PROJECT REPORT

Project 2
"Standards of the future"
Pilot Project 4 "New Work Item"

AUTHORS

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July 2021

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Introduction

To date, standards have mostly been written in prose and made available to standards users primarily in PDF format (sometimes also as HTML or XML), which makes it difficult to use the content flexibly and in a tailored manner, for example to integrate it into processes and applications.

When standards content is used, a great deal of time and effort is often invested into copying and pasting fragments of the standards content into systems, such as requirement management systems, and restructuring the content in order to make it usable in the respective systems. In addition, standards organizations use different ways of structuring standards documents, which creates additional work for the user.

This project was initiated on the basis of the project charter for the pilot project "New Work Item" (see [1]) as part of the CEN Digital Transformation Project 2 "Standards of the Future" in order to test and further develop the concepts developed in 2019 within the two pilot projects "Construction" and "Petroleum".

The aim is to make **s**tandards content available electronically in a sensibly fragmented, **m**achine-**a**pplicable and machine-**r**eadable form and for beneficial **t**ransfer to existing and new application systems, i.e. the development of SMART standards.

1 Project scope & project objectives (project charter)

1.1 General

In the summer of 2020, pilot projects 3 and 4 were launched to further develop the findings from the previous pilot projects. Analogous to the naming of the pilot projects in Project 2 the following is used in this report:

— pilot project 1: Construction (2019);

— pilot project 2: Petroleum (2019);

— pilot project 3: Product Standard (2020-07 - 2021-06);

— **pilot project 4: New Work Item (2020-07 - 2021-06);**

— pilot project 5: Information Model (2020-07 - 2021-09).

Figure 1 shows the relationships between those pilot projects.

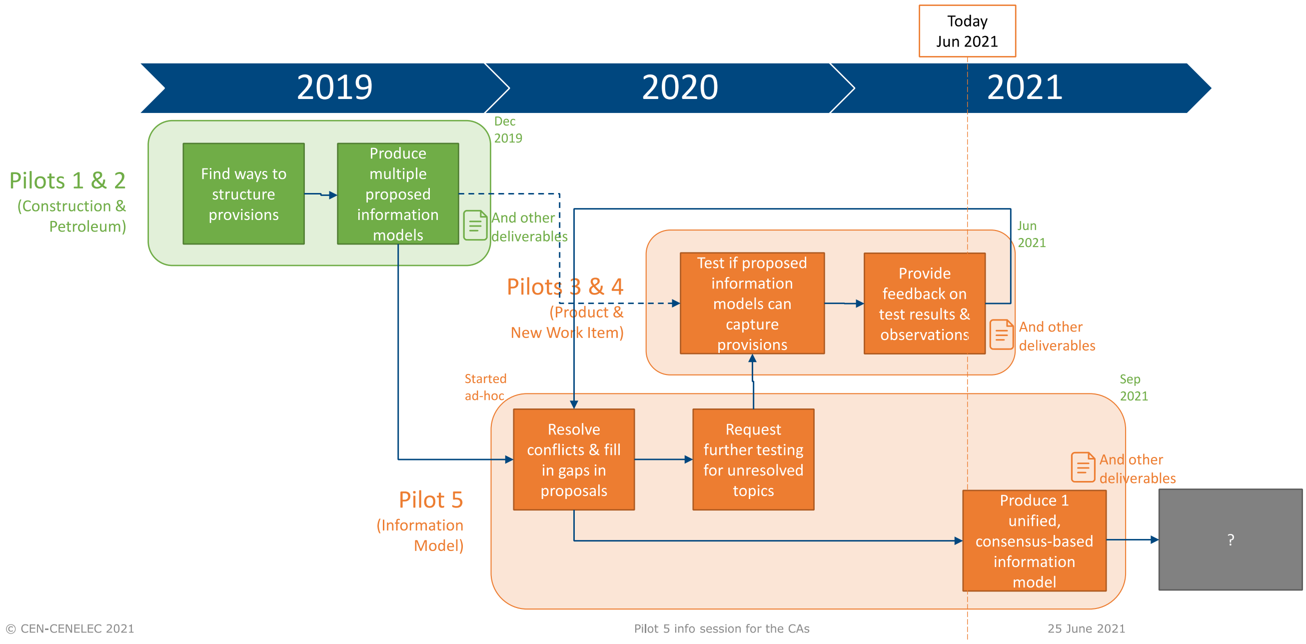

Figure 1 — Connection pilot projects 1 to 5[1]

For orientation with regard to the necessary degree of machine readability and machine interpretability, the SMART Utility Model was used as a basis for all pilot projects from pilot project 3 onwards. Figure 2 shows a simplified representation of the different levels.

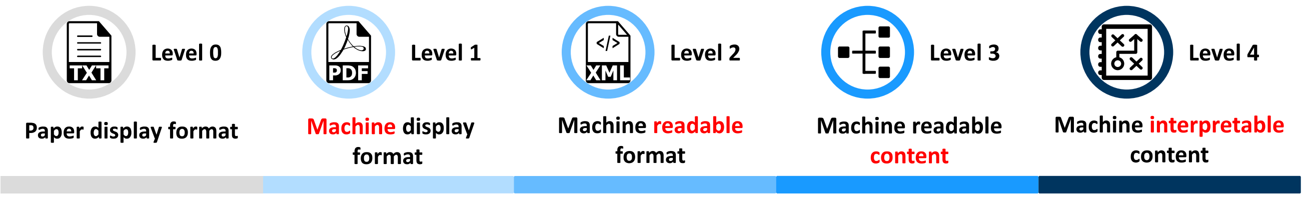

Figure 2 — SMART Utility Model[2]

The value creation process of standards can be divided into the four essential phases of Content Creation, Management, Delivery and Usage (see Figure 3). This is because SMART standards pose new challenges for both standards organizations and standards users.

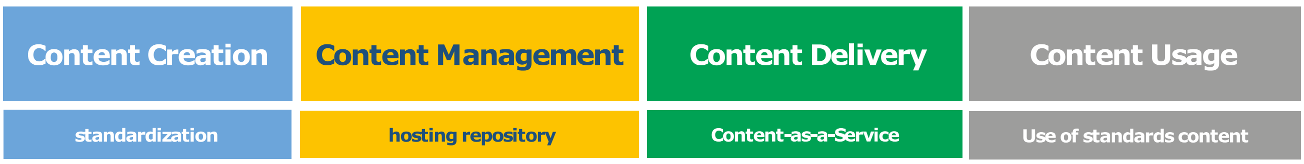

Figure 3 — SMART Process Model[3]

The realization of SMART standards can therefore only succeed if fundamental changes are made within all process phases with internationally and European coordinated objectives.

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1 TF Digital Content, 2021-06-23

2 Developed by IEC SMB/SG 12

3 [IDiS Whitepaper – Scenarios for digitizing standardization and standards]

In this pilot project, the focus was on the development of content in the standards organizations, i. e. on content creation. Nevertheless, Level 3 data could already be generated within this pilot project, which could be considered for direct use in content usage (see 6.4.3, 7.1.1.3, 7.1.3.1).

These could be used as a starting point for a continuous improvement process in cooperation with the standards users in order to validate the developed concepts efficiently on the user side as well (see 9.3). The goal of Project 2 "Standards of the future" to be able to provide Level 3 content by the end of 2024 could thus be significantly supported.

The objectives taken from the project charter of these pilots can be found in the following two sections.

1.2 General objectives[4]

"To understand and contribute to defining how the standards development process, supporting organization and tools need to be adapted to better serve the future needs of the industry and create machine readable/interpretable files. The output of this project should provide input and guidelines for:

— *the redefinition of the textual content rules of standards*

— *the restructuring of content, for example according to the parsing table or in the form of triples (subject, predicate, object) from which ontologies of standards can later be developed as well as an appropriate classification and tagging system of content*

— *the identification of the tools needed to support this process*

— *the scoping of what needs to be done within the standards development process, supporting organization and tools*

The focus is on the structuring of the 'requirements' (provisions), that is the four levels of requirements (shall (requirement), should (recommendation), can (possibility), may (permission)). Also, structuring the context and ontology (references and relations) within which the requirements are expressed is a key focus."

1.3 Objectives of this pilot[5]

"In the previous pilots different elements regarding content writing rules (construction) and content classification/semantics models (petroleum) have been developed. In these pilots we worked with existing standards and without technical domain experts. We were in this way able to experiment and develop models to create machine readable content which could be worked with (now brought together in the harmonized information model). These different elements combined in one consistent model will now be tested in the creation of a new work item.

One of the findings from this work is the need for a different mind-set when creating machine readable content. This needs to be tested in practice together with the technical domain experts in order to determine the skills that are needed, the roles that are needed and the impact on the speed of the development process. It will also give the opportunity to validate and/or further refine the present harmonized information model developed in the previous pilots. And it will further contribute to defining how the standards development process, supporting organization and tools need to be adapted."

4 Quote from the project charter (see [1])

5 Quote from the project charter (see [1])

1.4 Delimitation of pilot project 3 and 4

Different starting conditions were assumed for pilot projects 3 and 4. While pilot project 3 was primarily intended to deal with existing documents, the focus of pilot project 4 was to be on the development of new standards content within a new project (“New Work Item”). The information model or structuring concept (see [2]) created on the basis of pilot projects 1, 2 and the consolidating work carried out for them was thus to be tested where content was being formulated from scratch and not where existing content had to be processed.

It was expected that the initial application of such concepts, which provide additional rules in the formulation of content (see 6.2 and 6.3), would be significantly more time-saving if existing content did not have to be reformulated and thus possibly also discussed anew.

