Experiences from an Industry-Wide Initiative for Setting Metadata for Regulatory Requirements in the Nuclear Domain

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***Abstract*— The industrial organizations involved in developing and maintaining nuclear power plants need to comply with the requirements coming from the legislative regulation. In the newly renewed Finnish guidelines, there are over 6500 such requirements, which are not always easy to interpret. The industrial stakeholders particularly find the situation highly challenging. Therefore, the Finnish nuclear industry and regulators formed a joint task force to clarify the new requirements by attaching metadata to regulatory requirements. We observed the work process and created tooling to support this work. We present the initial results of the ongoing work of the task force at its halfway milestone, the KLAD tool and experiences on its usage. In the process of setting metadata, the industrial stakeholders reported increasing understanding of the content meaning of the requirements, and regulatory requirement authors learned about writing good requirements. The tool was successful, and in addition, it provides good opportunities for further analysis of the requirements and metadata.**

***Index Terms*—Nuclear, requirements management, requirements engineering, requirements attributes, requirements metadata, regulatory requirements**

I. Introduction

Legal and regulatory requirements are special cases of stakeholder requirements. They are put forward by parties that are completely external to the development organization, they typically must be complied with even though they are not always well-defined, and they might or might not change over the course of the system's life cycle. In the nuclear domain of Finland, regulatory requirements regarding radiation and nuclear safety are contained in guideline documents, called YVL guides.

The role of the regulatory requirements contained in the guides is different to the role of law. The regulatory requirements are based on law and decrees and maintained by the authority. The regulatory requirements cannot require more than the law does, but rather provide elaboration on how the law applies to particular situations and engineering areas. However, it is possible for a license holder to deviate from a given regulatory requirement as long as fulfilment of the law can be shown. In practice, this is a very arduous task for all involved parties.

Recently, YVL guides were subject to a complete rework effort undertaken by STUK, the Radiation and Nuclear Safety Authority, which is the governing body responsible for the guides. All old guides were done away with and a new set of guides was created as an attempt to improve relevance, readability and understandability of the regulatory requirements. For example, the structure of the guides was changed, and all requirements are now numbered in sequence as opposed to paragraphs of prose text under various chapters, which was the case in the old guidelines. Just this change alone makes finding and referring to individual requirements much easier.

However, the guide rework effort was not considered to be enough. Achieving mutual understanding of the regulatory requirements across and within organizations as well as in subcontracting work is still challenging. Understanding the actual content of the regulatory requirements is not easy and it is prone to errors in interpretation. An unequivocal licensing process does not exist in practice. Each regulatory guide has an appointed guide owner – a regulator who is responsible for the requirements contained in the guide. Similarly, each utility typically has an appointed owner for each guide, who is an expert on the guide's requirements. Despite other efforts to distribute knowledge, a lot of requirements information remains as tacit knowledge of the guide owners and is not explicitly documented. Another practical problem is discovering efficiently and uniformly the applicable regulation for a given entity, or for a certain life-cycle phase of a given entity.

Changing the actual requirements to overcome any found deficiencies is extremely laborious and could have unintended implications to existing and future designs. Furthermore, it might not even be possible to rewrite regulatory requirements in an unambiguous manner while keeping them prescriptive for a universal situation.

As a solution to the problem, the industry itself with public authority has come up with an initiative to clarify requirements by annotating requirements with metadata. The metadata is intended to be descriptive, i.e., the as-written regulatory requirements take precedence as the effective regulation. However, the attributes are intended to promote common understanding of what the requirements actually mean and help mine applicable requirements for a given situation. Consequently, it is hoped that the attributes will enable the creation of a reference processes for different situations encountered in the licensing of nuclear power plants, their systems and components, both in new build nuclear plants as well as system modifications and upgrades in existing nuclear plants.

In this paper, we present the starting point and initial results of a larger case study on how to facilitate this industry-driven metadata setting for regulatory requirements in the Finnish nuclear domain. The body of data processed consists of 8995 numbered items, of which 6599 are initially classified as requirements, and the others are either document references or headings.

We describe the metadata, which includes 14 attributes, each having from 3 to 38 different values and one freeform attribute used for annotating the regulatory requirements; the work process that was used to annotate regulatory requirements in the domain; and the tool we created to support this initiative.

The annotation work is currently ongoing, involving 172 domain experts working either for the utilities or the public authority. The experts cover all four current license holder companies for nuclear operation in the Finnish industry. As the annotation work is performed in multiple stages consisting of individual work, group work and reviewing per each item, the cumulative effort needed per item is considerable. For all 8995 items, the total amount of effort needed is massive. At the time of writing, the group work has been finished for 1895 items, and 2803 items are under individual work. Furthermore, we provide some early experiences of practitioners on the feasibility and usefulness of the effort.

The contribution of this paper is a description of a case and initial experiences. We describe how and why the effort, called VAHA, was initiated and what the industry is doing in its context. Then we describe the development of the tooling as well was the UI and architecture of the tool, and the work process for setting attributes.

II. Related Work

Achieving compliance with regulatory requirements is often very difficult. Otto and Anton [1] describe the general challenges in addressing legal and regulatory requirements in requirements engineering as stemming from the nature of legal text: It is intentionally ambiguous, contains numerous cross-references, domain-specific regulation and acronyms, and it is frequently amended.

Maxwell, Anton, and Earp [2] found that software engineers are unequipped to deal with legal cross-references impacting the systems they are developing. Massey et al [3] report that a graduate-level software engineer is unprepared and has no confidence in creating software that is compliant with applicable healthcare regulation.

