature that could be used for a new method in order to satisfy the requirements?

For each major issue, the first three stages of the five-stage grounded-theory method (Wolfswinkel et al., 2013) were used. The full list of search results can be found in the Appendix G.

During the issue-oriented literature review the following inclusion and exclusion criteria were applied:

Included

- Peer reviewed research papers from electronic databases.
- Papers that describe more than a single specialized process.
- Papers that describe processes for developing of semantic standards.
- Papers that are published in the top CS/IS and International Business journals. See Table 8.

Excluded

- Non-English papers.
- Papers that are application domain specific in such a content that it biases the findings.
- Papers which are obviously not related to the research questions.
- Letters and editorials. – Duplicate publications on the same approach.
- Papers published before 2000. (This was a soft rule, meaning that in case of no result of the search, the exclusion criteria was left out.)

During the structured literature review the following fields of research were examined:

- Information and Computing Sciences
- Economics
- Commerce, Management, and Services

To identify the most relevant studies, which have already been done, we will use the top 15 CS/IS journals and the top 7 international business journals. We are interested in the articles published after 2000. The search will be focusing on the research questions. The goal is finding answers from literature to these. The list of journals that were selected as base for the search is in the Appendix E.

Regarding two issues (characteristics and expectation management), the inclusion criteria was ignored. The topic of the research is not really popular research area, therefore in the case of lack of valuable search result in the journals listed in Table 8, the list of journals was extended. This means that a paper with high relevancy could have been included to the research even if it was not published in the top journals.

The specific search terms, keywords and results can be found in Appendix G.

Besides, in some cases the structured literature review revealed that certain issues (characteristics, reviewing and planning) have not been examined in the research field of semantic standards development yet. In these cases, the rules of inclusion and exclusion were broadened to other fields. The following section is discussing the result of the structured literature review regarding the major issues.

5.1.1 Characteristics

The Pressure Cooker method proved to be applicable in practice by the three TNO applications. However the characteristics that could be indicators of successful application are not recognized yet. The standardization experts expect that there are situations where the Pressure Cooker method will

be a good alternative for standards development but there are also situations where the time-extended standard development process should be followed for the good result. In the following part of the chapter, our objective is to identify and describe characteristics of a semantic standard development project that could be used for a ‘’fit-to-project comparison’’ of standardization methods.

The Pressure Cooker method has shown in practice that it can deliver a semantic standard in 6-8 months. The time is an advantage, but it certainly has tradeoffs as well. Because the idea of using pressure by organizing the work sessions in standards development right after each other is novel, the structured literature review did not produce any sources that could be used to address this issue. There are no papers published about the characteristics of a standard development project, which is similar to the Pressure Cooker, yet. Therefore the list of characteristics, shown in Table 9, is a result of the mix of brainstorming, expert interviews and survey. First, an initial list was created using the findings of the interviews (number of stakeholders, number of specifications, knowledge and experience need, target of the project) and the survey (number of stakeholders, knowledge and experience need). Second, we used brainstorming to identify more characteristics (level of commitment, complexity of the business network).

The number of the stakeholders
The number of specifications to develop
Knowledge and experience requirement of the standardization experts
The target of the project
Level of commitment
Complexity of the business network

Table 8 List of characteristics to investigate

Number of stakeholders

There is a stakeholder paradox in the selection of participants in a standard development project (Boh et al., 2007). The more stakeholders participate, the bigger the number of first adopters will be. But more stakeholders lead to more difficult decision making. In practice, the more stakeholders the Steering Committee has, the longer list of suggested workgroup members the standardization experts get. The reason is that the Steering Committee members want to make sure that their interest is represented in the workgroup. A big workgroup cannot be that successful, because of certain problems with the group’s work abilities. First, every single member increases the number of discussions, which costs time. Valuable time, that is very limited in the Pressure Cooker. Second, the productivity of a workgroup decreases as the number of members increases (Mueller, 2012).

Number of specifications to develop

Behrman (2002) defined two methodologies that can help to understand the characteristic better.

- “The minimalist approach values simple standards and rapid adoption by the user community. It is a bottom-up approach in which standards start small. The

development process places heavy emphasis on experimentation, testing, and iterative improvement of proposed standards in applications before adoption. Once such standards are adopted and gain acceptance, they are further developed as needed. ”

- “The structuralist approach values comprehensive and complete standards. It is a top- down approach. The development process starts with a high-level model and then proceeds with the elaboration of more and more detail. The process is often daunting and time-consuming. ”

The bottom-up approach is also called minimal model methodology (Laakso M, 2012). Typically, the minimalist methodology targets a small scope and provides quick solution but extensive testing is needed (Behrman, 2002). The top-down approach is described as time-extensive, but well suited to large, complex solutions (Laakso M, 2012). In this case, a large, complex solution means that it can be recognized as a group of many smaller modules, which could be individual projects. The structuralist and minimalist approaches are summarized in Table 10.

Minimalist approach	Structuralist approach
Simple standards	Complex solutions
Rapid adoption	Time-consuming development
Bottom-up approach	Top-down approach
Iterative improvement	**Adoption after the standard is completed**

Table 9 Minimalist vs. structuralist approach

Technical knowledge and related practical expertise of the expert

The Digitale Rotonde project proved that the success of the Pressure Cooker can be challenged by using technology that is not known by the experts. In this case, the VISI technology made the development much more difficult without lot of practical expertise of it among the standardization experts. The literature review did not result in support or refusal regarding the described characteristic.

The target of the development, 80 or 100% standard

The project management triangle is able to present the achievable quality of a project depending on the scope, budget and schedule of the project (Lauras, Marques, & Gourc, 2010). If we place the cost, the schedule and the scope in the edges of a triangle, as it is in Figure 12, then the triangle’s area represents the quality of the project.

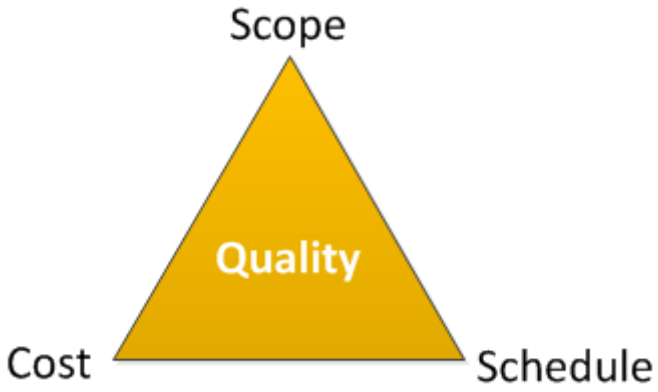

Figure 12 The project management triangle (source: Lauras et al., 2010)

The project management triangle helps to understand how the variables determine the quality of a project. If there is a goal requirement to shift any one of the attributes then at least one of the other attributes must also be manipulated. The focus on one or two attributes in a project comes with the cost on the third attribute. Because of the project boundaries, the third attribute cannot aim its maximal potential but must be decreased.

Level of commitment

In researches, where agile projects were analyzed, it was recognized that the members' commitment is key for the quality of the results developed in a short time (Chan & Thong, 2009; Conboy, 2009). Commitment is found to have a great impact on the quality of the collaborative work (Junjie, Qian, Dongxia, & Su, 2010).

Complexity of the business network, environment

In the context of standards development, it was shown that the socio-technical complexity of the project generates reflexive processes. The reflexive processes challenge the development of the standard by undermining the stakeholders' common aim (Hanseth et al., 2006). Besides the high complexity of the stakeholder network leads to longer decision making especially with consensus based decision making.

The discussion of the finding that are presented in this chapter can be found in Chapter 5.2.

5.1.2 Workgroup members

Conflict can typically appear when the parties cannot agree on the execution, scope of the work, specification, functionality, capacity, time schedule or payments (Spiess & Felding, 2008). Zur Muehlen et al. (2005) showed that the decision making in a standardization process involves social dimensions too, not just technical arguments. The literature review revealed that the conflicting interests are not necessary cause invaluable time-consumption and bad things if they can be turned into constructive conflicts (Garvin & Roberto, 2001). As Cuppen (2011) defines, a conflict is

constructive when the stakeholders' dialogue can benefit from this. It was already found quite a long time ago that diversity of a workgroup can positively influence the quality of outcome (Hoffman & Maier, 1961). Brodbeck, Kerschreiter, Mojzisch, Frey, and Schulz-Hardt (2002) found that the inclusion of variety of perspectives results more divergent thinking and more consideration of multiple perspectives and the consideration of these. This finding becomes more interesting when it is combined with Dunn's (2001) work, who emphasized the importance of marginal perspectives in a workgroup. Including Dunn's work in their research, Broedbeck et al. (2002) state that minority influence facilitates open-mindedness towards alternative solutions. However, it was reported in some cases that conflict is not in every form beneficial to group processes (Jehn & Mannix, 2001; Jehn, 1997). In addition to the gender, age and race, the skills and knowledge differences can create diversity in the group (Harrison & Klein, 2007).

Regarding the group size, the literature shows different alternatives for an optimal number of the size, but arguing why that exact number is the right one is quite complicated (Jung, Schneider, & Valacich, 2010). Some studies claim that the optimal group size is 7 (Blenko, Mankins, & Rogers, 2010), and others say it is between 5 and 12 (Mueller, 2012). Mueller (2012) says that the size of the group should come third after considering the task, which comes first, and the knowledge need that comes second. However, we have to aim for the smallest possible group. According to Blenko et al. (2010) each additional member reduces effectiveness of decision making by 10% over seven participants. If we accept this, it would mean that a group of 20 members is hardly able to make any decision.

(Löwer, 2005) defines 4 categories that represent the stakeholder types. The model with the categories is shown in Figure 13. The four categories are drivers, observers, contributors and adopters. The term divergent in Figure 13 means that the stakeholder diverge from some opinion that others are aligned to.

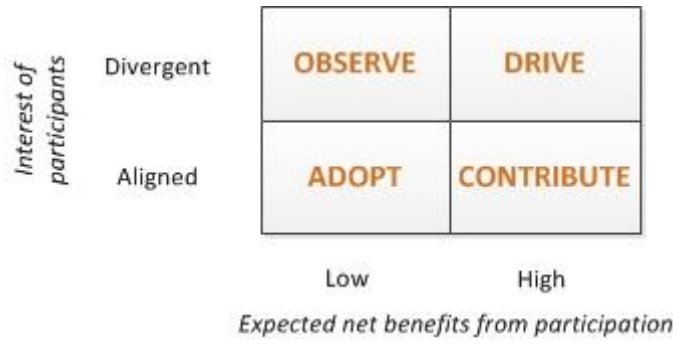

Figure 13. Generic Strategies Matrix for user Participation in IO Standardisation (Löwer, 2005, p219)

Grunert and König (2012) created a decision making tree, which helps to place the stakeholders in categories that represent their attitude to the standardization effort. The tree is shown on Figure 14.

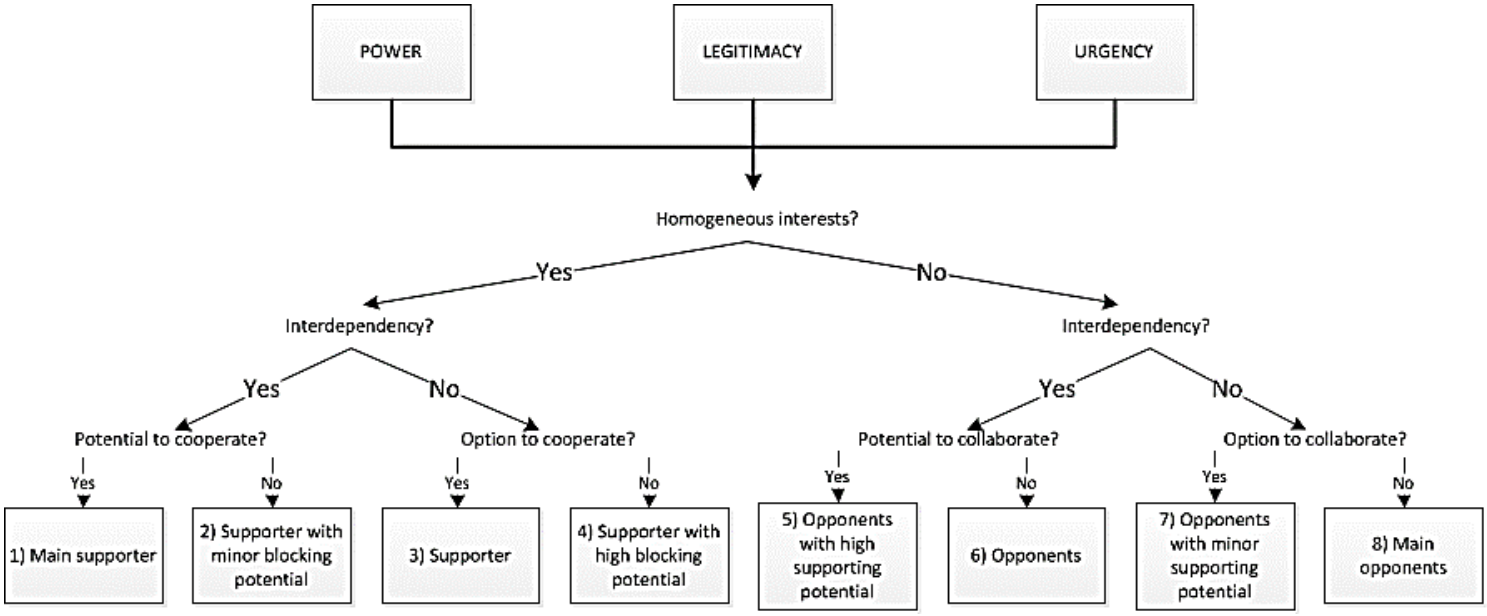

Figure 14 Decision making tree (source: Grunert & König, 2012)

By answering the questions from the top to the bottom of the tree, arriving to the bottom, a stakeholder will be categorized. A stakeholder who is either in Category 7 or 8 should not be included in project, but stakeholders in Category 5 and 6 have the potential to collaborate. Therefore these stakeholders have to be considered as participants when they own valuable resources (knowledge, technology, skill or regulatory power) that highly influences the success of the project.

5.1.3 Expectation management

Limited to the topic of standards development, the structured literature review did not result any related papers. The topic is undiscovered, at least in the selected journals. Extending the research field of the search mostly to the marketing and management fields resulted the following findings.

The management of stakeholders' expectations is a key factor for economic success (Grunert & König, 2012). Usually, the root of the problem comes from the expectation gap (Staples, Wong, & Seddon, 2002; Sue, Choi, & Lee, 2010). As it can be seen in Figure 15, the expectation gap is the difference between the expected value and the perceived value. In the figure, it is even a better situation, because the real value is higher than the expectation.

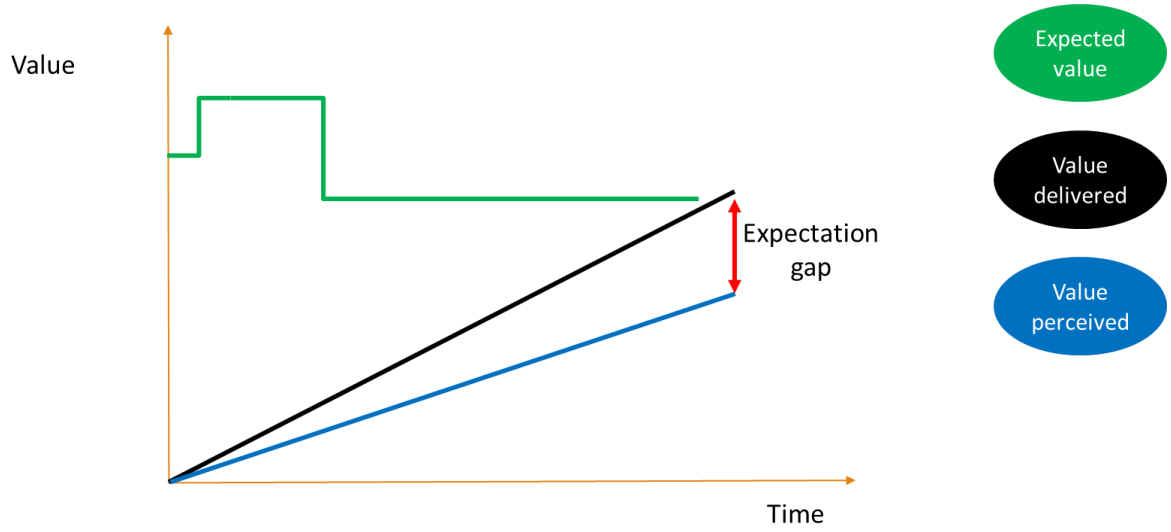

Figure 15 Expectation gap (source: Sue et al., 2010)

Focusing on the expectations about information systems, Staples, Wong, and Seddon (2002) examined the relationship between pre-implementation expectations and their perceived benefits based on post-implementation experience. Their results support the disconfirmation theory that predicts that the unrealistically high expectations will result in lower levels of perceived benefit than those who have realistic expectations. Where expectations match experience, in that case the expectation has been realistic. They concluded, that the creation and maintenance of realistic expectations are essential for the success of the project in the future. There is another solution to meet the post-implementation expectations, it is overdelivering (Nevo & Wade, 2007). Overdelivering means providing more and better than people expected. Although this is turned to be not a silver bullet, because it appears that the downside risk of underdelivering on expectations is greater than then an upside reward for overdelivering.