However, it already became apparent during the selection of project candidates in this pilot project that a large proportion of the planned standards content is already available, even for new projects. This is due to the fact that standards generally reflect the recognized state of the art, i.e. they are based on existing knowledge and content. A new formulation from scratch during the standardization process therefore tends to be the exception, even in the case of new projects.

For that reason it is not possible to provide a useful assessment of the extent to which concepts for reformulating the content of standards can be applied more efficiently in the case of content which is to be reformulated from scratch.

Compared to pilot project 3, the focus of this pilot project is that in addition to the SMART information model (see [2]) further concepts were tested:

— the requirement patterns of the company Qualicen (see 6.2) and

— the Triple Structuring Tool (TST, see 6.4), which allows to generate Level 3 and Level 4 content (see Figure 2) within the existing standardization processes and regulations.

1.5 Information model

The starting point for the work in this project was the work status of the information model from July 2019 (see [2]). The information model was continuously developed further in the course of this project by pilot project 5. The experience gained with the information model in pilot project 3 and in this project has been taken into account.

The tabular form of the information model (see Figure 4) serves primarily the purpose of presenting the metadata (attributes) in question, but it also contains suggestions for structuring the provisions themselves, the SMART and Triple information models.

The SMART information model was used and improved in the NEN subproject, the Triple information model was implemented and further developed in the TST, it was used in the AFNOR and SIS/DIN subprojects.

SMART | Triple information model

No.	property	value
Elements forming a provision		
0	title	text
1	**system | subject**	~
2	subject-type	~
2.1		• system
2.2		• term
3.1	**action | modal verb**	~
3.2	**action | main verb**	~
4	actor | factor	~
5	**performance | object**	~
6	object-type	~
6.1		• term
6.2		• provision
6.3		• numeric value
6.4		• unit
6	condition	~
7	margin	~
8	rationale	~
Attributes to the provision: Standard model		
9	relation	~
9.1		**• and**
9.2		• contains
9.3		• if-then
9.4		• is-part-of
9.5		• is-part-of-group
9.6		• not
9.7		• or
9.8		• replaced by
9.9		• replacing
9.10		• xor
10	class|role	~
10.1		• declarative
10.2		**• governing**
10.3		~~• informative~~
11	content type	~
11.1		• text - natural language
11.2		• text - smart expression
11.3		• text - triple expression

Figure 4 — Section of the information model N009[6]

6 Work status: 2021-05-20

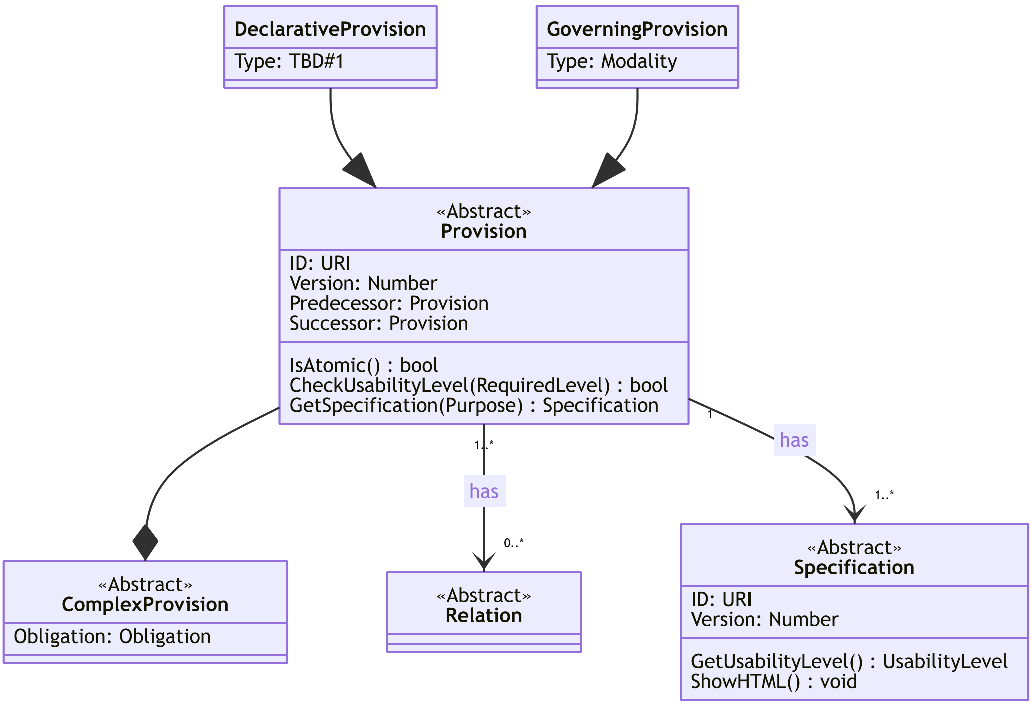

Figure 5 — UML Information model „Standard Model" pilot project 5[7]

During the development of the information model in pilot project 5, it was determined that the modeling of provisions, i.e., their linguistic analysis and decomposition, is to be assigned to Level 4 (see Figure 2). The class diagram in Figure 5 represents the currently stable version of the information model and, in accordance with the Project Charter, therefore does not explicitly deal with Level 4 content for the time being. Nevertheless, it is already indirectly covered in the "Specification" class.

A mapping between the information model in Figure 5 and its implementation in the Triple Structuring Tool is shown in Table 7.

In addition to capturing Level 3 metadata (see Figure 2), all tools and structuring concepts that were used in this pilot (see 6) structure the processed specifications more finely, i. e., they decompose textual specifications, i. e., sentences, into more or less elementary components. According to the currently valid definition by the information model, the standards content modeled in this project can therefore already be classified above Level 3 or can even be described as Level 4 content.

2 Project deliveries and subproject reports

This document contains the overall project report and the project reports on the AFNOR and SIS/DIN subprojects (see 7.1.1 and 7.1.3). For the subproject NEN (see 7.1.2) as well as for the participation of the company Qualicen (see 6.3 and 8) there are separate reports which are also part of this report. In addition, the tools used and project results from all subprojects of this pilot project are part of this report.

Table 1 lists all components of this report. Most elements of this list are linked to the CEN-Livelink section of this project and can be downloaded there or have been distributed as attachments to the ZIP-file version of this report.

7 Work status: 2021-04-23

Table 1 — Components of the project report

No.	Report component	Project reference			CEN Livelink
		AFNOR	NEN	SIS/DIN	
	Subproject reports				
1	NEN final report pilot project EN 15984 (see [6])		X		NEN
2	Standards of the Future - Qualicen Report (see [7])	X	X		AFNOR/NEN
	Project deliveries				
3	Original standard documents	X	X	X	AFNOR NEN SIS/DIN
	SMART Structuring Table				
4	SMART Structuring Table		X		NEN
5	SMART Structured Standards Document		X		NEN
6	Digital Prototype		X		NEN
	Qualicen patterns				
7	Qualicen patterns applied on EN ISO 14903/A1, Chapter 7.9 and 7.11 (see [8])	X			AFNOR
	Triple Structuring Tool				
8	TST-structured plain text (tracked changes to original)	X		X	AFNOR SIS/DIN
9	NISO STS XML standards document	X		X	AFNOR SIS/DIN
10	SMART XML TST file (auto-generated and manual structured)	X		X	AFNOR SIS/DIN
11	HTML Table	X		X	AFNOR SIS/DIN
12	ReqIF (auto-generated and manual structured)	X		X	AFNOR SIS/DIN
13	RDF Graph for each document and a joint Graph for all modeled documents (visualize here)	X		X	AFNOR SIS/DIN
14	French sample with all TST deliveries	X			AFNOR
15	Complete RDF Graph of all TST projects (see [10], visualize here)	X		X	AFNOR/SIS/DIN
	Tools				
16	SMART Structuring Table (see [2])		X		NEN
17	Qualicen Patterns (Cheat sheet)	X	X		AFNOR/NEN
18	Triple Structuring Tool (TST)	X		X	AFNOR/SIS/DIN
19	SMART XML XSD Schema file (see [3])	X		X	AFNOR/SIS/DIN

3 Terms

3.1
SMART
standard (content) that is **a**pplicable and **r**eadable for **m**achines, software or other automated systems and can also be made available digitally for specific applications or users (**t**ransferable)

3.2
Smart Structuring Table
Excel spreadsheet conceptualized in pilot project 1 and further developed in pilot projects 3 and 4 to semantically structure textual specifications

Note: Semantic elements in the Smart Structuring Table include Condition, System, Action, Performance, Margin, etc.

3.3
Qualicen-Patterns
patterns developed by Qualicen for semantic structuring and classification of textual specifications

Note: The Qualicen patterns differ from the Smart Structuring Table in particular in that a certain vocabulary is predefined for certain classes of specifications and thus, when specifications are formulated using the patterns, a classification of the specifications takes place at the same time.

3.4
Triple Structuring Tool[8]
TST
software developed during the pilot project 4 project for modeling textual and partially tabular specifications and converting the modeled specifications into user data formats

3.5
SMART XML
XML schema used by the Triple Structuring Tool to store the data modeled in it

Note: The schema file is part of this report (see [3]).

4 Project organization

4.1 Project team

Table 2 — Project team members

Name	Organisation	Subproject	Role	Country
Peter Rauh	DIN	All	Project leader	DE
Andreas Horn	Qualicen	AFNOR, NEN	Active	DE
Frederik Fehn	SIS	SIS/DIN	Active	SE
Henning Femmer	Qualicen	AFNOR, NEN	Active	DE
Jappe van der Zwan	NEN	NEN	Active	NL
Stefan Swejien	NEN	NEN	Active	NL

8 Table 1, item 18

Name	Organisation	Subproject	Role	Country
Timothée Boudier	AFNOR	AFNOR	Active	FR
Vincent Verneyre	AFNOR	AFNOR	Active	FR
Alioune Cissé	AFNOR		Observer	FR
Andreas Wernicke	Beuth		Observer	DE
Christina Thorngreen	CEN/CENELEC		Observer	EU
Cord Wischhöfer	DIN		Observer	DE
Damian Czarny	DKE		Observer	DE
Estelle Rivault	AFNOR		Observer	FR
Gian Luca Salierio	UNI		Observer	IT
Helge Olsen	SN		Observer	NO
Jo Collins	NEN		Observer	NL
Kylie Rodier	ISO		Observer	ISO
Maryam Imani	BSI		Observer	GB
Pablo Corrons Crespí	AENOR		Observer	ES
Padmaja Kamath	CEN/CENELEC		Observer	EU
Peter Maidens	BSI		Observer	GB
Samuel Gilet	CEN/CENELEC		Observer	EU
Sebastian Kriegsmann	DIN		Observer	DE
Shannon Kiernan	CEN/CENELEC		Observer	EU
Vincent Zwobada	AFNOR		Observer	FR

4.2 Meeting dates

All meeting dates within pilot project 4 are listed in Table 3.

Table 3 — Meeting dates

No.	Date	Reason	Project	Note
1	2020-09-09	Kick-Off	Pilot project 4	Evaluation of the project proposals
2	2020-09-14	Kick-Off part 2	Pilot project 4	Evaluation of the project proposals
3	2020-09-24	Regular Follow up meeting	Pilot project 4	
4	2020-09-29	Meeting with AFNOR	AFNOR	AFNOR project proposal EN ISO 14903
5	2020-10-06	Regular Follow up meeting	Pilot project 4	
6	2020-10-20	Regular Follow up meeting	Pilot project 4	
7	2020-11-06	Regular Follow up meeting	Pilot project 4	
8	2020-11-17	Regular Follow up meeting	Pilot project 4	
9	2020-11-19	Meeting with SIS	SIS/DIN	SIS/DIN/DKE Project meeting

No.	Date	Reason	Project	Note
10	2020-12-02	Regular Follow up meeting	Pilot project 4	
11	2020-12-15	Regular Follow up meeting	Pilot project 4	
12	2021-01-07	Regular Follow up meeting	Pilot project 4	
13	2021-01-08	Meeting with CEN/TC 182/WG 9 Experts	AFNOR	Work status
14	2021-01-13	Meeting with SIS	SIS/DIN	Work status
15	2021-01-21	Regular Follow up meeting	Pilot project 4	
16	2021-01-26	Meeting with CENELEC WG	SIS/DIN	
17	2021-02-04	Regular Follow up meeting	Pilot project 4	
18	2021-02-18	Regular Follow up meeting	Pilot project 4	
19	2021-03-18	Regular Follow up meeting	Pilot project 4	
20	2021-03-23	Meeting with CEN/TC 182/WG 9 Experts	AFNOR	
21	2021-03-23	Regular Follow up meeting	Pilot project 4	
22	2021-04-15	Regular Follow up meeting	Pilot project 4	
23	2021-04-20	Meeting with SIS	SIS/DIN	Work status
24	2021-04-21	Meeting with CEN/TC 182/WG 9 Experts	AFNOR	Focus Qualicen patterns
25	2021-04-29	Regular Follow up meeting	Pilot project 4	
26	2021-05-03	AFNOR Project members	AFNOR	Introduction of TST
27	2021-05-27	Regular Follow up meeting	Pilot project 4	
28	2021-07-01	Regular Follow up meeting	Pilot project 4	Introduction of this report

4.3 Project acquisition

4.3.1 General

In accordance with the project charter, a "call for participation" (see [4]) was sent to all CEN/CENELEC Technical Committees on August 3, 2020, inviting them to participate in the pilot project by proposing standardization projects.

The project proposals received (see Table 4) were evaluated at the kick-off of this project on September 9, 2020.

4.3.2 Project selection

The criteria for project selection were formulated in the "call for participation".

The following criteria in particular were decisive for the final selection of the projects:

— the willingness of the responsible technical committee to actively participate in the project;

— the work status of the project: work on the contents of the standard should already have begun.

4.3.3 Project proposals received

Table 4 — Project proposals

Nr.	Committee	Secretariat	WI	Description	Title	Comment
1	CEN/TC 182/WG 9	AFNOR	00182091	EN ISO 14903/A1	Refrigerating systems and heat pumps — Qualification of tightness of components and joints	Confirmed Subproject AFNOR
2	CEN/TC 19	NEN	00019468	prEN 15984 rev	Petroleum industry and products – Determination of composition of refinery heating gas and calculation of carbon content and calorific value - Gas chromatography method	Confirmed Subproject NEN
3	CEN/CENELEC/TC 106x	DKE	00072079	prEN 50663	Generic standard for assessment of low power electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (10 MHz - 300 GHz)	Confirmed Subproject SIS/DIN
4	CEN/CENELEC/TC 106x	DKE	00072080	prEN 50664	Generic standard to demonstrate the compliance of equipment used by workers with limits on exposure to electromagnetic fields (0 Hz - 300 GHz), when put into service or in situ	Confirmed Subproject SIS/DIN
5	CEN/CENELEC/TC 106x	DKE	00072081	prEN 50665	Generic standard for assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)	Confirmed Subproject SIS/DIN
6	CEN/CLC/JTC 3	NEN	00003056	EN ISO 13485/A1	Medical devices — Quality management systems — Requirements for regulatory purposes	Unfavorable project status
7	CEN/TC 153/WG 14	AFNOR	00153216		Equipments for slaughterhouses — Slaughtering traps for bovine animals — Safety and hygiene requirements	Unfavorable project status
8	CEN/TC 156/WG 1	BSI		EN 12792		Unfavorable project status
9	CEN/TC 326	TSE				Unfavorable project status
10	CEN/TC 442	SN	00442030	prEN 17412-2		Unfavorable project status
11	CEN/TC 442	SN	00442029	prEN 17412-3	Building Information Modelling – Level of information need – Part 3: Data Schema	Unfavorable project status
12	CEN/TC 153/WG 04	AFNOR	00153209		Food processing machinery – Pizza dough sheeter machines – Safety and hygiene requirements	Unfavorable project status
13	CEN/TC 256					General interest, no concrete project proposal
14	CEN/TC 310					

5 Approach

5.1 General

The tools used in this pilot project (see 6) also simultaneously reflect two different approaches that were used, referred to as "Explicit" and "Implicit" SMART Structuring.

5.2 Explicit SMART Structuring

This approach continues the concept developed in pilot project 1, in which standards content was reformulated with the aid of a parsing table in order to make it more generally comprehensible on the one hand and machine-interpretable, i. e. SMART, on the other (see [5]). The use of the parsing table in pilot project 1 made it necessary to reformulate the existing standards content.

Since such a reformulation generally involves a change in the technical content of a standard, however, this generally requires the involvement of the technical committees responsible for the content of the standard. Since such involvement was only possible to a limited extent in pilot project 1, this should now be investigated in greater detail within pilot project 4.

In the case of "Explicit SMART Structuring", the focus is therefore on direct cooperation with the experts from the technical committees.

With the SMART Structuring Table (see [2]), a further developed parsing table, and the Qualicen patterns, two tools were available for this concept within this pilot project.

The Qualicen patterns were used in the subproject NEN and AFNOR, the SMART Structuring Table in the subproject NEN. Detailed reports on the work with the SMART Structuring Table and with the Qualicen patterns are available with the reports on the subproject NEN and the Qualicen report (see [6] and [7]).

5.3 Implicit SMART Structuring

The "Implicit SMART Structuring" was developed in the course of the project together with the TST. This was prompted in particular by the severely limited resources available to the responsible technical committees and their experts for participation in this pilot project. The aim of "Implicit SMART Structuring" is therefore to intervene as little as possible in the working methods of the standardization bodies.

In principle, the concept is based on the process introduced at DIN for the development of (NISO STS-compatible) XML documents within the standardization process. For the standardization committees, this process hardly changes anything in terms of their usual working methods: the content is entered as usual in Microsoft Word. The conversion to NISO STS XML[9] is carried out **in parallel** with the standardization process, and any necessary adjustments to the content are returned to the standardization body during the standardization process. This results in valid NISO STS XML at the end of the standardization process, without any additional effort for the experts of the standardization committees and without potentially incorrect or incomplete post-processing.

Similarly, with "Implicit SMART structuring", the modeling of the contents of the standard takes place **in parallel** with the standardization process, without the experts on the standards committees necessarily having detailed knowledge of the concept used for the modeling. This is because the concept is based in principle on Natural Language Processing, which is manual in this project. In concrete terms, a fragmentation of the textual standard contents was used, which allows triple-structured RDF data to be generated. The natural language could be kept essentially unchanged.

9 https://www.niso-sts.org/

This creates two equivalent versions of the standards content, one human-readable in natural language and one machine-interpretable, SMART version. Parallel processing thus generates a machine-readable, SMART version of the standard content at the same time as the human-readable version.

In fact, only selective and editorial changes to the original text were necessary in the course of the project, and in all cases these were accepted by the responsible committees without any problems. The work of the standardization committees was thus hardly affected in practice.

In principle, the application of this concept does not require any training of the standards committees and no change to the current regulations for the development of standards.

Implicit SMART Structuring in conjunction with TST was used in the AFNOR and SIS/DIN subprojects.