Livingston (2003) found that the people in the group tend to bias their performance to what their managers expect from them upfront. This phenomena is called self-fulfilling prophecy. The self-fulfilling can result negative and positive adjustments too.

5.1.4 Reviewing

The structured literature review identified that the reviewing process of semantic standards development is not examined yet. The reviewing activity is ultimately a knowledge management and a collaborative document management problem. Therefore the structured literature review placed these topics in the spotlight. Knowledge management is about the content of the review and collaborative document management includes the practical information distribution and publishing topics.

In their work about open and proprietary software development, Rigby, Cleary, Painchaud, Storey, and German (2012) concluded that the agile reviewing is a better approach in both cases. Agile reviewing breaks the traditional process into iterations that provide fast feedback from the customer

and it requires active involvement of the customer during the development process. Active involvement is necessary because the customer has to provide feedback since the very first version of the solution. Even though formal inspection is recognized as one of the most effective ways to improve software quality, many organizations struggle to effectively implement a formal inspection process. Meanwhile, open source projects typically use an agile peer review process, which is based on asynchronous, frequent, incremental reviews (Rigby et al., 2012). In a simplified way, knowledge can be defined as an organized information that is useful to the organization (Kim & Lee, 2006). Knowledge management refers to the management of this organized information (Solis & Ali, 2010). Considering the knowledge as an asset of the organization. Since IT has a big impact on the business life – basically involved everywhere – it is not surprising that companies are looking for IT solutions. The most common solution is the deployment of a corporate wiki (Cooney, 2006; Schaffert, Gruber, & Westenthaler, 2006).

A knowledge management system is an information system that improves the organizational process of creating, storing, retrieving, transferring and applying knowledge (Leidner & Alavi, 2001). Wikis are popular solution for knowledge management (Jing & Fan, 2008; Wagner & Bolloju, 2005; Weiss, 2005).

The term “wiki” refers to a social computing system that allows a group of users to initiate and evolve a hyper-linked set of Web pages using a simple markup language (Wagner & Bolloju, 2005). A wiki is a public repository in form of a web site that can be edited by anyone, where every change to the contents is logged and document versions are archived and available to the users, providing the community a shared awareness on the knowledge base evolution (Baraldi, Bimbo, & Valli, 2006). Furthermore, the wiki technology has the potential to complement and enhance online collaboration (Parker & Chao, 2007). Wikis are a way to provide a usable solution for knowledge management in the organizations (Jing & Fan, 2008; Wagner & Bolloju, 2005; Weiss, 2005), in addition, it has been found that wikis in the corporations are sustainable too (Majchrzak, Wagner, & Yates, 2006). The wiki also tracks all individual contributions and changes (Díaz & Puente, 2012). There are no constraints of place or time but wikis also provide asynchronous communication. The advantage of using wikis is the freedom regarding time and space. A wiki is an asynchronous collaborative technology that allows people to share ideas ‘on their own time’ (Serçe et al., 2011).

A wiki provides an extremely fast and efficient way to collaborate and communicate knowledge among virtually anyone interested without the constraints of place or time (Díaz & Puente, 2012). Furthermore, the modification can be visible immediately online. A lot of work were mentioned regarding the redundant feedbacks during the expert interviews. Moreover, it is not hard to imagine that the workgroup members could spend less time on parts others already checked and do better reviewing of other parts. They could reflect on each other’s comments and discuss these that could either eliminate the need of physical review meeting or leave room for more important issues. All modifications through the process are recorded, which is essential for reviewing. This is considered as the most valuable part of wiki system in the web 2.0 environment (Kang, Chen, Ko, & Fang, 2010). According to Kane and Fichman (2009), the wiki technology is proved to be useful not only in education and learning environment but in business environment too. Besides the standard functionality of wikis, it is possible to handle structured knowledge in wikis (Baumeister, Reutelshoefer, & Puppe, 2010). Structured knowledge is currently supported by semantic wikis

(Schaffert et al., 2008). Oren et al. (2006) propose the use of semantic wikis for knowledge management.

The Intranet Global Survey reported that around 67% of the respondent companies were somehow using wikis in the organization (Ward, 2013). This report also claims that only 7% of the respondent companies are not planning and do not have any interest in implementation of a corporate wiki. Work practice with wikis is essential to achieve successful wiki deployments (Díaz & Puente, 2012). Cooney (2006) claims that companies use wikis for various tasks like product documentation, project management, collaborative workspace, a knowledge base, software development support, corporate yellow pages, idea generation, a corporate intranet and research and development.

Disadvantage of the wikis is that they capture explicit unstructured knowledge in the content of their wiki pages as hypermedia. Users are not able to interact with the wiki in order to structure and reorganize knowledge (Solis & Ali, 2010). Concerns have been expressed regarding possibilities of plagiarism and vandalism (Su & Beaumont, 2010). In a reviewing process these issues cannot play an important role because the modifications are continuously stored and the workgroup members need identification to access the wiki.

There is an interesting finding about wiki usage and anxiety. It has been revealed that anxiety may not only lead to negative affect when interacting with the systems but could also influence cognitive attention towards tasks through cognitive avoidance and off task thinking (Smith & Caputi, 2007). Negative first impression with the system can lead to less willingness to use it In-built wiki training spaces: sandboxes and in-built tutorials. Cowan and Jack (2011) found that instruction based trainings lead to better usability perception of the wiki..

5.1.5 Planning

There are two questions related to the planning. First, the preparation for the high pressure week should be improved. Second, on the last day of the high pressure week, the tasks have to be carefully chosen, because the members are tired and irritated by the end of the week. Moreover, their work on the last day can highly influence their perception on the results.

Regarding information distribution, the literature research found that knowledge management systems are a popular solution to spread the information (Leidner & Alavi, 2001; Mortensen & Neeley, 2012). The previous chapter covered this topic in details, therefore it is not repeated again.

The performance drop perceived by the experts seems to be unrecognized topic in the literature. Not just the search queries included the “standard” word ended up with no result, but even the broader scope did not contain any useful information.

5.2 Discussion of the findings in the Pressure Cooker perspective

5.2.1 Characteristics

Six characteristics were introduced in this chapter that could indicate the feasibility of the Pressure Cooker method. These characteristics are shown in table 11. In practice, TNO works with Steering Committees that usually have 4-5 different organizations as members. If we assume that all Committee members want to have at least one representative in the workgroup then we can realize that the Pressure Cooker does not suit to projects where the Steering Committee has too many members (e.g. 10 or more), because the workgroup filled up with other stakeholders such as software and hardware vendors and specialists would get way too big to function effectively.

The number of the stakeholders
The number of specifications to develop
Knowledge and experience requirement of the standardization experts
The target of the project
Level of commitment
Complexity of the business network

Table 10. List of characteristics

Considering the short development time during the high pressure week, there is an obvious limitation of the number of specifications that can be created within the high pressure week. The number cannot be stated clearly, because the difficulty to create a specification greatly differs from another. Until, within the high pressure week, the Pressure Cooker method follows top-down approach, which is structuralist methodology, the whole method itself suits to bottom-up projects. Considering the project management triangle (Figure 8), in the case of a Pressure Cooker project, the cost and schedule edges are fixed. This leads to the realization that, the quality can be adjusted by changing the scope variable. The Pressure Cooker is aiming an 80% standard that keeps the cost and schedule fixed. But the scope has to be shrunk in order to be able to deliver an 80% standard. This relationship of the triangle variables explain why the Pressure Cooker fits to a minimalist approach and does not to the structuralist approach. Delivering the same quality would be impossible with a broader scope.

There are two aspects of the commitment that is necessary for the Pressure Cooker method. First, the more obvious one is to give high priority to the project and facilitate the planning of it in order to manage to keep the short deadlines of the Pressure Cooker method (even with the buffers). Second, the workgroup members have to be committed to the project. Although it does not seem like that, because of the standardization experts, but they are responsible to create a standard that solves the business problem. The experts are facilitators of this process. They cannot do it without the workgroup, especially in such a short time there is no chance that they could gain all the necessary background knowledge.

5.2.2 Workgroup size

The survey showed that the workgroup is irritated by the repeated discussions, which are rooted in the different backgrounds but even more in the different interests of the participants. The BSI standard recommends to include wide variety of perspectives in the workgroup. Cuppen (2011) says that the diversity of the group should be created in such a way that the stakeholder sample reflects a balanced inclusion of the variety of perspectives that exists within the stakeholder population. But this is difficult, because according to the theory, the different perspectives should be recognized before the selection of the workgroup members. Another problem is that it is a quite a big assumption that the individuals would act according their personal view and not representing their organization's interest. Therefore, putting the perspective decision on a higher, organization level could be a better approach. There are probably special personal objectives for every organization in the shared business problem. Most likely, everyone has a bit different idea and plan for the solution. This thought is supported by the experts, who mentioned that they had to deal with the slightly different desires and ideas of the different stakeholders in the workgroup. Of course, during the high pressure week, there is no time to deal with all the small, less significant details, so it is easier to include some special requests as optional elements in the draft of the standard. This is a way to harmonize the process. To sum up the theories, it was found that diversity is valuable to the group work. An important step to create valuable diversity in such a way that it results a good standard, is the identification and consideration of the perspectives of the different organizations. If we can recognize the perspectives, it becomes possible to include these in the workgroup in a representative way that reflects the perspectives of the stakeholder community. So the goal should be the optimization of the involvement of different perspectives instead of elimination of the conflicts.

The survey results show that the workgroup members' perception on the group size gives the impression that the size is close to their expected optimal number. Meanwhile the experts found the big size more essential because of the more complicated work with more people in the group. As the literature showed, the exact size of the group seems to be very context dependent, therefore we believe it is more useful to investigate the workgroup members' selection process and suggest a guide to select the workgroup members than just pointing out an exact number without further considerations.

Based on the list (task, knowledge need, and size) from Mueller (2012) , we aim to define questions that can be used to guide the workgroup members selection process.

1. **Task.** What type of task does the group have to deal with? The answer to this question paves the way to the second step. The task defines the skills needed by the participants.
2. **Knowledge need.** What are the skills of the members that are needed to be included in order to get the task done? What is the team composition to have all the necessary knowledge in the group?
3. **Size.** After we defined the task and identified the knowledge needed to finish it, we have to consider the different stakeholders of the project. In the last step of the selection, the standardization experts have to make sure that all the important parties are represented in the workgroup and the power of these parties is balanced. For example, if a single company provides the majority of the members then the group is obviously influenced by this

company, because it's impact on the decision making process. In this case, this company could turn the standard to be the best fit to its own business problem, and it could miss to solve others' business problem with the best possible solution. An even worse situation happens, if this company is the technology provider. There is great chance then that the technology provider aims to change as little as possible in the current solution, keeping its own interest in mind and resulting a standard that fails to appropriately solve the shared business problem of the other stakeholders. As the example shows, the influencing power of the stakeholders has to be under control.

This approach is lack of the inclusion of perspectives though. But if we try to combine Cuppen's (2011) work with Mueller's (2012) list of questions then the result can be a stakeholder selection process. This can help to reduce the number of stakeholders in the workgroup by recognizing the necessary task-to do, the different perspectives and the necessary knowledge. This approach could help to create a workgroup, in which the members have the knowledge to do the task and represent the different stakeholder perspectives in a representing way of the problem sharing stakeholders' objectives. But in this case, there can be stakeholders who are left out. In the workgroup, there is definitely need of people who are in either the drive and contribute categories.

Drivers have divergent interest (different perspective) and high expected net benefit from the project. To guarantee the balance of powers in the workgroup, the number of representatives of a certain perspective should not be able to gain too much influence on the work, otherwise the constructive conflict of interests suffers and gets into an imbalanced state that results worse group performance (Jehn & Mannix, 2001). It seems that the drivers should be included in the workgroup, but meanwhile their influence on the group process has to be kept under control.

Contributors are stakeholders who have their interest aligned to the project and they also have high expected net benefit from the project. Their inclusion in the workgroup seems to be important because they have a lot to "win", therefore they are expected to do their best to develop a standard. What makes them even more appealing is the fact that their interests is not against the interest of participants, most probably the group process will not be hindered by them.

Adopters can be considered optional to involve in the workgroup since they are not expecting that much benefit from the project and they are willing to adopt the standard anyway. This is typically true for those stakeholders who are not that dependent on the data exchange technology. Observers are stakeholders with low expected net benefit and divergent interest. For some reasons (e.g. the party owns a proprietary solution to the problem, or different needs of the party) the standardization effort does not meet the observers interest, therefore it is not expected that they would contribute in the development.

Semantic standards need the support of all stakeholders and the standardization is generally characterized by the heterogeneity of interests among participating user organizations (Folmer, 2012). Although, the semantic standards development is surrounded by conflicting interests, which feature is even valuable when it is turned into constructive conflict, in order to finish the high pressure week in time, the main opponents of the effort (category 8 on Figure 9) should not be included in the workgroup. Their presence would hinder the entire process, because they are against the solution provided by a standard to be developed. The same is not valid to those who are against

the proposed solution but show minor supporting potential (category 7), because they could act as Drivers later.

Blenko et al. (2010) found that the effectiveness of a group's decision making drops by 10% with every additional members over seven. This means that the top of the range of 5-12 defined by others (Mueller, 2012), will cause 50% effectiveness decrease. The high pressure week is consensus driven and it is emphasized to the workgroup members already in the as-is Pressure Cooker method. In the first three Pressure Cooker projects, the workgroup typically consisted of 15-18 members. Considering the three applications of the Pressure Cooker in the past, the decision making was a bit challenged because of the large group size (mentioned in the interviews and in the survey too) but in no one reported a major issue with it. According to the finding of Blenko et al. (2010), the decision making would have been hardly possible during the high pressure week in the former applications. Although the practice shows that in these projects, there was indeed negative impact of the larger group on the decision making but it had smaller impact on the effectiveness than it is claimed by Blenko et al. (2010). We expect that the committed participants and good management of the group can balance the negative impact of the larger size until a certain level. We cannot define the certain level, but we can take a tradeoff for allowing the involvement of more people in the development, which can be beneficial for the adoption of the standard. If we maximize the **workgroup size in 10 members** (the standardization experts are not included), then even without focus on balancing the effectiveness loss, the group would achieve 70% of effectiveness in decision making. And this calculation takes the effectiveness decrease granted that seems to be not the case in practice.

The investigated theories could be used jointly in order to create a group with constructive conflict and with the smallest possible number of participants in the following way:

1. Define the task the workgroup has to deal with.
2. Identify the interests (perspectives) of the stakeholders by using the decision making tree.
3. Define the skills and knowledge set that is necessary to develop the standard.
4. Decide whether a stakeholder is driver, contributor, observer or adopter by using the Generic Strategies Matrix (Figure 13) and the Decision Making Tree (Figure 14).
5. Select the workgroup members based on the gained insights. Maximum size should be 10.

In the suggested stakeholder selection, the goal is to keep the group size as low as possible (preferably maximum 10) and this way decrease the expected negative effects of large group on productivity. If the number of stakeholders got very large, it could be a solution to subdivide the group into smaller ones and this would decrease the coordination and motivation costs in the groups (Mueller, 2012). However the task division and planning would get way more complicated between the subgroups, which in the end would cause losing the fast result of the Pressure Cooker method. Besides, if the speed is demanded to be fast, then the groups work should be done parallel in time. This would increase the number of standardization experts in the project that leads to much higher costs. In the case of such a number of stakeholders that could be managed most productively only divided into smaller groups, the Pressure Cooker cannot be applied without giving up one or more advantages of the method. Therefore, the time-extended standards development process should be chosen in these situations.