6 Tools

6.1 General

Table 5 shows the tools used in this project in each subproject.

Table 5 — Subprojects and tools used

Subproject	Tools	Approach
AFNOR	Triple Structuring Tool (6.4) Qualicen-Patterns (6.3)	Implicit SMART Structuring (5.3) Explicit SMART Structuring (5.2)
NEN	Smart Structuring Table (6.2) Qualicen-Patterns (6.3)	Explicit SMART Structuring (5.2)
SIS/DIN	Triple Structuring Tool (6.4)	Implicit SMART Structuring (5.3)

6.2 Smart Structuring Table[10]

The Smart Structuring Table is based on pilot project 1 conducted in 2019 (see [5]) and was extended in advance of this pilot to include findings from pilot project 2, also conducted in 2019. It is available in Livelink section of pilot project 5 (see [2]). The table was further developed in the course of this project in subproject NEN.

A detailed description of the Smart Structuring table used and about the project progress in subproject NEN is available in [6].

6.3 Qualicen Patterns[11]

The company Qualicen was brought in as an external service provider in pilot project 4. Qualicen has developed its own method of formulating technical requirements using a defined syntax. In practice, this method is applied with the help of sentence patterns, that have been developed in a joint project with DKE. Later in this project, Qualicen also provided a so-called "cheat-sheet" (see Figure 6), which greatly simplified the application of the patterns and made them clearer.

10 Download link

11 Download link

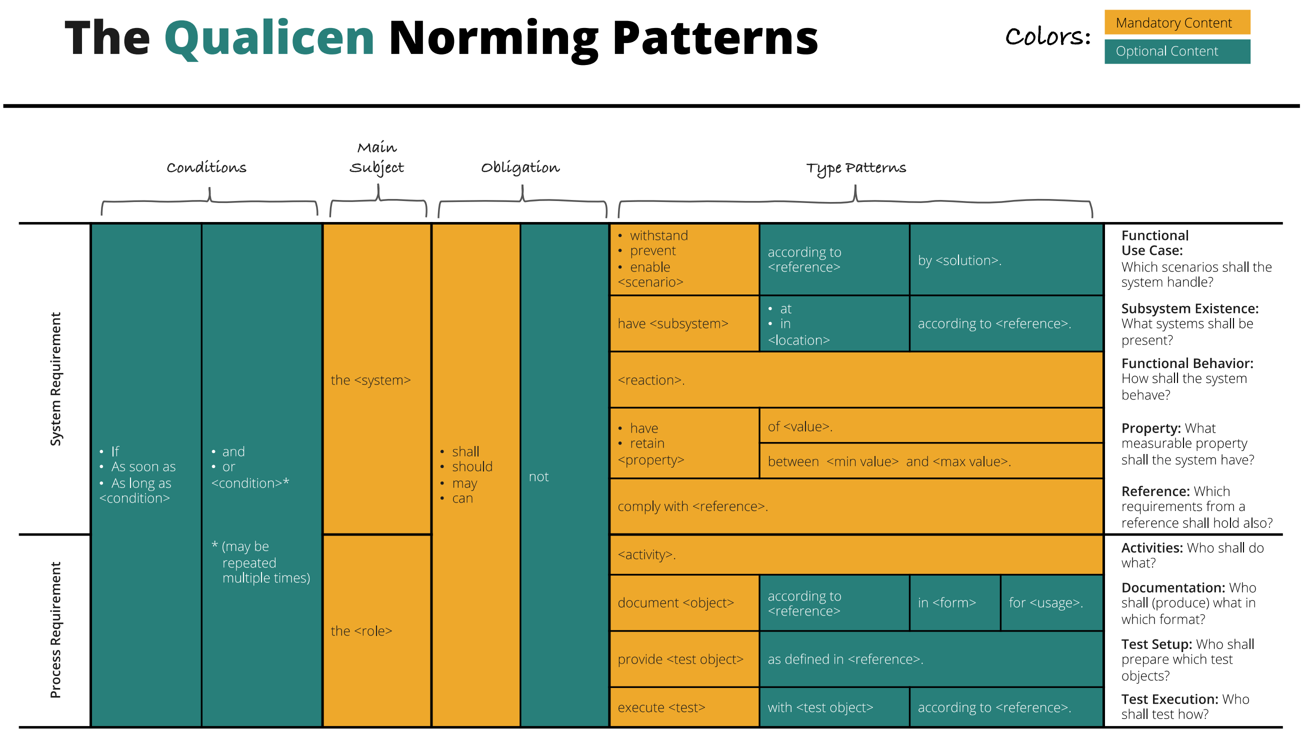

Figure 6 — Qualicen Cheat Sheet[12]

A detailed description of the Qualicen patterns as well as about the project progress in the subprojects NEN and AFNOR is available in [7].

The fact that the patterns do not allow the use of passive voice, raises a number of issues in the future implementation of such a concept in standardization that need to be considered and clarified in follow-up projects. Here, the demand for clearly formulated requirements (WHO is responsible?) competes with standardization principles (standardization of WHAT has to be done, not WHO has to do it).

6.4 Triple Structuring Tool (TST)[13]

6.4.1 General

The original purpose of the TST is to manually model the nested triple structure of natural language in XML. In a sense, a manual Natural Language Processing procedure was used in which the standards content was broken down into its smallest possible fragments and modeled (Level 4 according to Figure 2).

The classification of the specifications (requirement, recommendation, definition, etc.) can then be done on the basis of the modeled data, i. e. from the meaning of the fragments of the specification itself (e. g. modal verb "shall" means that it is a requirement, etc.) and does not have to be done manually. In the future, there will be numerous use cases for such Level 4 data, since all information contained in the standard content can be modeled in a machine-interpretable way. The entire content becomes SMART by modeling a semantic network.

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12 Table 1, item 17

13 Download link

Level 3 functionalities were also added to the TST during the course of the project. In particular, the NISO STS parser and the ReqIF generator should be mentioned here, which allow the tool to be easily integrated into current standardization processes and can generate Level 3 content automatically.

6.4.2 Implemented process

Figure 7 shows the approach implemented in the TST in conjunction with the Process (see Figure 3) and Utility Model (see Figure 2).

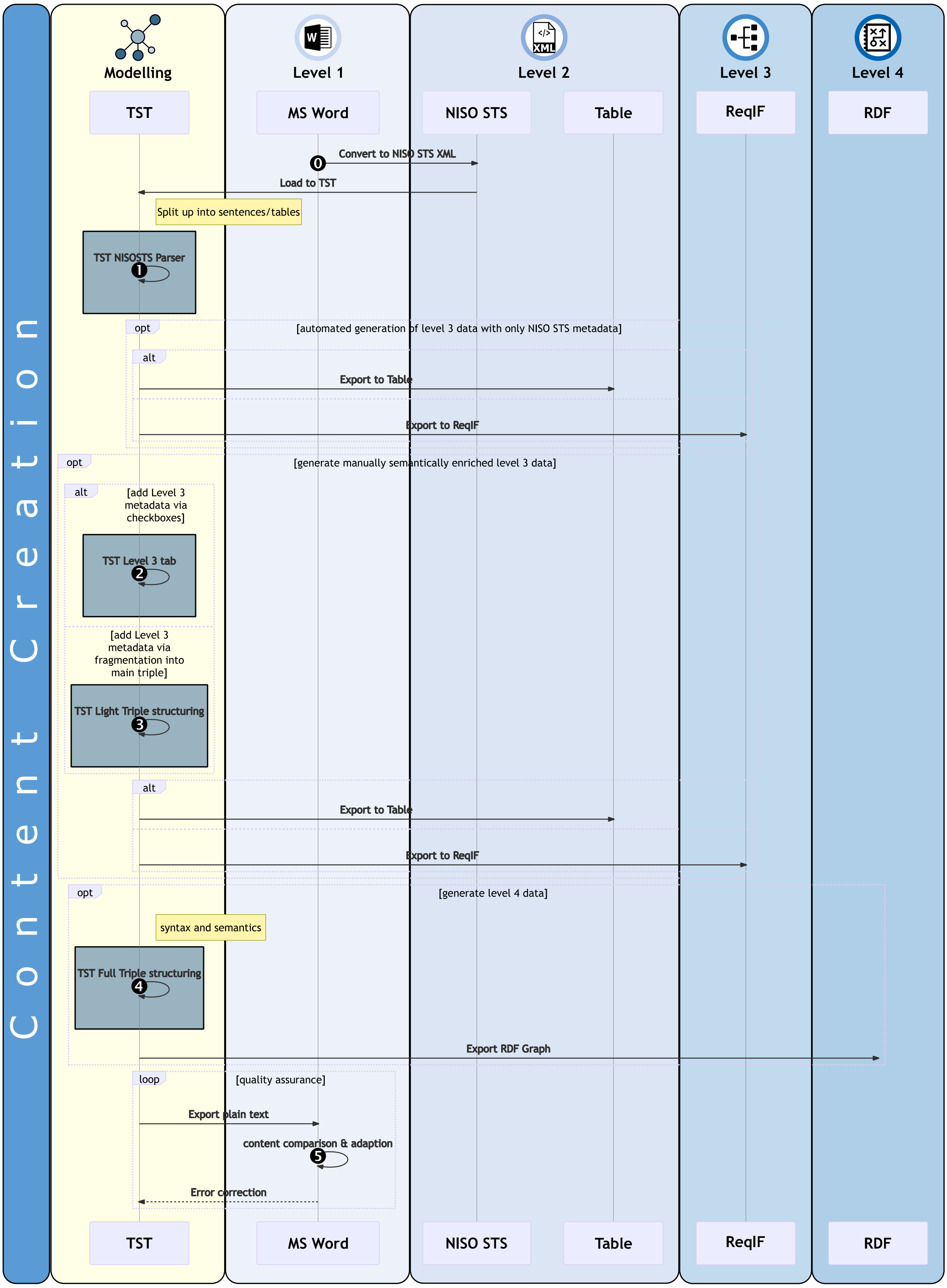

Figure 7 — TST approach in relation to process and utility model

Table 6 gives details on the steps in TST modeling shown in Figure 7.

Table 6 — Steps for implicit SMART Structuring by TST

Step No.	Description	Comment	Current availability	Time spent $\frac{\text{minute(s)}}{\text{page + person}}$	Chapter
0	Generate NISO STS	Implemented in CEN/ISO/NSB standardization process	CEN/ISO/NSB	0 (automated)	-
1	Parse NISO STS	Generate single provisions from (sentences/tables) from NISO STS	TST	0 (automated)	6.4.6
2	Add Level 3 Metadata	Add metadata to provision according to current Information Model	TST	5 - 10	6.4.6.1
3	Light Triple Structuring	Fragmentation of textual provisions into main triple elements	TST	10 - 15	A.2.4
4	Full Triple Structuring	Fragmentation of all textual specifications into their elementary components and modelling of their semantic links	TST	20 - 45	A.1
5	Quality assurance	Comparison of the generated SMART content with the original document - involvement of the technical experts or error correction, if necessary	TCs / TST	1	6.4.4

The TST and the information model in pilot project 5 were developed in parallel, for this reason the individual elements are not always identically named and structured.

Table 7 contains a mapping to find the elements of the information model from pilot project 5 in the TST.

Table 7 — Mapping SMART-XML – Information Model

TST		Pilot project 5 Information Model[14]		
Correspondence	**Comment**	**Information Model Class**	**Attribute**	**Operation**
SMART XML Schema	The SMART XML Schema is used by the TST to store all provision related information.	Specification		SMART XML()
RDF Export	Export functionality of the TST.	Specification		RDF()
ReqIF Export	Export functionality of the TST.	Specification		ReqIF()
HTML Export	Export functionality of the TST.	Specification		HTML()
SMART XML Content	XML XPaths in SMART XML ./provisionContainer/metadata/provision[@GUID] ./provisionContainer	Provision	ID:URI	
SMART XML Content	XML XPaths in SMART XML ./provisionContainer/metadata/modality ./provisionContainer/metadata/class	Governing Provision	Type: Modality	

14 See Figure 4.

TST		Pilot project 5 Information Model[14]		
Correspondence	**Comment**	**Information Model Class**	**Attribute**	**Operation**
SMART XML Content	XML XPath in SMART XML ./provisionContainer/metadata/class	Declarative Provision		
SMART SQLite DB	File path in TST folder /termDB/term.db	Relation		

A detailed user manual for the TST is not part of this report. Only the basic functionality of the tool is presented here.

6.4.3 Integration into the standardization process

In accordance with 5.3, the original wording of the standards committees can therefore essentially be retained, and the familiar Word template for standards committees can thus also be retained within this project as a capture tool for standards content.

This should demonstrate that SMART content can be generated from textual standards content, even for Level 4 without extensive rewording. It is therefore not necessary to make the TST itself available to the experts of the technical committees; the modeling work in this pilot project was carried out in parallel with the standards work and exclusively by the project team.

This approach is based on the assumption that the existing regulations for the creation of standards content (e. g. ISO/IEC Directives, CEN/CENELEC Internal Regulations) already cover a large part of the requirements for SMART content, if applied consistently, provided that the procedure used to model this content is flexible enough.

6.4.4 Advantages of the TST concept

This assumption was confirmed in the course of the project, since the few changes to be made to the original textual content as a result of the modeling in the TST were classified as editorial and accepted by all the technical committees concerned, and more in-depth training of the experts with regard to new rules for the creation of standards content could therefore be dispensed with.

Accordingly, the time- and resource-intensive training of the experts of the ISO/IEC/CEN/CENELEC technical committees with regard to new procedures in the compilation of standards content is not necessary for an area-wide implementation of an implicit concept comparable with the TST.

The results of this project show that the capture of SMART content, using the concept implemented in TST, does not require any fundamental change in standardization processes and regulations. At the same time, this method opens up a perspective for transferring existing content into SMART standards, without having to wait for a regular review or revision by the responsible standardization bodies.

In addition, it is to be expected that the greatest possible automated use of standards content and the best possible automated support for standards users, can be realized in the future with the aid of the level 4 data generated in a triple structure on the basis of RDF.

6.4.5 Disadvantages of the TST concept

However, the fact that the human-readable version of the standards content remains largely unchanged with this method also means that there are no direct improvements in terms of comprehensibility and unambiguous wording for the purely human-readable content (print document, PDF); in this respect, the advantages clearly lie with the Smart Structuring Table or the Qualicen patterns.

6.4.6 How the TST works

The TST allows the import of NISO STS XML and can thus be seamlessly integrated into existing standardization processes (see Figure 7). The rough structuring of the NISO STS (on a sentence basis) is performed by the NISO STS parser integrated in the TST.

The tool is divided into two areas, which allow the modeling and generation of Level 3 (see 6.4.6.1) and Level 4 content (see Annex A).

6.4.6.1 Level 3 tab

Figure 8 shows the Level 3 tab of the TST structured according to the definition of Level 3 content in pilot project 5. This states that the level of fragmentation of Level 3 content in natural language is at sentence level. Accordingly, metadata for the individual specifications (sentences) can be defined here. In addition, the tab contains an area for provision-related metadata that originates from the imported NISO STS XML.

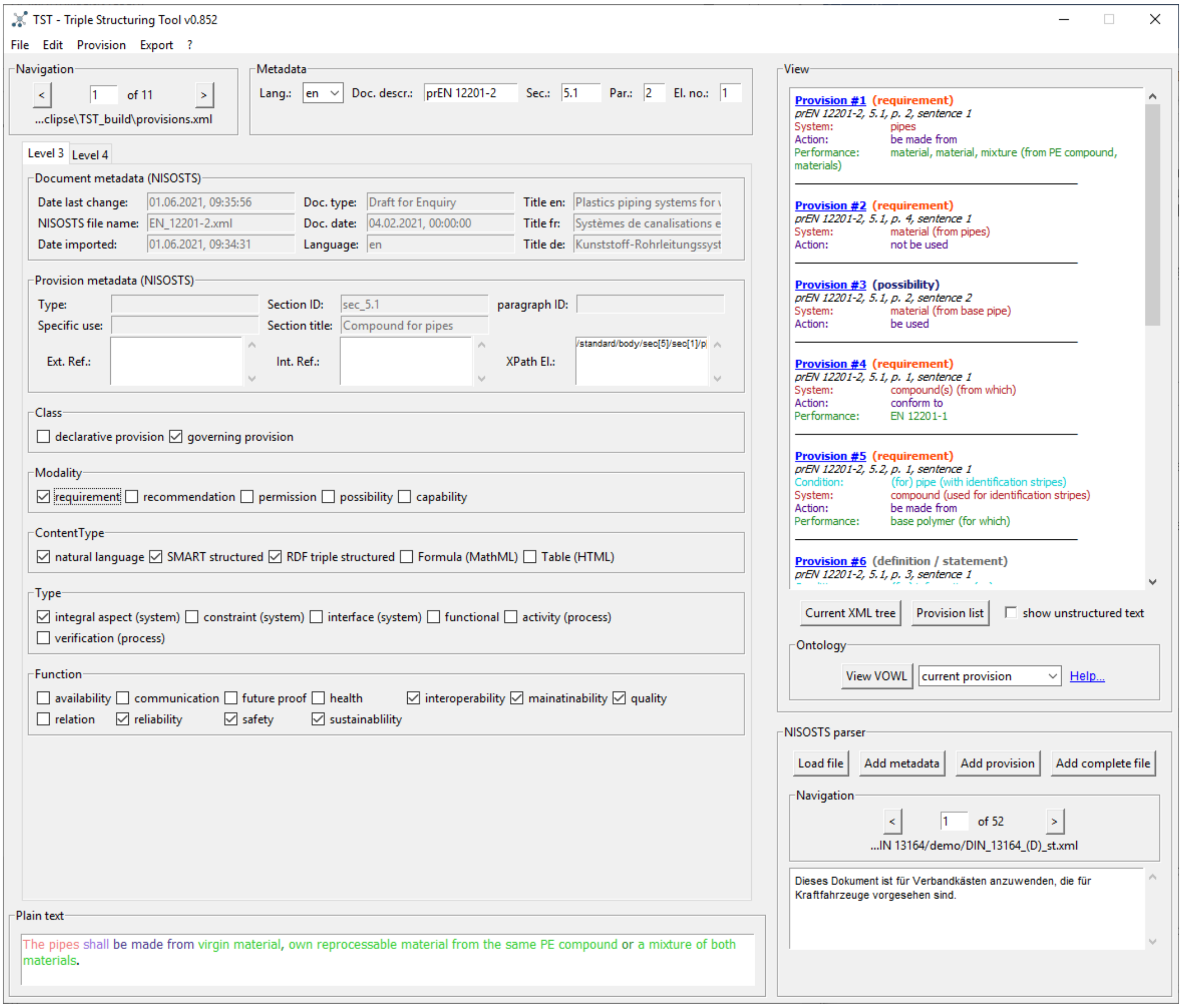

Figure 8 — TST – Level 3 tab

The metadata, which can be edited via checkboxes, implements the attributes for provisions defined in the information model. (see [2]).