5.2.3 Expectation management

The power of managing expectations could be used for bringing the unrealistic expectations closer to the realistic ones. Although this cannot happen until the workgroup members have erroneous expectations about the high pressure week. Without understanding the objectives, facing high expectations, the workgroup members will probably have high performance, but they will not feel the result of the high pressure week aligned with the quality of their work. This process directly leads to the expectation gap.

Expectations are based on what has come before. It should not be assumed that everyone knows what is going to happen next.

Ideas to tackle expectation problems:

- Focus on the clarification of the Pressure Cooker characteristics to shrink the expectation gap,
- Explicitly describe the tasks and objectives of the high pressure week to enable positive effects of self-fulfilling,
- Use visualization of the process from the beginning to provide an overview of the process (e.g. roadmap).

5.2.4 Reviewing

Both the survey result and the expert interviews pointed out that neither the workgroup members nor the experts are satisfied with the current reviewing process. There are two problems identified in the reviewing. First, it simply takes too long. Compared to the very impressive (short) development time, included the documentation of the draft, the reviewing still takes a lot of time, and causes delay with the delivery of the final standard. Second, the current reviewing process is very work-intense activity, it needs 10-15 man-hours from each workgroup member to do it.

How could these problems handled? What if we organize an extra, so-called review session to meet personally after the high pressure week and get through the documentation of the draft with a group effort? This solution would be very difficult to be squeezed into the busy agendas and would increase the costs too. Another solution could be to provide shorter time for reviewing. We can easily imagine the negative effects of this decision. The workgroup already complains that the available time could be longer, a time reduction would not be appreciated. Therefore, the solution should not increase the costs significantly, and should make the work easier both for the experts and the workgroup. Furthermore, the solution should ultimately result in shorter reviewing time.

To share and distribute information, the standardization experts need a new efficient way. Currently the reviewing is done by sending Word and Excel documents to the workgroup members and they send these back to the experts with their comments. A possible solution should be easy to use and up to date. The information should be presented in a structured, organized way like an information portal. A collaborative tool would be preferred to avoid the huge amount of comments, sometimes on the same part.

In the wiki as an information portal, the information uploading would be done by the standardization experts. They are responsible for the valid information sharing, therefore the likeliness of errors is expected to be low. In case of reviewing, errors can be caused by the workgroup members. Fortunately, in a situation like this, the version of the standard can be set back to a previous state. The advanced backlogging makes it possible to track all the modifications and when it is necessary to restore to an earlier version.

TNO has to provide support for the users (workgroup members) with a tutorial in order to reduce the emotional and technological barriers to wiki editing. Besides, if TNO wants to change the current practice of reviewing to a new wiki editing way, then the solution has to be appealing and easy to use to the workgroup members. There is also a chance that workgroup members are already familiar with wikis. This can greatly reduce the anxiety of using the system.

Pros	Cons
Dynamic	Risk of vandalism or erroneous data entry
Continuous	Need of internet connection
Backlog of changes	Content organizing tasks are more difficult than it was mentioned in the literature
Real-time changes	Users have to learn the use
	Difficulty with using variables in a semantic wiki

Table 11 Summary of the benefits and disadvantages of wikis

To sum up, the theory shows **solid proof of the beneficial wiki use in organizations and also reveals the potential of using a semantic wiki**. Based on the positive findings, a semantic wiki has been set up for testing the possibilities. Until the release of the research, the wiki experiment could not been finished. Combining the theoretical and practical findings, Table 12 presents the recognized advantages and disadvantages of a semantic wiki. An important practical finding for implementation is that **creating and managing a semantic wiki is not a basic task.** We are afraid that with the preparation, it can take longer in the end than the current reviewing process. However this need further testing to recognize the reusable parts from one project to another. Besides, **a logical problem** was identified regarding semantic wikis, which could be handled but with increased amount of work and difficulty with different versions of the standard. The problem is with storing certain elements of the standard as variables in the semantic wiki. This leads to easy reusability but in the case of change, the different versions cannot use the same variables anymore.

Next to the wikis, the research investigated what the market has to offer for collaborative reviewing. All the selected commercial solutions (*Buzzword, Zoho Writer, Writeboard, Google Docs, Microsoft Skydrive, Quicktopic, SynchroEdit, Gobby, TextFlow, WriteWith, ThinkFold, Mixedink, TitanPad, Solodox, J2e, AgileWords, Typewithme, Stypi*) missed important features (e.g. security, authorization, editing, converting to other formats, portability technology lock-in, etc.).

5.2.5 Planning

Currently, the information sharing is done with email lists in advance of the high pressure week. The information transfer is not optimal in this case for two reasons. First, the standardization experts have to format and distribute all the information they get from different sources. Second, the received information from the participants can be redundant in many cases. Considering that the

workgroup is expected to be committed to the project, it can be a solution to change the current, push sharing to a pull information sharing. The core of this solution would be a central point that can be reached by the workgroup members and they could individually access the information they need. At the same time, if the workgroup members are also asked to distribute their data using this solution, then they could see the information already shared and the information that is still missing. If the workgroup members are responding to the information need, the experts will get more information shared. This can lead to a better insight of the project background for the high pressure week. There are different forms of a solution like this. The central information storage and sharing point can be a website, a Content Management System (CMS) system or a wiki (Paroutis & Saleh, 2009). A platform that provides information for the workgroup members before the high pressure week is a knowledge management system, which is often a wiki in an organization. **A wiki can be a knowledge repository** before the high pressure week starts, containing all the essential information in an organized way for the workgroup members and the standardization experts. According to the literature review, **the easiest and least expensive solution seems to be a wiki**, which combining with reviewing would be a valuable combination of sharing and changing information too.

The careful examination of the Pressure Cooker schedules identified a gap in the plans. In the schedule, technical mapping is always included in the last day but in practice it is not part of the high pressure week. Combining the survey and interview results and mixing them with ideas for other issues resulted **a suggested plan for the last day**:

- Use the gap caused by the technical mapping in the morning, for managing the remaining work-related issues of the high pressure week (from the “Parking lot”).
- Set up technical requirements for the standard
- Lunch break.
- Use the remaining time to discuss the roadmap.
- Prepare the workgroup for the reviewing.
- Close the work with drinks in order to appreciate the work has been done.

5.3 Validation of the model and the improvement ideas

After the literature had been reviewed regarding the issues, the findings were presented a group of standardization experts. The session, on the 2nd of May in 2013, provided validation of the improvement ideas. Four standardization experts with time-extended and Pressure Cooker standardization backgrounds were present. Three of them had experience with the Pressure Cooker method. Table 13 summarizes the result of the experts’ evaluation.

Issue	Improvement idea	Expert ideas
1) Lack of list of characteristics	1) Number of stakeholders 2) Number of specifications 3) Technical knowledge and related practical expertise of the experts 4) Target, 80-100% 5) Level of commitment	4) Target: 80%, means good for pilot application Additional characteristics: • Maturity level of the standard • Innovation level • Awareness of the Steering

	6) Complexity of the business network/environment	Committee on what they want to get
2) Who should be in the workgroup?	5 steps of stakeholder selection guideline	All the possible stakeholders have to be identified otherwise the selection can miss an important actor.
3) Expectation management	Clarify the characteristics, tasks and objectives of the high pressure week. Make sure everyone knows their task and objective. Use visualization for an overview picture (e.g. roadmap).	Roadmap: should present both the activities left behind and also what is coming next. There are two expectation gaps: 1) Result of the PC perceived by the workgroup 2) What happens after the first result What do we expect from the workgroup? Magic box versus facilitation
4) Review process	Semantic Wiki. Warn the workgroup in time that they have to plan the review in their agendas.	Special task division among the workgroup members, splitting the work.
5) Planning	Provide information for preparation via a wiki. Suggested plan for the last day in 5 steps.	Consider a Kick-off session. A generic list of questions for preparation. Input survey.

Table 12 The input and output ideas of the expert session

The expert session consisted of five themes, which were meant to represent the five major issues.

1) The experts agreed that coming up with exact numbers as achievable targets cannot be a good approach to identify the characteristics. The solution contained description of the characteristics that can lead the experts' attention to the critical factors for successful application. Considering the features of the particular case guided by the list makes the expert able to make the go or no-go decision based on facts. The experts accepted the suggested characteristics and during the validation session, **three more characteristics were recommended**. These are
   - The maturity level of the standard (standard development from the scratch or a maintenance version)
   - Innovation (new technology or well-known)
   - Awareness of the Steering Committee on what they want (are they sure they want a standard or still debating)

2) It was emphasized that the model would have been found too simple without the inclusion of the different viewpoints of the stakeholders.
   The **use of one more stakeholder analysis model**, from NEN (Netherlands Standards Institute), was suggested to be able to make sure that all possible stakeholders are

recognized. The model is shown in Table 14. The importance of the stakeholder selection was pointed out. As the experts mentioned, the selected members are important because developers are the early adopter.

	Stakeholders	Description
1.	Direct users	End user of service, process or product
	Sector organizations direct users	As a group, in the form of interest groups
2.	Favourable organisations/clients and sector organisations of favourable parties	Organisations which set the conditions the product or service must fulfill. For example, clients. Legal conditions are set by lawmaking bodies.
3.	Advisory organisations	Organisations which can advise other interested parties (e.g. engineering firms, consultancies)
	Sector organisations of advisory parties	
4.	Executive/user/service-providing organisations and sector organisations of executive/user/service-providing parties	**Product normalization**: organizations which use/apply the product in their services towards end users (e.g. contractors, installers). **Service normalization**: organisations which provide a process of service to the end user (e.g. debt counsellors)
5.	Producers/suppliers of main product	In the case of **product normalization**, this is the main producer/supplier. In the case of **service normalization**, this category is not used.
	Sector organisations of producers/suppliers of main product	
6.	Producers/suppliers of attached products and services	In the case of **product normalization**, this concerns producers/suppliers of products which appear in the product chain as raw materials, semimanufactures or residual/waste products. In the case of **service normalization**, this concerns the providers of supplementary products.
	Sector organisations of producers/suppliers of attached products and services	
7.	Research and knowledge institutions	Institutions which supply knowledge or carry out research without a direct commercial interest.
8.	Inspecting bodies	Inspection services, certifying bodies
9.	Legislative bodies	Governments
10.	Existing/new initiators	Parties undertaking alternative initiatives comparable to NEN (standards, certification schemes, guidelines)
11.	Those who determine the context of the greater whole	Organizations (like foundations or platforms) involved in a generic way.

Table 13. NEN stakeholder analysis (source: Folmer & Punter, 2011)

3) The experts agreed on the recommended points with two additions. First, the visualization was considered as a good idea with a **roadmap**, which could be presented before the high pressure week starts. One improvement idea is to show this roadmap a couple of times through the standardization process. At every "checkpoint" both the **activities left behind the ones coming next should be presented**.

Second, according to the experts, there can be **two expectation gaps** (workgroup viewpoint) recognized:

1. Between the perceived and expected results of the Pressure Cooker,
2. Between the expected happenings after the first result and the reality

Small comment on the description of task and objectives is that it must be emphasized that TNO is facilitator of the development and the result of the high pressure week is the group's standard.

4) Neglecting the two solutions that were considered not appropriate was approved by the experts. Besides, the expert introduced another alternative from practice. **The reviewing can be divided among the workgroup members**. Critical point is the achievement of consensus on who is responsible for what, but if they manage to agree then everyone has less to do. When they managed to finish the reviewing, they send the comments to the experts. Another slightly different solution is to divide the document between the members and assign one responsible person to each part. Those who are reviewing the same part, have to send their comments to the responsible person. This person then combines the different comments and sends the result to the experts.
Furthermore, the roadmap, mentioned earlier, can help to prepare the workgroup to plan time for the reviewing after the high pressure week. The survey result, which shows that average 10-15 man-hours are spent with reviewing, can be used to make the task more tangible.

5) The wiki was found appropriate for information distribution by the experts, but they emphasized that the involvement of the workgroup is still a challenge. An idea **to get better input from the workgroup is a generic list of questions**:
    - How does your process look like?
    - What kind of forms do you use in the process?
    - Which standards do you use or do you think could be used?

Furthermore, considering the low number of workgroup members, it should not be a big effort by the experts to **call the participants** one by one and give them a short request to share their organization's knowledge.

5.4 Overview of the improvement ideas

Table 15 contains the list of ideas that were chosen in order to improve the as-is Pressure Cooker method by addressing its major issues. The majority of the ideas were found from literature and some ideas from standardization experts were added to these.

Issue	***Improvement idea***	***Comment***
Lack of list of characteristics	To decide whether the Pressure Cooker method suits for the development approach	• Should be below 10 Steering Committee members • The Pressure Cooker suits for minimalist

	consider the following project characteristics: 1. Number of stakeholders 2. Number of specifications 3. Technical knowledge and related practical expertise of the experts 4. Target, 80-100% 5. Level of commitment 6. Complexity of the business network/environment 7. Maturity level of the standard 8. Innovation level 9. Awareness of the Steering Committee on what they really want	approach, but does not for structuralist approach. • The Co-Pilot has to be familiar with the chosen technology and with the Pressure Cooker method too. Practical expertise with the technology seems to be crucial. • The Pressure Cooker suits for projects where the goal is an 80% standard. But not suitable for 100% standards. • Without committed participation the Pressure Cooker is not applicable. There are cases when certain stakeholders cannot be left out even if the analysis does not involve them. In these situations, the time-extended method is the better choice. • The larger complexity can undermine the common goal of the stakeholders and can make the decision making longer. If any of these occur, the Pressure Cooker method is not recommended. • Maturity is related to the target. In the case of a matured standard, the update always have to be a 100% standard. If the size of the modifications make the 100% standard impossible within the boundaries of the Pressure Cooker method then the time-extended method should be used to resolve the time or cost constraints. • The Pressure Cooker method cannot be applied in the case of anticipatory standards development. A Pressure Cooker project needs clear scope and the development time is limited. None of these features beneficial for the development of anticipatory standards. • Does the Steering Committee know what it wants? Are they sure they want a standard or still debating? Latter means a definitely no-go for a Pressure Cooker project.
Who should be in the workgroup?	6 steps of stakeholder selection: 1. Identify stakeholders 2. Define task 3. Identify interests 4. Define the skills and knowledge needed 5. Categorize the stakeholders 6. Select, aim maximum 10	1. Use Table 10. 2. What type of task do the group have to deal with? The answer to this question paves the way to step 4. 3. Use the decision tree from Figure 9. 4. What are the skills of the members that are needed to be included in order to have the task done? 5. Decide whether a stakeholder is driver, contributor, observer or adopter by using the Generic Strategies Matrix (Figure 13)

	members	and the Decision Making Tree (Figure 14).
Expectation management	3 tasks for the standardization experts: 1. Clarify the characteristics, tasks and objectives of the high pressure week 2. Describe the task and objective of the workgroup members 3. For visualization of the state of the process use roadmap	1. Make sure they understand that TNO is facilitator of the work but does not own it. The standard is their solution. 2. Use of self-fulfilling. 3. Should present both the activities left behind and coming next.
Review process	As part of the preparation, warn the workgroup members that they have to plan time for the reviewing following the high pressure week. On the last day of the high pressure week, **divide the workgroup into smaller reviewing groups who have to focus on only certain part of the Draft**. For reporting the feedback, there are two solutions. a) The workgroup members **directly send their reviewed part to the standardization experts**, or b) the divided parts of the Draft have **a responsible workgroup member, who has to combine others' reviews** regarding his/her part of the standard and send this combined version of the review to the standardization experts.	Semantic wikis need further research before implementation, therefore the use of it is not recommended now. Alternative b) needs some kind of analysis to be able to select reliable workgroup members with the necessary expertise to do the work. Because this analysis is not defined in the research, alternative a) is recommended.
Planning: preparation and the last day of the high pressure week	Use a wiki to distribute preparation information for the high pressure week. Use the following generic list of questions addressed to the workgroup members, in order to foster the better information input: 1. How does your process	A Kick-off session could be a boost of the preparation, but it can be exchanged with a phone call. The workgroup is relatively small and one of the standardization experts (Chairman) can call the members one by one. The phone call can be used to motivate the workgroup in answering the list of input questions. Besides, it is easier to do and has much lower costs than organizing a meeting.

look like? 2. What kind of forms do you use in the process? 3. Which standards do you use or do you think could be used? Plan for the last day of the high pressure week: 1. Manage the ideas/issues from the Parking lot 2. Set up technical requirements for the standard 3. Lunch 4. Present and discuss the roadmap 5. Form reviewing groups 6. Close the week with an informal activity (drinks)	

Table 14. The list of improvement ideas to use for a proposed Pressure Cooker version 2

The standards on standardization recommend the following aspects:

- Keep the workgroup size low.
- Make sure that wide variety of perspectives is present.
- *Limit the number of on-site/live meetings.*
- Use consensus in decision making.
- Make the Steering Committee responsible for the unsolvable workgroup questions.
- *Allow small-scale changes without consensus*
- Base the reviewing on consensus
- The Chairman's task: resolve disputes, lead, keep contact with Steering Committee
- The Assistant's task: administrative tasks

Except two items of the list, all the points are adopted in the improvement ideas. Limiting the number of live meeting is violated in the meaning that the development needs the presence of the Workgroup members. But on the other hand, for the preparation, information distribution and reviewing, the live meetings are just optional. However the standards refer to the standards development process via internet, therefore the list of improvement ideas are not supporting it. The second point in the list, which is violated, is the allowance of small scale changes without consensus. In the Pressure Cooker method, the decisions are always consensus based. The standards suggest the exception with small scale changes in decision making referring to large standards development efforts with a lot of stakeholders. This project characteristic does not suit for the Pressure Cooker method, therefore it does not have to be adopted.

The recommendations related to the stakeholder participation from Chapter 2.5 are all included in the ideas. The next chapter presents the proposed version 2 of the Pressure Cooker method that already contains the improvement ideas, which were shown in this chapter.

6 Proposed Pressure Cooker version 2

The main objective of the research was to find out how the Pressure Cooker method can be more reliable than the as-is Pressure Cooker method. The first building block to answer the research question was the representation of the as-is method. The three applications of the Pressure Cooker were compared and analyzed in order to be able to describe the as-is Pressure Cooker method. When the method has been explored, the participating workgroup members and standardization experts were approached. Targeting the identification of issues in the currently used process, the experts were interviewed and the workgroup members were asked to fill in a feedback survey. These information sources provided enough insights to recognize and distinguish major and minor issues. The major issues are addressed in the current work. The minor issues should be further investigated in a follow-up study.

In this chapter, the Pressure Cooker version 2 method is described. Considering that the proposed version is built on the as-is method, it shows many similarities. Therefore, on Figure 16, Figure 17 and the following description of activities contain color highlighting to make the changes more visible.

1. Setting up Steering Committee

Actors	Different stakeholders who are connected by a shared business problem
Task	Responsible for the development and management of the standard
Output	Operational and financial plan of the committee

The first activity determines four important things, the form of the organization, the members, the operational plan and the financial plan. The organizational form can be foundation, association or government organization and it does not influence the Pressure Cooker method. The Committee has to agree on the operational and financial plan in the beginning. The operational plan describes the way of doing their work including regulations of decision making, administrative work, and control type. The latter needs decisions on the financial support of the organization. Typical topics are membership fee, estimated costs, and price of the standard.

The Committee manages and the coordinates the development and management of the standard and recommends the Workgroup members to the standardization experts.

2. Decide on scope, set up planning, select the members of the Workgroup	
Actors	**Steering Committee members** and standardization experts
Input	Common goal
Output	Scope document version 1, Schedule, List of Workgroup members

(I) **Decide on the scope:** The Committee has to define the scope of the standard they want to be developed. The agreement on the scope ensures that all the stakeholders know what the problem is and what the business process, where the standard should provide interoperability, is. The scope document makes the list of requirements clear and shows what the solution does not have to cover. After the scope has been clarified, the Committee has to decide which standards development approach they want to apply.

(II) **Select standards development approach and set up planning:** At this point, the Steering Committee has to decide whether they want to use the Pressure Cooker method for the development of the standard or not. The standardization experts can help the choice with the following list of characteristics of the project:

1. Number of stakeholders
2. Number of specifications
3. Technical knowledge and related practical expertise of the experts
4. Target, 80-100%
5. Level of commitment
6. Complexity of the business network/environment
7. Maturity level of the standard
8. Innovation level
9. Awareness of the Steering Committee on what they really want

The guideline to make the decision is described in Chapter 5.4. In the following part, the selection of Pressure Cooker method is described, the time-extended approach is out of scope.

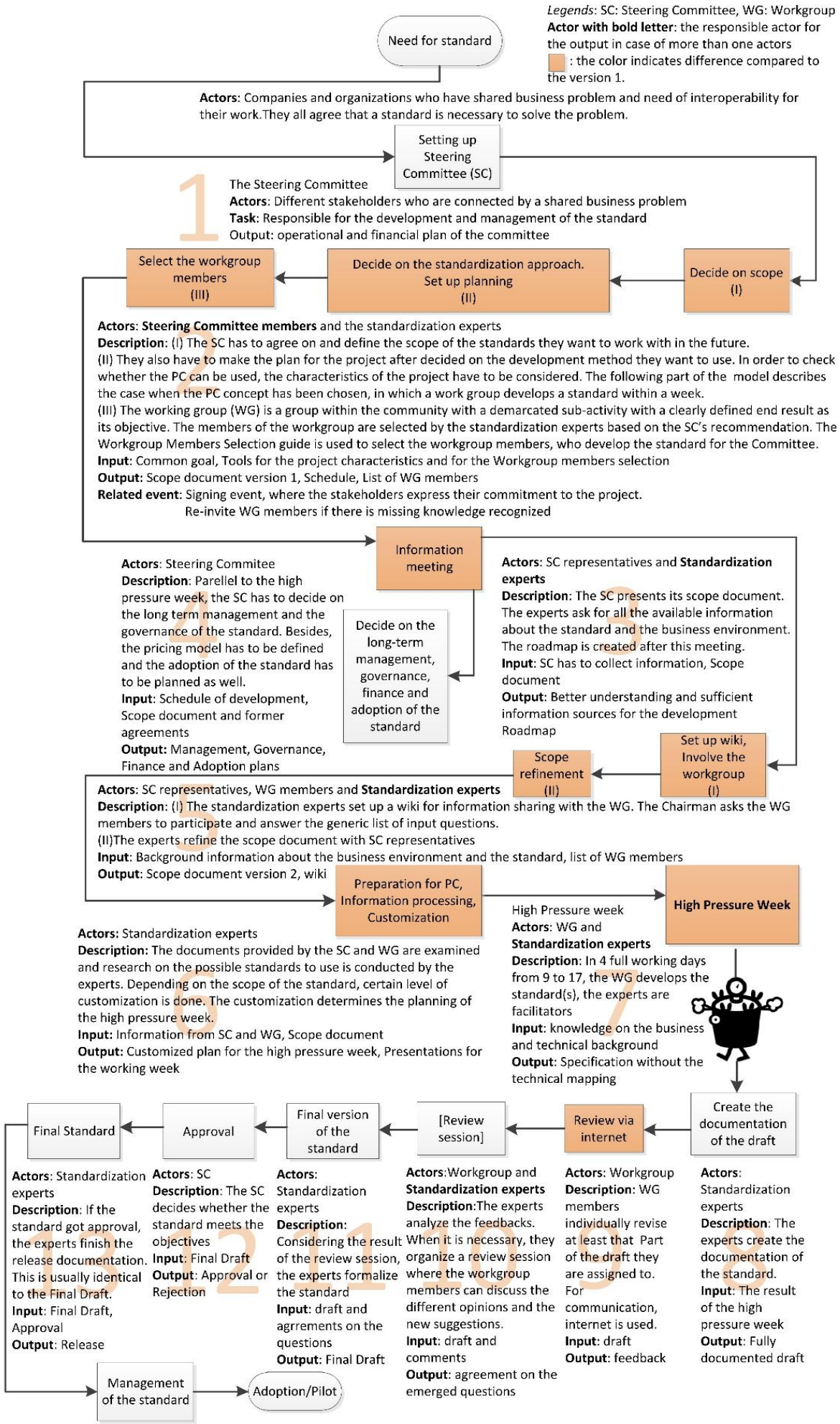

Figure 16 The Pressure Cooker version 2

The Steering Committee has to set up the planning for the development. They decide on the starting time and the dates of milestones. The milestones are the date of the draft version, the date of review, the date of delivery to the Committee and the date of the final standard. The planning is the key to be able to provide the standard for the pilot or adoption in time. The period for the high pressure week is also selected by the Steering Committee, but this can be slightly changed later.

(III) **Select the members of the Workgroup:** The Steering Committee recommends workgroup members to the standardization experts, who should follow the 6 steps of workgroup members selection guide to build a diverse and potentially productive group:

1. Identify stakeholders
2. Define task
3. Identify interests
4. Define the skills and knowledge needed
5. Categorize the stakeholders by using the Generic Strategies Matrix (Figure 13) and the Decision Making Tree (Figure 14)
6. Select the members, aim maximum 10 members

The steps are described in details in Chapter 5.4.

The second step of the model normally takes around 1 month, but this period highly depends on the Steering Committee members. If they can agree on the issues easily, then the agreement and plans can be done in shorter time.

3. Information meeting with the standardization experts	
Actors	Steering Committee representatives and standardization experts
Task	The Steering Committee has to collect documents with information that is essential for the standard, Scope document
Output	Better understanding on and sufficient information sources for the development, Roadmap

As preparation for the information meeting, the standardization experts ask the Steering Committee to collect all the available information about the standard and the business environment, where it would be implemented. Besides the aforementioned documents, the Steering Committee representatives also present the scope document, which they defined for the standard.

After the meeting, with the use of the information provided by the Steering Committee, the standardization experts create the roadmap that helps to visualize the development process. The roadmap is used throughout the standardization process in order to clarify the activities that either have been passed or are coming later. This way, the schedule, the roles and tasks can be easily communicated to the participants.

In total this activity can take up to two weeks, including the preparation and the one-day long information meeting.

4. Decide on the long-term management, governance, finance and adoption of the standard

Actors	Steering Committee
Task	Schedule of development, Scope document and former agreements of the Steering Committee
Output	Management, Governance, Finance and Adoption plans of the standard

This activity occurs parallel with the high pressure week in time. The Steering Committee has to finalize their plans with the standard. They have to decide on the long term management and the governance of the standard. Besides, the pricing model has to be set up and the adoption of the standard has to be planned as well. The questions, they have to decide on, can be summarized as:

Management: Who, how and what will do with the standard?

Government: Who and how can decide on the future of the standard?

Finance: Who, when and how much have to pay for the standard?

Adoption: Who, when and how will start the diffusion of the standard. Consider the use of a pilot project.

The Management and Development Model for Open Standards (BOMOS) model (Folmer and Punter 2011), which is currently in the progress of becoming an European standard for standards governance, is used for inspiration to answer these questions.

In ideal case, the Steering Committee should be done with these decisions by the end of the high pressure week in order to provide seamless process for the standard in the future. Previous practice showed that a delay in the deadline would lead to delays in the standard diffusion. Uncertainty does not help the process, and the Steering Committee has to try to mitigate it by reaching consensus in time.

In order to agree on the management, governance, finance and adoption of the standard, the Steering Committee can start the discussions a week before the high pressure week. This also means that they have two weeks to produce the output of this activity.

5. Set up wiki, involve the Workgroup and refine the scope

Actors	Steering Committee representatives, Workgroup and standardization experts
Task	Background information related to the standard and the business environment, Scope document, list of Workgroup members
Output	Scope document version 2, wiki

(I) For information distribution, the standardization experts set up a wiki for the project. The wiki is used to share information with the Workgroup and also allows the Workgroup members to add their documents to the knowledge repository. Since the experts already know the workgroup members, they can send them a list of questions that helps with the information gathering for the high pressure week. Because the amount of information shared and the quality of it highly depends on the activity of the participants, one of the standardization experts (Chairman) should call and ask for cooperation the members one by one.

The standardization experts typically use the following questions:

- How does your process look like?
- Do you use forms in the process?
- Do you use or know about standards that are or could be used?

(II) By this step, the experts checked the information and scope provided by the Committee. Two Steering Committee representatives and the standardization experts refine the scope together. This refinement makes sure that the standard development is feasible with the Pressure Cooker method and it is possible to develop it within the high pressure week. The scope document has to clearly state the boundaries, and the parts of the business process that must be included in the standard. In practice it was experienced that it is good to point out processes that are not in the interest of the standardization as well. This decreases the likelihood of getting out of the scope during the discussions of the high pressure week with the Workgroup.

Without the preparation time, the meeting takes only one day. With the preparation, it takes 1 week.

6. Preparation for the high pressure week, information processing and customization	
Actors	Standardization experts
Task	Information provided by Steering Committee and the Workgroup, Scope document version 2
Output	Customized plan and presentations for the high pressure week

The Chairman and the Co-pilot read and analyze the information provided by the Steering Committee and the Workgroup in detail. Based on the scope and their understanding on the needs and background, they make the planning for the high pressure week. The planning gives opportunity for some sort of customization. The type of standard can influence the time needed for the Business Domain Model or for the Information Model. The experts decide on this question and schedule the week according to that. For the information distribution, it is suggested to use a wiki. Here both the experts and the workgroup members can share information with each other.

The experts also prepare the presentations and supporting tools for the high pressure week. They need one week to get ready for the high pressure week.

7. High pressure week	
Actors	Workgroup and standardization experts
Task	Knowledge on the business and technical background, prepared materials for the work
Output	A standard draft without technical mapping, agreement on the reviewing

Activity 7, the high pressure week, is the core of the Pressure Cooker method. This week gives a quick first step in the standard`s life by decreasing the development time to one single week. Figure 17 represents the activities in the high pressure week. The dashed stroke in the figure shows the activities within a week. The high pressure week consists of four main activities.

First, there is the Kick-off. The Kick-off covers the welcoming and the introduction presentations. The first presentation introduces the Chairman, the Co-pilot, and the workgroup members. Later a Steering Committee representative presents the background and the goals of the whole project. This presentation places the upcoming work of the group into a broader context. Afterwards, the Chairman presents the goal and the schedule of the following days and explains the game rules for the work. The rules, shown in Table 16, are simple, but necessary for success. One of the rules introduces the Parking lot, which is basically a list of issues that cannot or just in too much time can be discussed when they occur.

Strive for consensus
Everyone has to be ready compromise
The time is limited, the participants must restrict themselves
The issues that cannot be solved immediately are written down and discussed later, this is the so-called "Parking lot"
The Steering Committee is available in case of 'emergency'
Everyone is expected to focus on this project during the week

Table 15. Game rules for the high pressure week

The Chairman should use the roadmap to make sure that the workgroup understands the schedule, the objectives and the tasks of the Pressure Cooker method.

Second, the Workgroup has to identify the roles in the business environment. The tasks and activities have to be determined for each role. If the process is relatively straightforward and there are not too many different scenarios, the workgroup builds the process model too. Afterwards, the information exchange points and the exchanged messages are identified. The creation of the Business Domain model starts on the first day, and depending on the customization, can be continued on the second day of the high pressure week.

Third, on day 2-3-4 depending on the customization, the Workgroup creates the Information model. The terms and definitions for each message element and the business rules are defined during these days.

Fourth, in the beginning of the last day of the high pressure week, the standardization experts return to the issues and questions stored (and not solved yet) from the Parking lot. The list is usually not too long by then, because most of them are discussed somewhat later than they occurred. Most probably, the majority of the features are included as optional element now, just to keep on the harmony and fasten the process. When the remaining issues are discussed, the Workgroup agrees on the technical requirements. The high pressure week does not include technical mapping, these requirements are defined for the draft that will include the technical mapping too.

After the technical requirements have been discussed, the Chairman wraps up the achievements and presents the process with the roadmap. Besides, the Chairman describes what to expect from the upcoming reviewing process. To speed the reviewing up and make it less time-consuming, the revision of smaller parts of the draft are recommended to be assigned to a few members. In other words, the standardization experts divide the documentation of the standard into parts and assign 2-3 workgroup members to each part.