6.4.6.2 Level 4 tab

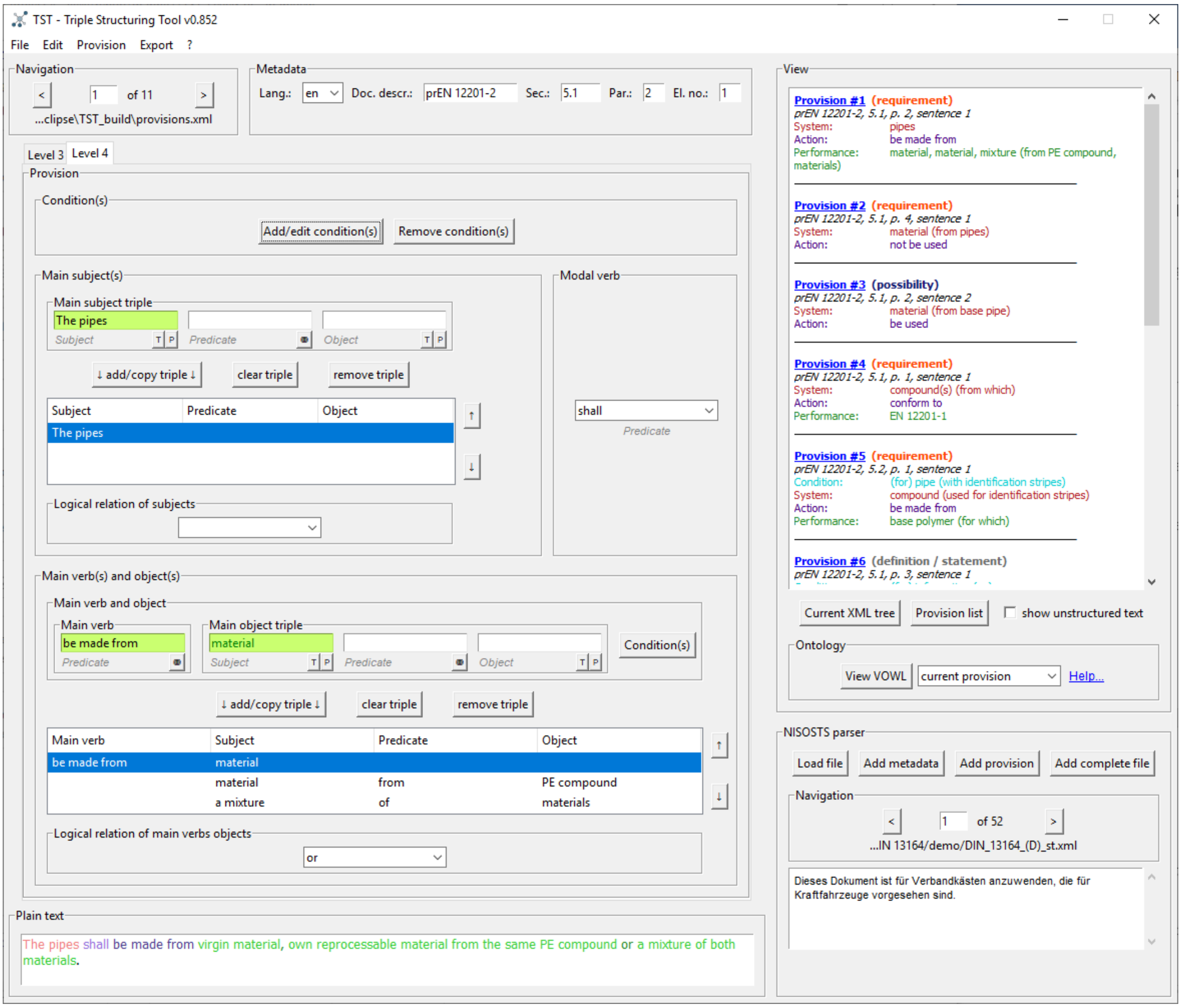

Figure 9 — TST – Level 4 tab

In the Level 4 tab, triple-based fragmentation of standards content is performed; this is described in more detail in Annex A.

6.4.7 Data export

Accordingly, the TST handles four output formats for the modeled content, depending on the level of modeling:

— **Plaintext**, the human-readable content preserved in the modeled data for use in the regular standardization process (Level 1, 2);

— **HTML (table)**, a listing of the captured specifications, roughly structured by subject, predicate, object, as well as with some metadata (Level 3);

— **ReqIF**, an XML-based requirements exchange format, used to output and exchange Level 3 content with requirements management systems, the TST exports all provisions **including all tables** found in the NISO STS;

— **RDF-XML** (Resource Description Framework), used as a Level 4 data container for the semantic network (graph) generated from the standards content.

The extensive possibilities for evaluating the RDF data generated by the TST could not be investigated in detail in this project; it can be assumed that such data structures are the basis for Level 4 use cases.

7 Subprojects

7.1 General

The standardization projects 1 to 5 according to Table 4 were selected and assigned to the following three subprojects, each with responsible national standards organizations:

1) subproject EN ISO 14903/A1: **AFNOR**

2) subproject EN 15984: **NEN**

3) subproject EN 50663, EN 50664, EN 50665: **SIS/DIN**

The dates of the subprojects are summarized in Table 3.

7.1.1 EN ISO 14903/A1 (AFNOR)

7.1.1.1 General

The EN ISO 14903/A1 project was the first to be proposed by AFNOR. Accordingly, it was also possible to contact the responsible committee at a very early stage.

7.1.1.2 Cooperation with the Technical Committee

Since the committee management and the experts of CEN/TC 182/WG 9 were able to invest resources in the participation of this project, two tools were tested in this subproject: the TST and the Qualicen patterns.

As expected, the application of the TST resulted in only editorial changes to the standards document, which were confirmed at short notice by the experts of WG 9. The modeling was carried out independently of the standardization committee, which was only presented with a document containing the changes made with tracked changes after completion of the modeling according to Annex A. In this respect, it was possible to confirm the concept in which only a small amount of additional effort is required on the part of the standards body for the creation of SMART content.

Furthermore, the section 7.11.1 of the document in French was modeled entirely within the TST to demonstrate the cross-language compatibility of the TST approach.

In a second step, the structuring of selected passages (chapters 7.9 and 7.11) was performed using the Qualicen patterns. For 7.9, a comparison to the TST-structured content is available (see [8]). In addition, the report of WG 9 (see [9]) dated 2021-04-21 on the one hand, and that of Qualicen (see [7]) on the other hand are relevant for this. The patterns were generally positively received by the panel experts.

7.1.1.3 Project deliveries

In addition to this report, the following project deliverables are available:

7.1.1.3.1 Explicit SMART Structuring

a) EN ISO 14903/A1, Chapter 7.9 and 7.11 modelled with the Qualicen patterns (see Table 1, item 7);

b) Qualicen report (see Table 1, item 2).

7.1.1.3.2 Implicit SMART Structuring

a) EN ISO 14903/A1 Word standard documents (see Table 1, item 3 and 8):

   1) Original content,

   2) TST-structured plain text,

   3) comparison between both versions

b) NISO STS XML standards document (see Table 1, item 9)

c) SMART XML standards document (see Table 1, item 10)

   1) Automatically generated from NISO STS

   2) Fully modeled

d) HTML Table (see Table 1, item 11)

e) ReqIF (see Table 1, item 12)

   1) Automatically generated from NISO STS

   2) Fully modeled

f) RDF-XML - fully modeled standards document as graph (see Table 1, item 13)

g) French translation (see Table 1, item 14)

   1) SMART XML

   2) HTML Table

   3) ReqIF

   4) RDF

7.1.2 prEN 15984 (NEN)

7.1.2.1 General

This subproject was entirely managed and organized by NEN. A detailed project report is available with [6].

Here, too, it was possible to cooperate extensively with the experts of the responsible CEN/TC 19. The focus was on the testing and further development of the SMART Structuring Table and the comparison with the Qualicen patterns, so both tools were used in the project.

7.1.2.2 Project deliveries

In addition to this report, the following project deliverables are available:

a) NEN subproject report (see Table 1, item 1)

b) prEN 15984 - modeled in the SMART Structuring Table (see Table 1, item 4)

c) prEN 15984 - as revised standard document (see Table 1, item 5)

d) prEN 15984 - as digital prototype at this link (see Table 1, item 6)

e) Qualicen report (see Table 1, item 2)

7.1.3 prEN 50663, prEN 50664, prEN 50665 (SIS/DIN)

This subproject was carried out jointly with SIS and DIN.

It was not possible for the CEN/CENELEC/TC 106x committee to provide the greater time resources required for an "Explicit SMART Structuring" during the project period. For this reason, the "Implicit SMART Structuring" was carried out with the TST for this subproject. However, the changes made to prEN 50664 as a result of the TST modeling were reviewed by the chairwoman of the committee in January 2021 and confirmed as essentially editorial.

The unique selling point of this subproject was therefore that it was possible to demonstrate that SMART modeling of the contents of the standard can also be carried out largely without interaction with the responsible committee.

All three standards documents were successfully modeled in full in TST.

7.1.3.1 Project deliveries

In addition to this report, the following project deliverables are available for each of the three standards documents:

a) Word standard documents (see Table 1, item 3 and 8):

    1) Original content,

    2) TST-structured plain text,

    3) comparison between both versions

b) NISO STS XML standards document (see Table 1, item 9)

c) SMART XML standards document (see Table 1, item 10)

    1) Automatically generated from NISO STS

    2) Fully modeled

d) HTML Table (see Table 1, item 11)

e) ReqIF (see Table 1, item 12)

    1) Automatically generated from NISO STS

2) Fully modeled

f) RDF-XML - fully modeled standards document as graph (see Table 1, item 13)

8 Qualicen survey

In addition to the workshops in the AFNOR and NEN subprojects for the practical approval of the patterns, a survey was conducted by Qualicen to confirm the benefits formulated in chapter "Hypotheses" of [7] by the use of the requirement patterns from the experts of the technical committees. The original drafts and the drafts transferred into the patterns from the workshops were used as references.