This solution enables the Workgroup members to finish their reviewing part faster, since they do not have to focus on the entire document. Of course, no one is prohibited to do more than the necessary.

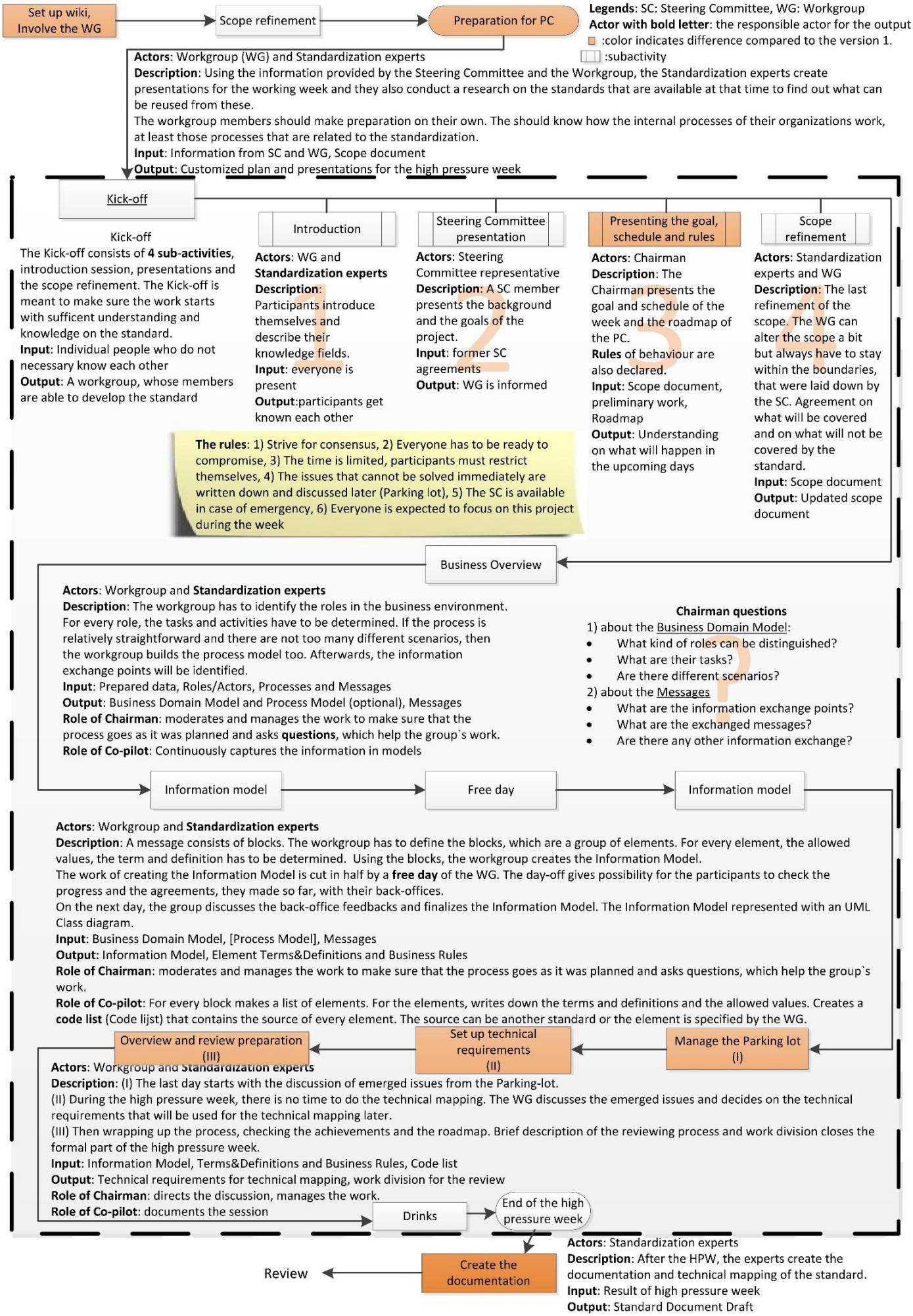

Figure 17 High pressure week in the Pressure Cooker version 2

8. Create the documentation of the draft

Actors	Standardization experts
Task	The result of the high pressure week
Output	Fully documented draft

After the high pressure week, the experts create the documentation and technical mapping of the standard. The experts finish the documentation in the 2 consecutive weeks. In this step, additional experts can be involved in the project to fasten the work.

9. **Review via internet**

Actors	Workgroup members
Task	The draft version of the standard
Output	Feedback on the draft

The workgroup members individually revise that part of the draft they were assigned to. Internet is used for communication. This makes the information gathering easier and decreases the response time compared to reviewing of printed documents. The workgroup members have 2 weeks to do the review and send their comments.

10. Review session

Actors	Workgroup and standardization experts
Task	Draft and comments
Output	Agreement on the emerged questions

The standardization experts analyze the workgroup's feedback on the standard. If they think it is necessary, they organize a review session where the workgroup members, where they can discuss the different opinions and the new suggestions. The meeting takes place on one day, but with the preparation, the activity takes a week.

11. Final version of the standard

Actors	Standardization experts
Task	Result of the review session
Output	Final Draft

Using the result of the review session, the standardization experts finalize the standard and its documentation. This process takes up to 1 week.

When the work on the standard is finished, the experts deliver the final standard to the Steering Committee. This final standard is usually used for pilot projects first. From now on, the Steering Committee has the responsibility to decide what to do with the standard. If step 4 has been successfully concluded, then there are no open questions about the management at this point.

12. Approval

Actors	Steering Committee
Task	Final Draft
Output	Approval or refusal

The standardization experts deliver the standard that has been revised by the Workgroup. This version has already included small changes where it was necessary. The Steering Committee reviews the final draft and decides whether it satisfies their needs or not. According to that decision, they either approve or refuse the standard. It is possible to approve a standard with the request of minor changes as well.

The model does not contain the extra activities that occur when the Steering Committee does not approve the standard, because that event could be followed by a few different scenarios depending on the cause of the refusal.

In the case of approval, the standard will be called Release and the Pressure Cooker standards development process ends as soon as the standardization experts deliver the Release.

This activity usually takes 1 week.

13. Final standard

Actors	Standardization experts
Task	Make minor changes and finish the standard
Output	Release

In the case, the final draft has been accepted, the standardization experts put the documentation of the standard in the final form. If minor changes without the need of another approval are suggested by the SC, these are done in this activity.

14. Management of the standard

From this point, the Steering Committee has the responsibility to decide what to do with the standard. If Activity 4 has been successfully finished in time, then there are no open questions about the management.

7 Discussion

The research described a new semantic standards development method; the Pressure Cooker method. Although the method has been adopted in three applications successfully, the characteristics of the method were not recognized. The presented research aimed to fill in this gap in order to create a theoretically grounded method that is not just able to shorten the development time of semantic standards but also capable to achieve successful implementations. The final design of the method has to meet the 12 requirements, which were defined in Chapter 4.2. The requirements are listed in Table 14.

Requirement	Proposed Pressure Cooker, method version 2	
The Pressure Cooker should not be more expensive than it is now.	The proposed improved Pressure Cooker method does not contain any activities or processes that would significantly increase the price. Moreover, if the improvement ideas are able to handle the issues, then we can expect that the development process gets closer to the theoretical optimal of 15 weeks. In this case, if other characteristics of the method stay the same (e.g. number of standardization experts) then we can say that fewer man-hours are spent on the development ergo leading to lower costs. But this holds true only in the case, where the other characteristics are not changing.	
If the current length of the high pressure week is to be changed, care should be taken that there is no negative impact on other characteristics of the method	The length neither got longer, nor got shorter. Maybe the reviewing process can become shorter with the new task division, but this would not cause radical change either. Therefore, there is no negative impact that is rooted in the change of the development time.	
The quality of the standard developed with the Pressure Cooker method should not be lower than it is now (80% standard)	The proposed Pressure Cooker method provides the same quality of the standard as the original method, but in a more thoughtful way. The achievable quality for a Pressure Cooker approach has been defined as an 80% standard and it is recognized that the method does not fit to projects where the target is 100%.	
The final standard of the Pressure Cooker has to achieve the objectives set by the Steering Committee.	The proposed method provides the same and some additional outputs compared to the as-is Pressure Cooker. There is no reason to think that the Steering Committee would have any reason to perceive the results differently.	

The standards development time with buffer-time included has to be less than 18 months. Additionally, the theoretically shortest standardization time has to be clearly stated.	The proposed method has the 13 activities just like the as-is Pressure Cooker. Because the reviewing process has not been radically changed, in the end the theoretical shortest development time remained 15 weeks. If we estimate the buffer time based on the as-is model, the proposed Pressure Cooker method will be between 6 and 8 months.	
To foster the repeatability of the Pressure Cooker method, the process must be documented and supported with a guide.	The research provides two workflows that represent the proposed method. The first is an overview of all the activities in the process and the second is focusing on the high pressure week. The textual explanation of both workflows is rich, but the activities are described one by one to enhance the details. The workflows and the extra descriptions have overlapping parts to be useful individually as well. However the authors advise to use both products simultaneously for the better understanding	
It has to be identified, in which context the method can be used successfully, and the characteristics of such a context have to be listed. Additionally, characteristics have to be identified and listed that make the method not applicable.	Nine characteristics have been identified that can be used to determine whether the proposed Pressure Cooker method can be applicable or not. For each characteristic, the required values for Pressure Cooker are described. These characteristics are shown in Chapter 6.	
The method has to propose a guideline for the workgroup size and the composition.	A 6 step Workgroup members selection guideline is presented in the work that suggests to aim a diverse workgroup of 10 members maximum.	
The method has to pay attention on managing the expectations of the participants according to what the Pressure Cooker is able to and supposed to do.	The research defines three additional tasks to the standardization experts that help them to manage the expectations. These tasks are shown in Table 12.	
The reviewing process has to become less work-intensive for the workgroup members and the experts by eliminating unproductive activities from the current method. To do so, the unproductive activities have to be	The unproductive activities have been identified as the redundant work and information generation. The two proposed method contains a solution to reduce the workload and work-redundancy for the reviewers. Because the semantic wiki did not proved to be beneficial and therefore was left out of the proposed solution, the reviewing did not change a lot to the standardization experts.	

identified first.		
There should be a tool to support the preparation for the high pressure week.	Supporting the preparation, the use of a wiki was found to be the simplest and cheapest solution to spread information among workgroup members and standardization experts.	
The tasks to be done on the last day, in order to get the most out of the high pressure week, should be described.	According to the proposed Pressure Cooker method, the following activities should form the program for the last day: 1. Manage the ideas/issues from the Parking lot 2. Set up technical requirements for the standard 3. Lunch 4. Present and discuss the roadmap 5. Form reviewing groups 6. Close the week with an informal activity (drinks)	

Table 16. The proposed Pressure Cooker (version 2) and the requirements

As Table 17 evaluates the proposed Pressure Cooker method regarding the requirements, we can see that 11 out of 12 requirements are fully met (tick symbol: ✓) and one requirement is partly satisfied (negative symbol: –). Compared to the as-is Pressure Cooker, the proposed method managed to satisfy almost all the requirements, till the other one met only two. The proposed Pressure Cooker version 2 also managed to handle four major issues, which were identified in the as-is method, and provide a part-solution for the issue regarding the reviewing.

The following table summarizes the changes between the two versions of the Pressure Cooker method regarding the satisfaction of the requirements.

Requirement	As-is Pressure Cooker	Proposed Pressure Cooker
The Pressure Cooker should not be more expensive than it is now.		
If the current length of the high pressure week is to be changed, care should be taken that there is no negative impact on other characteristics of the method		
The quality of the standard developed with the Pressure Cooker method should not be lower than it is now (80% standard)		
The final standard of the Pressure Cooker has to achieve the objectives set by the Steering Committee.		

The standards development time with buffer-time included has to be less than 18 months. Additionally, the theoretically shortest standardization time has to be clearly stated.		
To foster the repeatability of the Pressure Cooker method, the process must be documented and supported with a guide.		
It has to be identified, in which context the method can be used successfully, and the characteristics of such a context have to be listed. Additionally, characteristics have to be identified and listed that make the method not applicable.		
The method has to propose a guideline for the workgroup size and the composition.		
The method has to pay attention on managing the expectations of the participants according to what the Pressure Cooker is able to and supposed to do.		
The reviewing process has to become less work-intensive for the workgroup members and the experts by eliminating unproductive activities from the current method. To do so, the unproductive activities have to be identified first.	not applicable	
There should be a tool to support the preparation for the high pressure week.	not applicable	

The tasks to be done on the last day, in order to get the most out of the high pressure week, should be described.	not applicable	

Table 17. Comparing the Pressure Cooker versions regarding the requirements

8 Conclusions

8.1 Results

The research question was as follows:

How can the Pressure Cooker method be consolidated into a reliable method for the development of semantics ICT standards?

The answer to the research question is that the Pressure Cooker method can be consolidated by being formalized and described. The contribution of this thesis is that the Pressure Cooker method is formulized in a way that both practical and theoretical knowledge have been applied. Besides the method includes guidance for the successful application. Furthermore the thesis also identified conditions that consider the features of the method and make the standardization experts able to determine whether the method can be applied in a standardization project. As a result, we expect that the proposed Pressure Cooker method does not only shorten the development time compared to the time-extended method but it also handles the issues that are present in the as-is Pressure Cooker method. Because the proposed Pressure Cooker method is understood better and can be applied more reliable than before, we expect the method to be more reliable than the as-is Pressure Cooker method.

The Pressure Cooker method speeds up the Workgroup's work by organizing the work sessions within a week. These work sessions normally take around 4-5 months with the time-extended method. The shortened development time implies tradeoffs though. This research identified nine characteristics of a standardization effort that can determine whether the Pressure Cooker method is applicable. To be able to use the Pressure Cooker method the following characteristics have to hold true to the project:

- The number of the Steering Committee members should be below 10.
- The project has to follow a minimalist approach, and not a structuralist approach.
- The Co-pilot has to be familiar with the chosen technology and with the Pressure Cooker method too.
- The goal has to be an 80% standard. The Pressure Cooker can give a fast first step toward the final standard. The result of a Pressure Cooker can be best used for a pilot project and subsequently fine-tuned in the pilot.
- Without committed participation the Pressure Cooker is not applicable. There are cases when certain stakeholders cannot be left out even if the analysis does not suggests the involvement of them. In these situations, the time-extended method is the better choice.

- The larger complexity of standardization project has can undermine the common goal of the stakeholders and can make the decision making longer. If any of these occur, the Pressure Cooker method is not recommended.
- In the case of a mature standard, the goal is not an 80% standard anymore, but a 100% one. Therefore, if the size of the update does not allow 100% standard scope in the project management triangle (Figure 12) with the given time and cost attributes, the Pressure Cooker method cannot be used. With small changes, the Pressure Cooker method can be applied, because the 100% target can be reached within the boundaries of the project.
- The Pressure Cooker method cannot be applied in the case of anticipatory standards development. A PC project needs clear scope and the development time is limited. None of these features beneficial for the development of anticipatory standards.
- If the Steering Committee does not unanimously agree on the development project then the Pressure Cooker should not be used because of lack of commitment and clear goal.

We found that when the characteristics allow the application of the Pressure Cooker method, it can reduce the development time theoretically to 15 weeks and in practice to 6-8 months.

The proposed Pressure Cooker method version 2 is expected to be even better than the as-is method, because it provides solutions for 5 major issues that were recognized in the first approach. Important benefits of the proposed method compared to the as-is method are:

- the repeatability, enabled by the models and the guidelines,
- the possibility to determine the suitability to the standardization effort,
- the guideline to set up a Workgroup that can work effectively and has the necessary skills and knowledge,
- the suggestions for in-built expectation management,
- the less work-intense reviewing process for the Workgroup members,
- the structured schedule for the high pressure week, and optimized plan for the last working day for the best result.

The research goal was reached by the proposed improved Pressure Cooker method, since it describes a semantic standards development approach that handles the issues of the as-is Pressure Cooker method and results in a solution faster than the time-extended approach when the project has the previously described characteristics.

8.2 Limitation

The structured literature review proved that the field of semantic standards development is not matured enough yet. The participation in standardization efforts is examined in details but the development time is just addressed as a factor to distinguish the formal and informal standardization organizations. Although the processes used by informal organizations are faster than the methods used by SDOs, but the Pressure Cooker method clearly shows, there is still room for improvement.