The survey reinforces the assumption that requirements written in pattern form are more machine readable, human comprehensible and complete than requirements written without requirements patterns. No requirement has been found that could not be expressed by the requirements patterns. In addition, a large proportion of the experts participating in the survey have a positive view of the future use of the patterns.

The results are available in [7] and show an overall positive impression of the standards bodies involved.

9 Conclusion and recommendations

9.1 General

One objective of this pilot project, namely to test the information model developed in pilot project 5, has been achieved. In retrospect, however, this was not the actual challenge, since a decomposition of the textual standard contents into individual specifications, i. e. sentences, including the recording of specific metadata, was necessary anyway for the application of all the tools in this pilot project.

More decisive was the question of the technical and organizational applicability of the tools used in this project.

9.2 Limited resources in the technical committees

In all subprojects of this pilot project, there was limited availability of resources within the technical committees for additional work on standards content. This was also expressed by the rather sparse project proposals in the course of the "Call for participation".

Particularly in view of the fact that standardization work is organized on a voluntary basis, it is difficult to imagine that significant additional capacities can be mobilized here in the medium term. This becomes particularly relevant in the reformulation of existing standards content.

This should be considered both in the future planning of pilot projects and in the selection of the actual concept to be implemented.

Moreover, new and possibly more complex rules for the formulation of standards content must first be communicated to the technical experts for widespread application, which, in view of their large number (e. g. 50,000[15] at CEN) and fluctuation, represents a long-term objective that can only be achieved with continuous training efforts.

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15 https://www.cen.eu/work/ENdev/WhoDevelops/Pages/default.aspx

9.3 Validation by users of standards

Even if the definition of metadata is to be solved primarily in the area of the information model, these play an important role for the evaluability of the project results from this pilot project by the standards users.

This is because in the fragmentation of (textual) standards content beyond Level 3, the trend appears to be towards RDF, so there do not appear to be that many options on the table. Moreover, the use of data beyond Level 3 in the application of standards content is not yet very widespread.

In this respect, the evaluation of the project results of this project on the part of the users in the course of the project with regard to the fragmentation techniques used (SMART Structuring Table, Qualicen patterns, TST) has been rather reserved. The most important criterion for the evaluation of the project results by standards users initially remains the metadata. The knowledge gained in this regard during the course of the project was implemented in the tools used or incorporated into pilot project 5.

The ideal provision of the right metadata to the right extent can therefore only be developed in direct exchange with the standards users. In order to keep the degree of abstraction as low as possible in this coordination process with the users, a concrete starting point is required. ReqIF with a metadata set from the current state of the SMART/Triple Information Model (see [2]) can represent such a possible starting point for an iterative improvement process (cf. Table 1, item 12).

9.4 "Explicit" vs. "Implicit"

In particular, the NEN subproject and, in part, the AFNOR subproject, with their application of "Explicit SMART Structuring", provide valuable insights into the question of how standards content should ideally be developed and formulated by technical committees in the future, and what skills and knowledge are required on the part of the technical committees for this purpose.

Furthermore, they provide information on how exactly the necessary cooperation between modeling experts and standardization bodies can be organized and at which points standardization processes and regulations must be adapted for this purpose.

The testing of the SMART Structuring table and the Qualicen patterns in this project has demonstrated the feasibility of this concept.

"Implicit SMART Structuring" in conjunction with the TST, on the other hand, provides a more technological approach to the development of SMART standards. The TST was intentionally designed within the regulations and standardization processes already in place to allow for near-term feasibility.

The application of the TST was also successful. The assumption that the concept implemented there would enable SMART content to be generated without involving the technical committees was confirmed. In particular, the automated generation of ReqIF data from NISO STS standards documents demonstrated in the TST raises hopes for near-term feasibility with respect to the delivery of Level 3 content.

Even though their use in this project was to a certain extent under laboratory conditions, it can be evaluated as successful for all tools of this pilot project. The results are conceptually different.

In the overall view, however, the two approaches are not competing approaches, because both complement each other. For example, standards content that has been formulated in accordance with the SMART Structuring Table or the Qualicen patterns can also be evaluated more easily and (partially) automatically at a later stage and transferred into TST-like data structures.

Even if the "Implicit" approach promises quick results from today's perspective, the pursuit of both approaches would, however, be ideal for the future development of SMART standards.

Annex A

RDF & Level 4 in the TST

A.1 Basic concept

In the Level 4 tab of the Triple Structuring Tool, a procedure was implemented in which natural language is decomposed into the basic elements of the Resource Description Framework (RDF), into so-called triples.

With the help of the local terminology management implemented in TST, a semantic network, a graph, can be generated from these.

The data of the graph can be exported as RDF-XML and visualized, for example, in online tools[16]. RDF XML files can be used for queries with the graph-based query language SPARQL[17].

This represents the concrete use case for Level 4 data. With the help of SPARQL, arbitrary logical statements can be queried from semantic networks, and the entire information stored in the language thus becomes machine-understandable, i.e. SMART.

A.2 Triple Structuring (syntax)

A.2.1 General

An RDF triple consists of

— subject;

— predicate;

— object.

For complex sentences, this division alone cannot achieve full Level 4 modeling. However, such sentences always have a main subject, main predicate, and main object. Already the modeling of these basic elements can contribute to a considerable facilitation in the management of provisions (see A.2.4).

For full Level 4 modeling, these principal components must be further decomposed.

A.2.2 Triple and sub-triple

A simple example[18] of a sentence where the simple decomposition into subject, predicate, and object would suffice, would be something like:

```
Bob knows John.
```

The verb "knows" links the two names Bob and John and defines their relationship.

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16 http://www.visualdataweb.de/webvowl/

17 https://en.wikipedia.org/wiki/Apache_Jena

18 https://en.wikipedia.org/wiki/Semantic_triple

However, this principle of linking two linguistic elements (subject or object) with the help of a connecting element (predicate) can also be applied to linguistic elements nested in more complex sentences.

Another simple example of an already (simply) nested sentence would be:

```
Mike → said → (triples → can be → objects)
```

The nested partial triple in this case also consists of two nouns and a verb, but it is already clear here that the two nouns are no longer the subject and object of the sentence, but that the entire triple represents the object of the sentence.

Also, a verb does not necessarily have to represent the connection between two linguistic objects. If, for example, an adjective is assigned to a noun, a triple is created again.

```
Mike → said → (triples → can be → (complex ← <hasProperty> ← objects))
```

The linking element remains empty in this case, but its meaning is implicitly determined by the relationship of the noun and the adjective.

Subordinate clauses can also be semantically nested according to this principle.

```
(Mike ← <relatesTo> ← (who → is → clever)) → said → (triples → can be → (complex
← <hasProperty> ← objects))
```

The type of linkage is determined by the type of subordinate clause. In a relative clause, there is a relationship between the relative pronoun and an object from the parent clause. In a causal clause, the conjunction determines the type of linkage, and so on.

The parentheses in the examples shown summarize semantic triples. The TST converts this into a graphical user interface in its Level 4 section and stores the generated structures as XML:

```xml
<provision>
    <subject>
        <subject>
            Mike
        </subject>
        <predicate>
        </predicate>
        <object>
            <subject>
                who
            </subject>
            <predicate>
                is
            </predicate>
            <object>
                clever
            </object>
        </object>
    </subject>
    <predicate>
        said
    </predicate>
    <object>
        <subject>
            triples
        </subject>
        <predicate>
            can be
        </predicate>
        <object>
            <property>
                complex
            </property>
            <object>
                objects
            </object>
        </object>
    </object>
</provision>
```

In the examples, the most important component of the concept around the TST becomes clear: the natural language remains. When the (XML) structuring elements are deleted, what remains is the sentence that can be understood by any human being.

Triple structuring was therefore carried out in the background in this project, and the experts on the standards committees were able to continue working with their usual tools without having to deal with the details of data structures.

A.2.3 The CEN/CENELEC languages in triple structures

Even if the English language follows the order subject - verb - object in large parts, this is not always the case in exceptional cases. Other languages, such as German, deviate even more from this order[19].

However, since on the one hand the verb is needed as a connecting element between two nouns for the formation of a semantic network, and on the other hand the modeled language should correspond to the natural language without structuring elements, a tagging system was developed in TST, which allows the shifting of individual (partial) elements within a triple in order to preserve the natural language. The tagging system is described in more detail in the TST help.

Let us consider the modified example from A.2.2.

```
Bob knows John, too.
```

The adjunct "too" obviously refers to a context outside this sentence, but in a triple structure it belongs to the verb, because it specifies its meaning. Thus, the predicate splits into two elements here:

```
<provision>
        <subject>
            Bob
        </subject>
        <predicate>
            knows
        </predicate>
        <object>
            John
        </object>
        <predicate>
            too
        </predicate>
</provision>
```

With this method, all three CEN/CENELEC languages could be completely modeled in this pilot project, while maintaining the natural language structure, and RDF could be generated from them.

A.2.4 Light Triple Structuring

Besides the fact that almost any linguistic construct can be decomposed into the described nested triple structure, it is also a result of this project that this decomposition, if done manually as here, is quite time-consuming. The empirical values for this project, with some practice, were about half an hour to a full hour per page.