An approach that did look promising from the literature is semantic wiki technology. But we could not apply this successfully in practice during the research. It needs further investigation whether the potential of using semantic features are worth the preparation, building and setting up of a wiki.

8.3 Further research

In general, the literature is exclusively focused on the reasons behind the involvement in standardization projects. Another finding about the research field is that the formal SDOs are overrepresented in the studies, even if informal SSOs seem to provide more exciting results in terms of development techniques and speed. Furthermore, the importance of consortia based standardization often seems to be lower than studies about SDO decision making or revenue sources.

The proposed Pressure Cooker method should be validated in practice by TNO. This could result valuable feedback about the improvement ideas.

In the proposed method, the major issues were addressed but some minor ones remain. Probably, after a real case implementation, the list of issues could be reevaluated. A new list of issues would pave the way for new research aiming for the improvement of the method.

An issue left open by this study is the reviewing process. The possible use of semantic wikis or other alternatives should be the topic of a future study.

This thesis is focusing on the field of semantic standards development. Research should examine and cover the generalization of the proposed Pressure Cooker method in order to fit to other kind of projects.

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Appendix

Appendix A - The guide for the interviews

1. In how many Pressure Cooker applications have you participated?
2. What was your role in this/these?
3. Do the participants from the companies consider it successful? Do you consider it successful?
4. What do you think about the Pressure Cooker method?
5. How did the standardization process look like?
6. What are the milestones in the Pressure Cooker?
7. How many people participate? How do you select the right stakeholders? Is it easy to convince the companies to participate?
8. What do you think about the workgroup? (size, represented knowledge, etc.)
9. What kind of preparation do the TNO experts have to do? What kind of preparation do the participants have to do?
10. Did you use existing standards as a base? Re-use?
11. What are the tasks of the TNO experts? Before, during and after the PC. How is the process captured, recorded? Are there supporting tools? Is there need for them?
12. How were you capturing the information during the high pressure week? Did you face difficulties?
13. When do you agree on the final (target) deliverable? What is the % of this standard?
14. Are there development supporting tools used? Are there decision making methods used?
15. How strict is the schedule of the PC? How much deviation is possible?
16. Is the workload during the week in balance with the final deliverable? Too much work, not good enough result maybe?
17. How much freedom do the participants have in the development process?
18. How much work is left after the PC? (in number of days, and in %) Who has to do this work?
19. Do you think a second short PC or a sidetrack meeting with developers and technical people only would be beneficial after the PC? When the business perspective is clear and the technical part could be done precisely.
20. In your opinion, what is the problem or limitation of the Pressure Cooker?
21. How would you improve the Pressure Cooker?

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	29	20	21
I.	Expert A	X	X	X	X	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-
II.	Expert B	X	X	X	X	X	X	X	-	X	X	X	X	X	-	X	X	X	X	X	X	X
III.	Expert A	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	-	X	X	X	X	X
IV.	Expert C	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	X	X	X	X	X	X
V.	Expert C	-	-	-	-	-	-	-	X	-	-	-	X	X	X	X	-	X	-	X	-	X
VI.	Expert D	X	X	X	X	-	-	X	X	X	-	-	X	-	X	-	-	-	X	-	X	X

Table 18. Topics on the interviews

The heading of Table 18 represents the 21 questions and topics of the guide. The first column contains the interviews with the experts. The "X" means that the particular question was asked in the interview and "-" means that the topic was not covered by the interview.

Appendix B - Interview summaries

Summary of Interview 1, with Expert A – 10/12/12

Key findings
In the scope document, the business problem has to be addressed.
There are different expertise with different objectives in the workgroup. How to deal with this?
15 people form a too large workgroup.

The standardization experts A, who was the Chairman of one Pressure Cooker project, described the standardization process from the first meeting between the Steering Committee and TNO. This is activity 3 in Model 0. Expert A contributed to the research with three refinement ideas. First, he emphasized that there are many open questions related to the scope. Scope must be clear and well-described in a way that the business problem is addressed. Second, he argued that the stakeholder selection activity could be more regulated, formalized. Third, he presented the problem of the stakeholders with different backgrounds and expertise. Business and technical demands are often opposite, this has to be handled during the high pressure week. He suggested that this situation might be solved with two workgroups. One business-oriented and another technical-oriented.

His opinion is that a workgroup of 15 –that is the number he had in his case- is too large. The high pressure week in this project took 4 days, and a free day was not included. Although, the third day morning was reserved to let the workgroup discuss the issues and the progress with their back-office.

Expert A also recognized a problem that the organizations need more support from TNO after the Pressure Cooker project. According to him, the Steering Committee had no clear understanding on where the boundaries of the Pressure Cooker and the experts' tasks lie and partly therefore the formulization of the standard took too long.

Summary of Interview 2, with Expert B – 13/12/12

Key findings
The place and objective of the Pressure Cooker should be clear to the stakeholders.
Standardization experts have to face hard workload during the high pressure week.
The price of the Pressure Cooker is an important factor for the customers.

The idea of the Pressure Cooker method comes from Expert B. He also participated in two projects as Chairman. Expert B described the standardization process (the high pressure week was excluded) in details. After he shortly presented the history of the method and the projects, I got insight on issues with the current practice. In his opinion, there should be clear separation of the Pressure Cooker and other processes like a pilot project. His finding is that the type of work is needed for the Pressure Cooker does not fit to everyone. In his last project, he slept 6 hours per day and spent the rest with working. He also emphasized the low fix price of a Pressure Cooker project. The fix price

makes the customers' financial calculation much easier. Expert B talked about the interesting group process effects related to the tiredness and irritated behavior for the last work day. He suggests not to start a new standard on the last day. He tried once, it was not the best approach.

Furthermore, Expert B reflected on the questions were arisen during the first interview. He claims: "The standards should be finished after the Pressure Cooker as soon as possible". In Expert A's project the standard was finished one month after the high pressure week because of the change requests arrived after the development week. The customer should understand that the Pressure Cooker gives a quick first step, a big jump, but it result a good enough (80%) standard for a pilot. As he says, "It must be clear where the Pressure Cooker ends, make the customers aware of it".

According to Expert B, the scope document is appropriate, the problem is that in some cases it is not accepted or dealt well by stakeholders.

On the idea of having two workgroups, one business- and another technical-oriented, I learn a new important factor. The price. Two workgroups would roughly double the price of the Pressure Cooker, which is in the current form a very appealing feature for the customers. Expert B expects a serious drop in the customers' interest with increased costs.

Moreover, he agrees with Expert A that 15 people form a too big group for the high pressure week.

Summary of Interview 3, with Expert A – 28/01/13

Key findings
In case of a semantic standard, the maintenance and governance are crucial.
In an optimal scenario, the Steering Committee also has some technical expertise.

The spine of the interview was an extensive discussion on the standardization process in details. This topic took most of the available time. In the remaining time, the standardization expert revealed what caused a significant delay in the project. Activity 4 (Decide on the long-term management, governance, finance and adoption of the standard) in model 0 should end with Activity 7 (High pressure week), but in this case the governance faced a problem and they did not manage to deliver the output in time. The problem rooted in the lack of a main stakeholder and also lack of management structure. In the absent of this driving force, the decisions were made slower than expected. In Expert A's opinion, the Steering Committee also needs view of IT, in the topic of information exchange. Without this perspective, the Steering Committee can have ill-driven thoughts about the standardization as "We need a standard. Let's do a standard! Here is our standard, we are done now". Obviously, this is a wrong picture in the minds, a semantic standard needs maintenance and management too.

Reflecting on Expert B's point on the importance of the price, Expert A described a new division of the workgroup members. According to this idea, on the first three days business-oriented people would be included, then two days for the experts to formalize and on another two days, technical-oriented people would form a workgroup. He also suggests, that not just the Pressure Cooker process itself but the management around it should be supported by TNO experts.

Summary of Interview 4, with Expert C – 29/01/13

Key findings
The limitation of the standard should be clearly communicated.
Unanswered question: In which situations can the Pressure Cooker successfully be used?

Expert C was the Co-pilot in one Pressure Cooker project with Expert B. Significant amount of the interview was spent on the discussion of the process and the rest was used to elaborate on Expert C's improvement ideas. From this interview, I gained a lot of knowledge on the high pressure week included the preparation period for it.

Reflecting on the high workload, Expert C suggested a high pressure week with three standardization experts involved. The additional expert would increase the price (40 hours of a junior expert would add around €6000 to the final prize), but definitely decrease the pressure on the experts. He also emphasizes that practical knowledge is needed from the experts, otherwise the Pressure Cooker project is highly challenged. He adds, that a way to decide in which cases the Pressure Cooker can be used, would be very useful.

According to him, there is lesson learnt for TNO: the information should be shared better among experts.

He agrees that the limitation of the standard should be clearly communicated to the customer.

Summary of Interview 5, with Expert C – 31/01/13

Key findings
The used tools information capturing and recording tools (Visio, Powerpoint, Excel, Word, Flipchart).
In the current practice, reviewing is a very time consuming process.

The interview helped me to understand the differences between the Pressure Cooker projects, and to filter out the preferences of the experts from the schedules. I got critical feedback on the first draft of the Model as well.

In the high pressure week, the information was captured by Visio diagrams, Powerpoint slides, Flipcharts, Excel sheets and notes were taken in Word document.

Expert C advises to create a checklist with factors that could determine whether the Pressure Cooker fits or not to the standardization project. Besides, he feels the reviewing could be significantly improved. He suggests that the use of a wiki should be considered for the latter activity.

Summary of Interview 6, with Expert D – 14/03/13

Key findings
The Chairman should always stay neutral.
The high pressure week follows top-down approach.

Parking lot of rising ideas for later discussion.

Expert D was the Co-pilot in the project with Expert A. The interview focused on the high pressure week and the closely related events. The interviewee extensively describes the different roles of the standardization experts during the high pressure week. He emphasizes the Chairman's neutral position during the group work, explaining how the group process would be negatively influenced otherwise. Most important point is that the plan could not been followed if the Chairman defends or neglects certain topics instead of managing and leading the process.

He concludes that the high pressure week follows top-down approach in the standard building.

He used the same tools like Expert C. He mentions that Excel sheet proved to be very effective, because hierarchy can be done with it, but it is easy to make changes or add new things to it. Furthermore, Expert D agrees with Expert C regarding to the possible improvement of the reviewing activity.

He finds the "Parking lot" idea very good. It was used for ideas that were interesting but would have drifted the discussion away. These ideas were written on the board, placed in the Parking lot, and were checked and handled later. He found it useful in moving the discussions forward. "Put the idea on the board, even if you know it is not a good one. Just put it on the board and you save a lot of time instead of starting a long, pointless debate on it." As he experienced, most of the ideas were handled later in the planned process, and only a couple of them remained there for discussion. Saying that the workgroup members have to be aware of the Parking lot, he also adds that the agenda of the week should be clear, well communicated and shared.

Appendix C – The variable model for the survey

Figure 18 Variables for the survey

Appendix D - Survey results

Question 1. **In which standard development project did you participate?**

Aan het ontwikkelproces van welke standaarden hebt u deelgenomen?		
Answer Options	**Response Percent**	**Response Count**
STOSAG	29,6%	8
EBA	25,9%	7

Digitale Rotonde	44,4%	12
	answered question	27

Question 2. **In the workgroup, the participants presented either the business or the technical view. Did you bring more knowledge from the business or from the technical side to the group? Maybe from both?**

In de werkgroep hebben de deelnemers de business kant of de technische kant ingebracht. Hebt u meer technische of meer business kennis ingebracht? Of beiden?		
Answer Options	**Response Percent**	**Response Count**
Business	33,3%	9
Technisch	22,2%	6
Beiden	44,4%	12
	answered question	27

Question 3. **Question related to the preparation**: **The support you got, in terms of supplied materials, for the preparation before the high pressure week was enough.**

Vraag betreffende de voorbereiding							
Answer Options	**Helemaal mee oneens**	**Mee oneens**	**Deels eens, deels oneens**	**Eens**	**Helemaal mee eens**	**Rating Average**	**Response Count**
U hebt genoeg informatie gekregen ter voorbereiding van de high pressure week.	1	4	2	18	2	3,59	27
					answered question		27

Question 4. **How helpful did you find the scope document provided by the Steering Committee?**

Hoe nuttig was het document waarin de scope werd beschreven dat u hebt ontvangen van de Stuurgroep?								
Answer Options	**Helemaal niet nuttig**	**Niet nuttig**	**Neutraal**	**Nuttig**	**Zeer nuttig**	**weet ik niet**	**Rating Average**	**Response Count**
	1	0	7	10	8	1	3,92	27
						answered question		27

Question 5. **Did you find the planning for the week sufficient?**

Vond u de planning voor de week voldoende?		
Answer Options	**Response Percent**	**Response Count**
Ja	77,8%	21
Nee	22,2%	6
zo niet, graag kort toelichten		6
	answered question	27

If not, please explain briefly

Number	zo niet, graag kort toelichten
1	te weinig aandacht voor voorbereiding
2	met name in het laatste deel zijn misschien iets te snel beslssingen genomen. dat heeft geleid tot onduidelijkheid in het vedere verloop en de betrekking op de koppelvlakken.
3	Te kort dag voordat deze werd ingepland in een lastige periode van het jaar. Hierdoor kon ik mijn agenda onvoldoende leeg maken om de volledige week deel te nemen.
4	Tijdens het proces zijn heel veel in- en beperkingen geweest op de Scope. Achteraf heeft dat geleid tot heel veel bijstellingen.
5	Er was niet geheel duidelijk wat het product ging zijn. In grote lijnen was dit bekend (een "electronische begeleidingsbrief"), maar er misten details welke problemen gaven tijdens het proces. Zo was er b.v. niet duidelijk wat de afbakening was.
6	Voor de EBA hadden we nu 5 dagen achter elkaar gepland. Beter was geweest als we gestart waren met 3-4 dagen en dan na een eerste uitwerking van TNO 1-2 dagen. Aandachtspunt hiervoor is alleen dat de periode tussen de eerste en tweede sessie dan niet te lang mag zijn.

Question 6. **During the high pressure week...**

A) **It was easy to you to keep track of the actual status of the work.**
B) **The information presented at the high pressure week was good. (presentation slides, flipchart, etc)**
C) **Besides the free day, there were enough opportunities to consult with the back-office during the working week.**
D) **There is no need of technical mapping (transforming the information model into xml code) in the high pressure week.**
E) **The workgroup composition (mix of knowledge) was good.**
F) **The necessary knowledge was represented in the workgroup.**

Gedurende de high pressure week

Answer Options	Helemaal mee oneens	Mee oneens	Deels eens, deels oneens	Eens	Helemaal mee eens	Rating Average	Response Count
A Het was eenvoudig om op de hoogte te blijven van de status van het werk.	0	4	4	17	2	3,63	27
B De informatie die tijdens de high pressure week werd verstrekt was goed (presentaties, flipover, etc.)	0	3	5	15	4	3,74	27
C Naast de vrije dag waren er genoeg mogelijkheden om te overleggen met uw collega's tijdens de high pressure week.	1	3	7	13	3	3,52	27
D Het is niet nodig om tijdens de high pressure week de technische mapping van de standaard uit te voeren (dit betreft het omzetten van het informatie model in XML).	2	1	7	10	7	3,70	27
E De samenstelling van de groep (mix van kennis) was goed.	3	3	1	15	5	3,59	27
F De noodzakelijke kennis was in de werkgroep vertegenwoordigd.	1	2	5	14	5	3,74	27
				answered question			**27**

Question 7. **What do you think about the way of the information were presented during the working week? (presentation slides, flipchart, etc.)**

Wat vindt u van de manier waarop de informatie tijdens de week werd gepresenteerd? (presentaties, flipover etc.)

Number	Response Text
1	Goed en gedegen
2	goed maar afg en toe rommelig
3	Prima en verzorgd
4	matig
5	Prima, belangrijkste is dat de scope niet uit het oog verloren werd.

6	Niks op aan te merken.
7	prima
8	goed
9	Vanuit de voorbereiding werd de opgegeven informatie via de presentaties goed in plaatjes weergegeven. Dit soms in Word document format soms in excel lijsten of gevisualiseerd op de fliptovers of powerpoint. Dit was een goed mix.
10	Prima, alles werd goed genoteerd op een flipover
11	kan beter. rommelig. hier investeren in betere visualisatie materiaal. en iemand die snel is met visio of ea
12	Goed genoeg
13	vldoende
14	voldoende
15	De presentaties gaven structuur aan het gesprek en aanlediign tot dicussies en daarmee dus functioneel.
16	Rommelig en niet tranparant
17	Goed
18	De gebruikte middelen voldoen aan wat nodig is om de informatie over te brengen.
19	Redelijk
20	Goed
21	ok
22	We schoten gelijk de diepte in; Ik had behoefte aan eerst een hoog over view en vervolgens de detaillering. De Visie standaard is gebaseerd op een gestructureerde methode van DEMO. Deze is in mijn beleving niet methodisch gevolgd. De interacties hadden methodischer doorloen kunnen worden.
23	Het leek een gezamenlijke speurtocht naar het eindresultaat, documentatie was dus ook op ad hoc basis verzameld. Het werkte prima.
24	Prima
25	Goed.
26	de wijze waraop was prima. Goed afbakening van onderwrepen, vervolgens samenvatten en vervolgens met een voorstel komne. die werden duidelijk gepresebteerd
27	Voldoende

Question 8. **How much time?**

A) **The amount of time that Chairman allowed for discussions was ....**
B) **With one free day, how much time did you have to consult with your colleagues in the back-office?**

	Hoeveel tijd?							
	Answer Options	Veel te weinig	Een beetje te weinig	Precies voldoende	Iets te veel	Veel te veel	Rating Average	Response Count
A	De hoeveelheid tijd die de voorzitter beschikbaar stelde voor discussies was	1	6	18	2	0	2,78	27
B	Met één vrije dag beschikbaar, hoeveel tijd had u om te overleggen met uw collega's?	3	6	17	1	0	2,59	27
						answered question		27

Question 9. **The size of the workgroup was ...**

De groepsgrootte was...							
Answer Options	Veel te klein	Iets te klein	Precies goed	Iets te groot	Veel te groot	Rating Average	Response Count
	0	0	13	14	0	3,52	27
					answered question		27

Question 10. **Did you find it easy to work in the high pressure week?**

Vond u het makkelijk uw werk in de werkgroep uit te voeren gedurende de high pressure week?		
Answer Options	Response Percent	Response Count
Ja	85,2%	23
Nee	14,8%	4
Zo niet, graag een korte toelichting.		4
	answered question	27

If not, please explain briefly.

Number	Zo niet, graag een korte toelichting.
1	Er werd te veel ingegaan op techniek en niet op het functionele vlak. Dit beperkt in het opzetten van een functionele standaard. De technische kennis over passen, frequenties, XML, Soap was niet voldoende om technische zaken vast te stellen.
2	Ik denk dat de business kant en de technische kant te veel door elkaar lopen waardoor belangen uit de verschillende domeinen niet begrepen worden of verkeerd geïnterpreteerd worden.
3	Zie antwoord vraag 5
4	Nee. Ik "ben" van de standaarden. vb1 GML standaard was bv geheel niet bekend. En werd dus ook niet meegenomen. vb2 DEMO standaard niet meegenomen. Kreeg een beetje het gevoel "handje klap en we hebben de nieuwe standaard". Te kort door de bocht naar mijn gevoel.

Question 11. **Was the length of the high pressure week too long, too short or right?**

Hoe hebt u de lengte van de high pressure week ervaren?		
Answer Options	Response Percent	Response Count

Te kort	14,8%	4
Goed	70,4%	19
Te lang	14,8%	4
	answered question	27

Question 12. **Thinking about the high pressure week..**

A) The pressure was helpful in the standard development.

B) The objectives of the high pressure week were met.

C) The high pressure week resulted a good standard.

Denkend aan de high pressure week….							
Answer Options	Volledig mee oneens	Oneens	Deels eens, deels oneens	Mee eens	Helemaal mee eens	Rating Average	Response Count
A De tijdsdruk was nuttig bij de ontwikkeling van de standaard.	1	2	3	15	6	3,85	27
B De doelen van de high pressure week zijn bereikt.	1	3	4	16	3	3,63	27
C De high pressure week heeft een geode standaard opgeleverd.	3	3	11	8	2	3,11	27
					answered question		27

Question 13. **The available time for the review of the first documentation of the standard was too much.**

Er was teveel tijd beschikbaar voor de review van de eerste versie van de standaard.							
Answer Options	Helemaal mee oneens	Mee oneens	Deels eens, deels oneens	Mee eens	Helemaal mee eens	Rating Average	Response Count
	1	13	8	5	0	2,63	27
					answered question		27

Question 14. **How much time did you spend on reviewing? (approximately)**

Hoeveel tijd hebt u besteed aan het reviewen? (ongeveer)	
Number	Response Text
1	16 uur
2	12 uur
3	0,5 dag

4	8u
5	3 uur
6	Weet ik niet meer. Maar minimaal halve dag.
7	2 dagen
8	8 uur
9	16 uur verdeeld over twee weken.
10	Verspreid over meerdere dagen, maar exact zou ik het niet weten
11	2 uur
12	2 dagen
13	4 uur
14	32 uur
15	+- 8 uur inclusief overleg collega's. Collega's hebben er samen ook ongeveer 8 uur aan besteed.
16	15 uur
17	40 uur in de afgelopen periode
18	10 uur
19	Te weinig
20	2 uur
21	1 dag
22	1 Dag
23	Daar is binnen het bedrijf een halve dag aan besteed met een werkgroep van zo'n 8 personen.
24	paar uur
25	Weet ik niet.
26	enkele uren
27	6-8 uur

Question 15. **Overall, are you satisfied with the result of the high pressure week?**

Bent u over het algemeen tevreden over het resultaat van de high pressure week?

Answer Options	Response Percent	Response Count
Ja	77,8%	21
Nee	22,2%	6
	answered question	27

Question 16. **Are you satisfied with the final standard, which was submitted to the Steering Board?**

Bent u tevreden over de definitieve standaard die is opgeleverd aan de Stuurgroep?		
Answer Options	**Response Percent**	**Response Count**
Ja	55,6%	15
Nee	44,4%	12
Zo nee, graag een korte toelichting.		11
	answered question	27

If not, please explain briefly.

Number	Zo nee, graag een korte toelichting.
1	achteraf bleek deze toch niet correct te zijn. tijdens dit soort weken ook een expert cq consultant van een gecertificeerd software bedrijf mee laten doen of een groter rol door bv TC van de standaard
2	te theoretisch
3	Er wordt nog hard gewerkt aan een implementatie profiel. Dat is wel over het hoofd gezien tijdens de week. Of onterecht buiten de scope terecht gekomen.
4	Er zijn nog meerdere afstemmingsmomenten nodig geweest om het geheel werkend en volledig te krijgen. Daarnaast mist het de concreetheid van invulling van de Excel sheet naar Visi raamwerk tijdens de Pressure Cooker naar een werkend product wat tastbaar is. Ik doel dan op de laatste slag nml van Visi raamwerk naar een applicatie invulling. Dit is een groot gemis in het Visi raamwerk, concreet maken in een applicatief voorbeeld.
5	ik had meer demo verwacht en minder blind het proces proberen te mappen naar een standaard. het maken van een standaard is het moment om ook kritisch naar het proces te kijken en dat ontbrak.
6	De standaard zit vol met gaten. WDSL / XSD kloppen niet.Foutmeldingen blijven achterwegen. Test inrichting blijft achterwegen. Technische zijn er zoveel zaken afgedicht dat deze technische ontwikkelingen in de weg staan
7	Ik vind dat er onvoldoende test en "certificatie" mogelijkheden zijn. De inhoud van de standaard is werkbaar.
8	Ik vind dat er voor de tijd die er voor stond een goede standaard is opgeleverd! Maar Ik merk dat in de uitrol van de standaard, wellicht als gevolg van de tijdsdruk, er toch veel zaken bijgewerkt/uitgewerkt moeten worden.
9	Ik had graag iets meer tijd besteed aan de standaard die is opgeleverd. Naar mijn mening was deze nog niet voldoende uitgewerkt en gedeeld.

10	Datgene wat is opgeleverd is: Te beperkt van scope en teveel gebasseerd op de situatie van nu;
11	De afbakening van de standaard is niet juist. Dit zien we nu terug komen in het natraject. Er worden nu toevoegingen op de standaard gedaan die extra beperkingen opleggen op het gebruik van de standaard. Dit had tijdens de pressure kooker behandeld moeten worden. Er is meerdere keren met TNO getracht te kijken naar de afbakening, maar dit is vanuit TNO niet juist opgepakt. Daar hebben we nu de lasten van. In plaats van dat TNO het belang hiervan inzach en de afbakening duidelijker ging definieren, werd deze vraag in de groep gelegd en door de reactie afgekaatst. TNO had hier meer initiatief in moeten nemen en meer moeten aansturen om dit proces wel in te gaan.

Question 17. **How likely that you would participate again in a high pressure week?**

Hoe waarschijnlijk is het dat u een volgende keer deelneemt aan een high pressure week?

Answer Options	Zeer onwaarschijnlijk	Onwaarschijnlijk	Misschien	Waarschijnlijk wel	Zeker	Rating Average	Response Count
	0	2	5	15	5	3,85	27
					answered question		27

Question 18. **What do you think about the free day during the week? Please address the topics: necessity and usefulness.**

Wat vindt u van de vrije dag gedurende de week? Graag een reactie waarin u de de noodzaak en het nut van een vrije dag meeneemt.

Number	Response Text
1	Goed om even een dag afstand te nemen
2	goed, werk gaat gewoon door.en even te checken of we nog op de goede weg zitten en even de eerste dagen te laten bezinken.
3	Zinvol, dit geeft tevens ruimte voor ander werk, dat noodzakelijk is in die week
4	Goed
5	Goed om bij de eigen achterban de voortgang door te nemen en zo goed het tweede deel in te gaan.
6	Goed bedacht. Kon even alles laten bezinken en even goed met kantoor overleggen of er mogelijke knelpunten zouden kunnen zijn
7	even sparren met achterban
8	prettig, om te overleggen met de afdeling
9	Deze zijn absoluut vereist ivm afstemming met zowel de organisatie als ook de ICT afdeling.
10	Weet ik niet, aangezien ik pas op het laatste moment er bij ben gekomen, kon ik slechts 2 dagen, maar een vrije dag nemen lijkt me wel nuttig om de informatie even op de plaats te laten vallen en er over na te denken.

11	op zich niet nodig.
12	Bezinning en interne evaluatie is noodzaak
13	goed, noodzakelijk om even een rust in te passen
14	Nuttig
15	nodig on een aantal zaken even te laten "beklinken" en nodig om vragen voor te leggen aan collega's
16	Heeft geen invloed gehad voor de rest van de sessies
17	Is absoluut noodzakelijk om met interne collega's wat te kunnen overleggen
18	Voor mij had de vrije dag geen toegevoegde waarde voor de standaard zelf. Het was wel goed om op het kantoor aandacht te kunnen besteden aan andere projecten.
19	Prima om een vrije dag in te lassen voor raadplegen achterban en delen tussentijdse resultaten.
20	Mogen er 2 zijn i.p.v. 1 en dus zeer nutti
21	belangrijk voorlopende zaken
22	Is nodig voor reflectie.
23	Nuttig: even iets anders. En je krijgt toch de mogelijkheid om rustig na te denken. Niet nuttig: je bent uit de flow.
24	Kunnen laten bezinken. Feedback vragen bij collega's
25	Geen reactie.
26	zat er bij ons niet vanwege een feestdag op maandag
27	We hebben met de EBA volgens mij geen vrije dag gehad!? We zijn de disndag na Pinksteren begonnen en doorgegaan tot de vrijdag!!

Question 19. **Considering your performance, what do you think about the work on the last day of the working week with the workgroup compared to the other days?**

Als u kijkt naar uw bijdrage, wat vindt u van het werk op de laatste dag van de high pressure week in vergelijking met de andere dagen?

Number	Response Text
1	goed verlopen. Was tot en et de ochtend inspannend. daarna meer evaluatie
2	geen bijzonderheden
3	prima dag
4	te veel open eindjes
5	Ruim voldoende
6	Voldoende werk verzet om eerste review in elkaar te kunnen laten zetten

7	helaas niet bij geweest
8	gelijk waardig
9	Daar komt alles samen en wordt het voor mensen die niet abstract kunnen denken ook echt tastbaar en zichtbaar wat de resultaten zijn.
10	Toen werd de koppeling meer besproken die voor ons van belang is en waar wij wat meer van weten, de eerste 2 koppelvlakken gingen veel over de techniek.
11	prima!
12	Eerste dag was zoeken..De laatste dag was afmaken (zeer productief)
13	voldoende maar onder druk te snel toegeven zonder precies de gevolgen te kunnen overzien.
14	zijn keuzes gemaakt en dat was nodig
15	Ik denk niet dat dat wezenlijk verschilt.
16	Matig
17	Minder
18	Laatste dag bestond voornamelijk uit reviewen van verzamelde informatie
19	Niet aanwezig geweest bij laatste dag.
20	Goed
21	de laatste dag was niet productief
22	Lastig terug te halen. Maar gelijkmatig oever de dagen verspreid zou ik zeggen.
23	Goed, je moet naar het eindproduct werken. Juiste die laatste dag ga je keuzes maken, ook op zaken die je eerder hebt geparkeerd.
24	Uiteindelijk zijn we de laatste dag gekomen tot een goede afronding. Dag rust geeft soms wel aanleiding tot het opnieuw voeren van eerdere discussies. Maar hier werd redelijk goed door de voorzitter op ingegrepen. Mogelijk dat uitwerken technische details als resultaat door een deel van de groep had kunnen worden uitgevoerd.
25	Geen reactie.
26	doel was om de laatste dag met een tevreden gevoel huiswaarts te keren. dat is gelukt
27	Laaste dag was soort evaluatie, maar TNO stond niet echt (meer) open voor noodzakelijke wijzigingen/toevoegingen.

Question 20. **What did you like about the high pressure week?**

Wat beviel u het meest tijdens de high pressure week?

Number	Response Text
1	Dat je direct tot een door alle partijen gedragen oplossing komt
2	de losse structuur en toch de gedrevenheid van de deelnemers, het commitment op vele

	zaken ook veroorzaakt door goede voorbereiding verschillende werkgroepen van de DR
3	In korte tijd is er een resultaat
4	locatie
5	De eensgezindheid onder de deelnemers om een eindresultaat te bereiken.
6	Dat men ruim de kans kreeg over hun ideeen te discussieren
7	de druk om tot resultaat te komen
8	setting, omgeving, snelheid van werken
9	De onderlinge overleggen om te komen tot een gezamelijke taal (CDM)
10	Het goed noteren van de bevindingen
11	de druk zorgt wel voor focus
12	Besluitvaardigheid van de groep (Dankzij de voorzitter)
13	snelle stappen
14	Concept pressure week is nodig om tot besluit te komen
15	de goede sfeer en de doelgerichtheid.
16	Visie uitwisseling met collegas
17	focus en snelle doorgang van zaken
18	Goede saamhorigheid en enorme daadkracht. Snelle en goede resultaten met veel verschillende partijen in enorm korte tijd.
19	Ik relatie korte tijd een eerste versie van een gedefinieerd opleveren.
20	Samenwerking
21	tempo, deskundigheid aanwezigen
22	Locatie
23	Dat iedereen gemotiveerd was, iedereen wilde het resultaat. Een must voor succes.
24	Openheid van de deelnemers. Snel schakelen van de mensen van TNO van discussie resultaten naar oplossingsrichting.
25	Geen reactie.
26	De onderlinge saamhorigheid en de strrakke leiding van TNO
27	De snelheid

Question 21. **What did you dislike about the high pressure week?**

Wat beviel u niet tijdens de high pressure week?