For this reason, a strongly simplified variant of the triple structuring should be pointed out here, which in principle only includes the first step of the complete triple structuring. Here, only the main subject, main predicate and main object of a specification, as well as any conditions linked to them, are structured.

```
(Mike who is clever) → (said) → (triples can be complex objects)
```

19 [Map of the distribution of SVO languages]

This type of structuring can be done very quickly and easily. Although it does not make the entire content of a provision accessible to an automated evaluation, it opens up the possibility of being able to automatically generate a large part of metadata much more easily and also lays the foundation for later complete modeling.

E. g. the evaluation of the main predicate allows a reliable identification of used modal verbs and the genus verbi (active or passive), whereby metadata can be generated automatically (modality and type), furthermore the human reader can get a quick overview of the content with the structured representation of the main elements even in case of complicated provisions. Such a representation was chosen, for example, in the TST for the Provision List (see Figure 8 and Figure 9).

A.3 Terminology management (semantics)

A.3.1 From Triple to RDF

The decomposition described in A.2 models the links defined by the syntax of the language. However, the goal is to generate a graph, a semantic network.

In order for semantic networks to be usefully usable and extensible, their elements and connections must be defined and known, for example in a database available in the entire scope of the semantic network.

In our example with "Mike" from A.2.2, this means that whenever someone wants to extend the semantic network at the node "Mike", i. e., to add a new statement or definition to "Mike", he must know who "Mike" is.

The same applies to the use of links between objects. For example, it must be stored that "can be" defines that "triples" are a subset of "complex objects", i. e. a link "isPartOf".

In order to create such semantic networks at global (ISO/IEC) or European (CEN/CENELEC) level, i. e. in order to be able to develop Level 4 standards content, a corresponding global infrastructure must be created, such as a corresponding Object Type Library (OTL). In other words: Level 4 can only be achieved with such a common infrastructure.

In this project, the management of the semantic network objects was implemented in a local SQLite database within the TST, which means that the semantic networks created, such as the exported RDF data, are only valid within the data modeled in this project.

A.3.2 Semantic links

A.3.2.1 General

In addition to the syntax-related linking of linguistic elements described in A.2.2, there are also links that are based on the meaning of the elements. Such elements do not have to be elementary, they can also be triples, which may contain sub-triples again. These links also belong to a complete semantic network.

A.3.2.2 Pronouns, number words, etc.

```
Bob knows John. They go to school together.
```

The fact that in this example "they" refers to Bob and John is obvious to the human reader from the context. However, this link is not machine understandable at first, especially not if the second sentence is considered in isolation. Such links are typical for pronouns or number words and can be stored accordingly in the TST database, as well as taken into account in the subsequently generated semantic network.

A.3.2.3 Global system breakdown structure

In addition, relationships exist due to the nature of the real world. Those that are defined according to the classification in the current information model (see Figure 5) with the help of "declarative" specifications.

```
Grass is green. Water is blue.
```

A link exists between these two sentences, since both subjects, grass and water, are assigned a color.

In TST, this can be stored by defining sub or equivalence relationships. Synonyms, for example, are also organized via this type of linkage.

In addition, other (indirect) relations from an already existing semantic network would of course be conceivable, e. g. that grass as a plant needs water to grow.

Figure A.1 shows the visualization of this example with the representation of the RDF XML generated by the TST in VOWL.

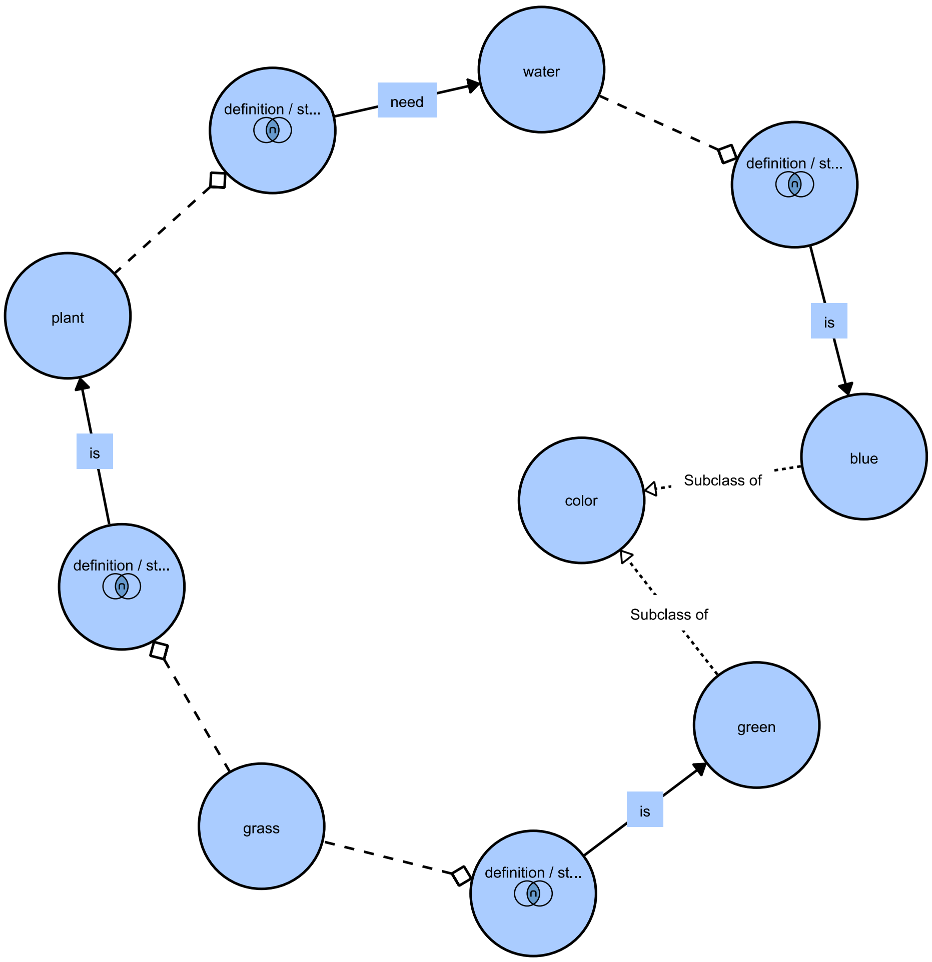

Figure A.1 — Visualization of the generated RDF XML by the TST in VOWL[20]

20 http://www.visualdataweb.de/webvowl/

A.3.3 Implementation in the TST

In TST, each object modeled according to A.2.2 is registered in a local SQLite database so that it can be referenced again if it is used elsewhere (see Figure A.2). This also covers the use of homonyms. Once all objects are registered, the semantic links (A.3.2) can be stored.

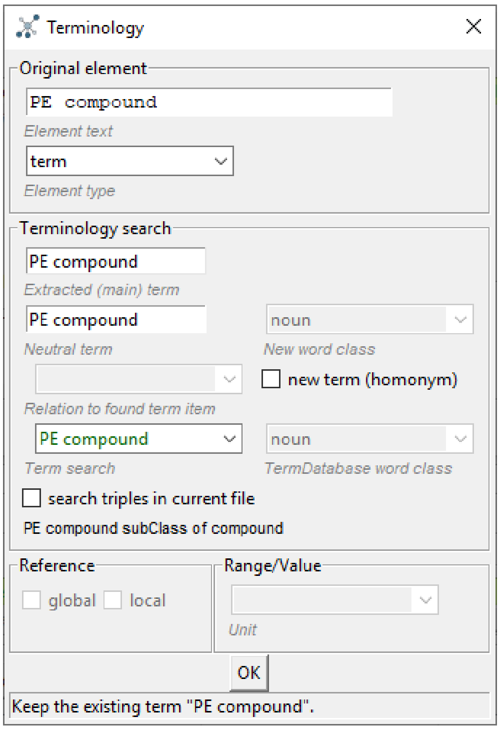

Figure A.2 — TST Terminology window

Double-clicking on a modeled element in the Level 4 area of the TST opens the terminology dialog, where all the relationships mentioned in A.3.2 can be modeled.

Once all elements or fragments and their relationships of a document have been modeled, the associated complete graph can be exported to RDF-XML or visualized in VOWL (see Figure A.1).

A.4 Implementation in this project

All processed standards content in the AFNOR and SIS/DIN subprojects was completely modeled according to the concept described in this annex. In addition to the project results listed in 7.1.1.3 and 7.1.3.1, an overall semantic network of all four modeled documents was also generated (see Figure A.3). It has approximately 1,000 nodes and 1,425 edges.

The underlying RDF file (see [10]) is also attached to this project report as a project result and can basically be used for SPARQL queries. The diverse evaluation and interpretation possibilities of this network are not part of this report.

Figure A.3 — Overall semantic network of subprojects AFNOR and SIS/DIN

Bibliography

[1] A01 – Project charter pilot project 4 – NWI (Link)

[2] A02 – N009 Consolidated Requirements Writing Parsing Table (Link)

[3] A03 – SMART XML XSD schema file (Link)

[4] A04 – Call for participation – Pilot project 'New Work Item' under Standards of the future (Link)

[5] A05 – Final report pilot project 1 “Construction” (Link)

[6] A06 – NEN final report pilot project EN 15984 2021-05-10 (Link)

[7] A07 – Standards of the Future - Report Qualicen (Link)

[8] A08 – Proposal for amendment to EN ISO 14903 (Link)

[9] A09 – CEN/TC182/WG09 N138 Report of the webmeeting (May 2021) (Link)

[10] A10 – Complete Semantic Web AFNOR-SIS-DIN (Link)