Number	Response Text
1	herhaling van discussies
2	Geen
3	n.v.t.
4	Leiding
5	De lange discussies door een gebrek aan inzicht.
6	Dat sommige discussies te lang uitliepen zonder dat voorzitter ingreep. Of dat als er iets was afgesproken er naderhand op werd terug gekomen omdat er bijv weer een uitzondering zou zijn.
7	deelnemers die uitgangspunten ter discussie stelden omdat ze niet ingecheckt waren
8	Niets
9	Het gemis dat Visi een raamwerk is en de verantwoordleijkheid van gebruik ervan bij andere partijen heeft neergelegd. Ik had op het eind wel willen zien dat twee partijen in een pilot omgeving met elkaar communiceren. Dat is immers waar we het allemaal voor doen. Visi kan wel degelijk zelf ook dit als voorbeeld opleveren.
10	-
11	weinig ruimte voor optimalisatie. moeite om de groep mee te nemen in demo concept. wat wel jammer is als je een op demo geente visi standaard probeert op te schrijven.
12	Herhaling van standpunten en discussies
13	te weinig tijd voor preciese uitleg waardoor beslissingen op gevoel weren genomen en minder op feiten
14	geen opmerkingen
15	de omgeving waar we zaten was nogal "karig".
16	Het dwingende karakter om maar een standaard te kunnen opleveren.
17	is me goed bevallen
18	Veel herhalende discussies over de scope. Aantal, gevoelsmatig onnodige, technische compromissen gedaan. Vermoedelijk door onbegrip of miscommunicatie tussen business vertegenwoordigers en technische vertegenwoordigers.
19	Te grote groep met te diverse achtergrond.
20	Te veel mensen
21	Geen
22	Wa ik al zei de aandacht voor het echt toepassen van standaarden, het resultaat mede bepalen obv een werkwijze in gebruik zijnde software pakket. En de beperkte scope/ korte termijn insteek.
23	Sommige discussies zijn voor de een belangrijker dan voor de ander.

24	Niet echt specifieke zaken
25	Zie antwoord vraag 16.
26	Dat er toch soms mensen zich lieten vervangen of maar 1 of 2 dagen aanweizg konden zijn
27	Enkele noodzakelijke aanpassingen / uitbreidingen van de standaard kregen we niet meer door bij TNO.

Question 22. **In your opinion, how could the high pressure week be improved?**

Hebt u suggesties voor verbetering van de high pressure week?

Number	Response Text
1	niet direct
2	zoals al eerder gezegd expert op gebied van de standaard in de praktijk meer in betrekken
3	Nee
4	betere uitwerking en terugkoppeling einde dag
5	De standaard is gebleken niet alleen de inhoud van het bericht te zijn, maar ook de afspraken over het naar elkaar versturen. Dat moet de volgende keer anders, meegenomen worden.
6	Voorzitter eerder laten ingrijpen in discussies die te langdradig worden.
7	kleinere groep en mensen die het voortraject en uitgangspunten kennen
8	Geen
9	Zie punt 21. Verder nog er meer op toezien dat het kwaliteitsniveau van de deelnemers meer op gelijk niveau ligt door beoordeling van de input.
10	-
11	betere toolkit om zaken direct uit te werken en te visualiseren. digiboard of zo of iemand die gewoon mega snel is in visio of enerprise architect
12	Focus op één doel (Dus of berichten definiëren of deze afbeelden in VISI niet beiden tegelijk)
13	iets betere accommodatie met meer faciliteiten en uitstraling.
14	concept was goed
15	Nee niet echt.
16	Eerst functioneel bepalen wat er nodig is. Dus los van de techniek.Dan de functies tegen de technische haalbaarheid aanleggen. De keuze van techniek gedeeltelijk vrij laten
17	Nee
18	Ik denk dat het zeer nuttig is om eerst een pressurecooker sessie over de scope te hebben waarbij voornamelijk de deelnemers vanuit de business kant vertegenwoordig zijn. Om vervolgens een pressurecooker sessie te houden voornamelijk gericht op de oplossingen binnen de bepaalde scope.
19	Deelnemers meer gericht op het onderwerp en benodigde expertise. Wellicht in twee sessie uitsplitsen te weten, ontwerp standaard en praktische toepassing.

20	Minder mensen en 3 i.p.v. 4 dagen
21	Nee
22	Nee maar vraag is of ze voor het ontwikkelen van een standaard geschikt is. 1 keer is m.i te weinig. Meerdere keren en iteratief zou goed kunnen werken.
23	Iets meer handvaten; een format die wordt afgelopen om het creatieve proces binnen kaders te brengen.
24	Technische uitwerking door secialisten laten uitvoeren en dan aan de complete grope presenteren.
25	Zie antwoord vraag 16.
26	Toch een strakker commitment van de partijen die deelnemen, dus i/p geen vervanger
27	Opdelen van de week. Eerst 2-4 dagen en dan een vervolg binnen 2 weken van 1-2 dagen.

Appendix E – Selected journals for the literature search

The following journals were selected as base for the search:

Top CS/IS journals (Mylonopoulos & Theoharakis, 2001)
1. MIS Quarterly Management Information Systems
2. Communications of the ACM
3. Information Systems Research
4. Journal of Management Information Systems
5. Management Science
6. IEEE Transactions (various)
7. Harvard Business Review
8. Decision Sciences
9. Decision Support Systems
10. Information and Management
11. European Journal of Information Systems
12. Sloan Management Review
13. ACM Transactions (various)
14. Data Base*
15. Organization Science
TOP International Business Journals (DuBois & Reeb, 2000)
1. Journal of International Business Studies
2. Management International Review

3.	Journal of World Business
4.	International Marketing Review
5.	Journal of International Marketing
6.	International Business Review
7.	International Studies of Management and

Table 19 Journals selected for the search, *: not available neither in Scopus nor in EBSCO

Appendix F - The list of major and minor issues

The analysis of the survey and interviews resulted in the ten issues enumerated in Table X. The relative importance attributed to each issue was calculated based on the scores obtained from two different categories: the source that mentioned the issue and the importance of the issue to the presented research. The first criterion intends to identify the issues mentioned by a larger number of individuals and, in this way, leaving aside those ones resulting from a specific project or situation. The second criterion aims to analyze the suitability of the issue to the research objectives. The classification process works as follows:

(1) Relatively to the source of information, an issue is weighted positively if it has been addressed by one of the sources, i.e. interview and survey, and it has greater importance if mentioned by both. The plus sign ("+") means that the issue has been explicitly mentioned by a significant amount of individuals. Minus sign ("-") indicates that the source contains contradictory results. The cross ("x") presents the case when an issue has not been mentioned at all or has been mentioned, but it cannot be clearly put in one of the above mentioned categories;

(2) An important issue has to be relevant to the research objectives what means that it must address a problem about the planning, the setup, the work, or the result of the Pressure Cooker. One could argue that the issues all fit to the objectives because they can influence other issues but for matter of time and not to lose the scope of the research, those issues originating some doubts were left aside. The classification was establishing bearing in mind that the goal of the presented research is to address the development time and repeatability of the method. This parameter does not include the cross ("x") option and so a relevant issue was rated with a plus ("+") while not to important issues got a minus ("-").

	Score			
Issue	Source: interview	Source: survey	Suitability to the research objectives	Total

1. Conflicting interest of business- and technical representatives, Group size	+	+	+	+++
2. The price of the Pressure Cooker should not be increased and kept low.	+	x	-	.
3. The Steering Committee should have some technical expertise	x	+	+	++
4. Not realistic expectations among the workgroup members.	+	+	+	+++
5. In which situations (what context) can the Pressure Cooker method be successfully used? The scope has to address the business problem.	+	+	+	+++
6. Information capturing- and recording tools need improvement (Visio, Powerpoint, Excel, Word, Flipchart)	x	-	+	.
7. The reviewing process is very time consuming	+	+	+	+++
8. Work does not fit to everyone – workgroup members, Standardization experts have to face hard workload	+	-	+	++
9. Planning related issues: Efficiency on the last day of the high pressure week is lower, preparation for the high pressure week is not good enough	+	+	+	+++
10. Absence of technical mapping	-	+	+	+

Table 20 Evaluation of issues found in the current practice

Based on the weighted table the list of major and minor issues are presented in Table 21 and Table 22.

1.	**In which situations (what context) can the Pressure Cooker method be successfully used?**
2.	**Conflicting interest of business- and technical representatives and the too large group size**
3.	**The expectations of the participants are not realistic in many cases, and therefore they are not satisfied with the delivered standard**
4.	**The reviewing process is very time consuming**
5.	**Planning related issues: preparation for the high pressure week is not good enough, work on the last day is less effective than the rest.**

Table 21 Major issues

6.	**The high pressure week has special work conditions and high workload. To whom does this kind of work fit?**
7.	**Absence of technical mapping.**
8.	**Information capturing is too difficult and have a messy result.**

Table 22 Minor issues

Two issues have been dropped from the list. First, the workgroup has no authority to make decisions related to the price of the Pressure Cooker, therefore they were not asked about this. The importance of the price has been mentioned by standardization experts, but I consider it out of the scope. Rather than use the price as a variable, I consider it as an attribute of the method. It is preset and I do not want to differ from it.

Second, in the survey, someone argued that the Steering Committee should have some technical expertise not just business knowledge. This statement was sort of confirmed by a standardization expert. Not entirely, because as he and the other experts said, there is always technical knowledge involved in the Steering Committee directly or in an individual Technical Committee. This shows that the survey respondent seems to be wrong and there is not such an issue.

Appendix G - Literature review with the five-stage grounded-theory method

In general, addressing the issues by restricting the search to standards and to the standard development process ended up without significant result. First, the search was limited to the IS standardization or IS standards development or IS standard making, then to standardization or standards development or standard making but the query resulted either empty result list or a list with not relevant works. The topics of conflicting interest and group size, expectation management proved to be undiscovered in the selected papers.

The query:

(TITLE-ABS-KEY-AUTH(*keywords*) AND PUBYEAR > 1999) AND (LIMIT-TO(LANGUAGE,"English")

AND (

LIMIT-TO(EXACTSRCTITLE,"MIS Quarterly Management Information Systems")

OR LIMIT-TO(EXACTSRCTITLE,"Communications of the ACM")

OR LIMIT-TO(EXACTSRCTITLE,"Information Systems Research")

OR LIMIT-TO(EXACTSRCTITLE,"Journal of Management Information Systems")

OR LIMIT-TO(EXACTSRCTITLE,"Management Science")

OR LIMIT-TO(EXACTSRCTITLE,"* IEEE *")

OR LIMIT-TO(EXACTSRCTITLE,"Harvard Business Review")

OR LIMIT-TO(EXACTSRCTITLE,"Decision Sciences")

OR LIMIT-TO(EXACTSRCTITLE,"Decision Support Systems")

OR LIMIT-TO(EXACTSRCTITLE,"Information and Management")

OR LIMIT-TO(EXACTSRCTITLE,"European Journal of Information Systems")

OR LIMIT-TO(EXACTSRCTITLE,"Sloan Management Review")

OR LIMIT-TO(EXACTSRCTITLE,"ACM *")

OR LIMIT-TO(EXACTSRCTITLE,"Organization Science")

OR LIMIT-TO(EXACTSRCTITLE,"Journal of International Business Studies")

OR LIMIT-TO(EXACTSRCTITLE,"Management International Review")

OR LIMIT-TO(EXACTSRCTITLE,"Journal of World Business")

OR LIMIT-TO(EXACTSRCTITLE,"International Marketing Review")

OR LIMIT-TO(EXACTSRCTITLE,"Journal of International Marketing")

OR LIMIT-TO(EXACTSRCTITLE,"International Business Review")

OR LIMIT-TO(EXACTSRCTITLE,"International Studies of Management and Organization")

)

Stakeholder diversity

Keywords: conflict* interest?, different, stakeholder, group size, group conflict, team, member?

Reviewing process

Keywords: review, collaboration, online, process, work, team, group, agile

Expectation management

Keywords: group expectation, workgroup, manage*, team, expect*

Characteristics

Keywords: project characteristic?, determents, work, feature?, factor?, develop*, standard*

Planning

Keywords: last day, work, group, team, collaboration, plan*, schedule*,

Authors	Title	Journal	Year	Topic
Robert H. Schaffer	Four Mistakes Leaders Keep Making	Harvard Business Review	2010	**Expectation management**
D. Sandy Staples, Ian Wong, Peter B. Seddon	Having expectations of information systems benefits that match received benefits: does it really matter?	Information & Management	2002	**Expectation management**
Dorit Nevo, Michael R. Wade	How to avoid disappointment by design	Communications of the ACM	2007	**Expectation management**
Ram L. Kumar	Managing risks in IT projects: an options perspective	Information & Management	2002	**Expectation management**
J. Sterling Livingston	Pygmalion in Management	Harvard Business Review	2003	**Expectation management**
Tom L. Roberts, Paul H. Cheney, Paul D. Sweeney and Ross T. Hightower	The Effects of Information Technology Project Complexity on Group Interaction	Journal of Management Information Systems	2005	**Expectation management**
Bill Fischer, Andy Boynton	Virtuoso teams	Harvard Business Review	2005	**Expectation management**
Frank K.Y. Chan, James Y.L. Thong	Acceptance of agile methodologies: A critical review and conceptual framework	Decision Support Systems	2009	**Review**
Tore Dybå, Torgeir Dingsøyr	What Do We Know about Agile Software Development?	IEEE Computer Society	2009	**Review**
Kieran Conboy	Agility from First Principles: Reconstructing the Concept of Agility in Information	Information Systems Research	2009	**Review**

	Systems Development			
Susan Gasson, Jim Waters	Using a grounded theory approach to study online collaboration behaviors	European Journal of Information Systems	2013	**Review**
Philip Emma	A Collaborative IP-Development Session	IEEE Computer Society	2008	**Planning**
Juan Rodon, Juan Ramis-Pujol, Ellen Christiaanse	A process-stakeholder analysis of B2B industry standardisation	Journal of Enterprise Information Management	2007	**Group**
Marcia W. Blenko, Michael C. Mankins, Paul Rogers	5 Steps to breakthrough performance in your organization	Harvard Business Review	2010	**Group**
Junbin SU, Vladislav V. Fomin	Public Dominated Standardization	IEEE	2010	**Group**
Juha-Miikka Nurmilaakso, Paavo Kotinurmi, Hannu Laesvuori	XML-based e-business frameworks and standardization	Computer Standards & Interfaces	2006	**Group**
Lynda Gratton, Tamara J. Erickson	Eight Ways to Build Collaborative Teams	Harvard Business Review	2007	**Group**
James R. Marsden, Ramakrishnan Pakath, Kustim Wibowo	Decision making under time pressure with different information sources and performance-based financial incentives: part 3	Decision Support Systems	2006	**Group**
Michael zur Muehlena, Jeffrey V. Nickersona, Keith D. Swenson	Developing web services choreography standards—the case of REST vs. SOAP	Decision Support Systems	2005	**Group**
Luigi Marengo, Corrado Pasquali	How to Get What You Want When You Do Not Know What You Want: A Model	Organization Science	2012	**Group**

	of Incentives, Organizational Structure, and Learning			
Rita A. Ribeiro, Ana M. Moreira, Pim van den Broek, Afonso Pimentel	Hybrid assessment method for software engineering decisions	Decision Support Systems	2011	**Group**
Souren Paula, Priya Seetharamanb, Imad Samaraha, Peter P. Mykytyn	Impact of heterogeneity and collaborative conflict management style on the performance of synchronous global virtual teams	Information & Management	2004	**Group**
Souren Paul, Derek L. Nazareth	Input information complexity, perceived time pressure, and information processing in GSS-based work groups: An experimental investigation using a decision schema to alleviate information overload conditions	Decision Support Systems	2010	**Group**
Heng-Li Yang, Jih-Hsin Tang	Team structure and team performance in IS development: a social network perspective	Information & Management	2003	**Group**
Timothy Butler, James Waldroop	Understanding “People” People	Harvard Business Review	2004	**Group**
David A. Garvin, Michael A. Roberto	What you don’t know about making decisions	Harvard Business Review	2003	**Group**
Sue Young Choi, Heeseok Lee, Youngjun Yoo	The Impact of Information Technology and	MIS Quarterly	2010	**Expectation management**

	Transactive Memory Systems on Knowledge Sharing, Application, and Team Performance: a field study			
P. J. Lamberson, Scott E. Page	Optimal Forecasting Groups	Management Science	2012	**Group**
Ramanath Subramanyam, Fei Lee Weisstein, and M.S. Krishnan	User Participation in Software Development Projects	Communications of the ACM	2010	**Group**
Akhilesh Bajaj, Robert Russell	AWSM: Allocation of workflows utilizing social network metrics	Decision Support Systems	2010	**Review**

Table 23. The result of the strictured literature review