Nekvi et al [4] divide the problems of achieving compliance in large projects to three clusters: The size and nature of regulatory text, contractual complexity, and the large scale of the system. They found that the contract of a large systems development project in the railway domain referenced over 300 distinct standards and regulations in addition to the 12,000 requirements contained in the contract. Furthermore, the list of references was non-exhaustive, so the set of regulation that needs to be adhered to is not well-defined and possibly not even known.

Raatikainen et al [5] describe challenges of requirements engineering in the nuclear domain to be in efficient representation and management of various requirements. Sannier and Baudry [6] found the specific challenges in the analysis and management of nuclear regulatory requirements landscape to be variety of documents, number of requirements, high levels of abstraction and ambiguity, and their implicit and complex relationships.

Several efforts to provide solutions for helping achieve aspects of regulatory compliance have been put forward. Some recent examples are as follows. Breaux et al have presented a methodology for extracting privacy and security requirements in the healthcare domain [7, 8]. Maxwell, Anton and Swire [9] present a taxonomy for legal cross-references that can be used to classify their effect of compliance requirements, including identification of conflicts. Uusitalo et al [10] investigate using structured natural language patterns in order to make nuclear requirements more understandable. More generically, Otto and Anton [1] suggest that in order to support requirements engineering processes in a legal context, 9 different topics specifically supporting the management of legal or regulatory requirements should be incorporated.

The specific problem domain and peculiarities of regulatory requirements engineering in the nuclear field of Finland is described as parts of [5, 10].

III. Background of VAHA

In this section, we describe the vision of how the management of regulatory requirements is going to be changed due to the work in the initiative to set metadata, henceforth referred as VAHA (an acronym for the Finnish project name). Also, we discuss the relevant concepts and provide a brief overview on the history of the industry-driven initiative.

A. Vision

The regulator's current process of handling licensing material is strict and well defined. There are a variety of defined roles responsible for various aspects of document review and handling. Despite this, there currently is no pre-defined way to determine which YVL requirements are applicable to a certain issue. Rather, finding the right YVL requirements relies on expert understanding and experience.

The vision enabled by the work of VAHA initiative is that there will be standard and automated tools and templates that will support licensing work. By selecting a set of relevant metadata based on the licensing material, the coordinator of the work automatically gets the relevant YVL guidelines and a refined inspection memorandum template which is passed on to the responsible inspector. As a rough example, if the licensing material contains a quality plan of an automation system, the coordinator selects "Engineering discipline: Automation" and "Deliverable: Quality plan". The system then produces an output containing the relevant YVL requirements for such material in a template which can then be applied by the responsible inspector.

The challenge of STUK also pertains to utilities: To ensure and plan ahead which YVL guidelines and individual requirements concern the project and phase at hand is time-consuming and requires extensive expert knowledge on the topic, and can be especially challenging when performing subcontracting.

The regulatory requirements annotated with metadata are stored in a database maintained by STUK. The license holders can at any time extract current and relevant regulatory requirements from the database. These requirements can be then imported into a requirements management tool of the utilities' choosing. This enables viewing and tracking of relevant requirements for each system, work process, lifecycle phase et cetera. The final goal is to ensure that all relevant YVL guidelines are covered at the proper point of time, and to enable better planning and more predictable project work.

B. Brief History of the Initiative

The origins of the attribute setting initiative can be seen as originating from long time needs of the utilities to improve their processes and compliance of regulatory requirements. However, there had not been enough momentum to start such an effort before the long-pending update of all regulatory guides had been finished. After the finalization of the new YVL guides, the efforts of the utilities were able to gain sufficient traction amongst the necessary stakeholders to realize it. This took place during 2013.

The main stakeholders formed a steering group, representing all the license holders in the Finnish nuclear industry as well as STUK, the public authority. The initiative was discussed on several occasions amongst the steering group and an initial starting point for the requirements attributes and their values was created. The attribute definitions arose from practical needs of both license holders and the authority. As buy-in was acquired from the necessary management levels of the participating organizations, the project moved in to piloting.

In the piloting, which was a two-day workshop in late 2013, setting metadata for several requirements from different guides was attempted. The main goal was to evaluate the suitability of different attributes and their values, as well as to estimate the feasibility and effort needed in the work. It was found that most of the attributes were valid and minor changes to the set of attributes and their values were made.

One main discovery by the end of the first day of piloting was that the Excel spreadsheet template that was used was found to be clumsy, unreliable and generally user unfriendly. As it was estimated that tens of man-months' worth of effort are going to be spent in setting the metadata, a better solution was hoped for. This led Aalto University to mocking up a quick prototype application for the purpose of demonstrating what could be done with low effort. The prototype was demonstrated on the second day of piloting and the decision to build a real tool was made.

The other possibilities that were made concrete by developing a bespoke tool were that it was possible to include features for user group authorization, reporting functions and status tracking. However, the most important consideration was usability. This was particularly important as the guide owners of both the regulator and the utilities were thought to be reluctant to the entire idea of setting metadata for all requirements, and it was important not to aggravate them with poorly functioning, unusable tools.

IV. Research Method

This paper describes the starting point and initial experiences about setting metadata for requirements, and the general process for setting the metadata. Moreover, additional objectives are to assess the development and usage of a tool for setting the metadata.

The research described in this paper is carried out within a larger initiative to study how to make regulatory requirements clearer in order to facilitate more effective communication between the regulator, the license holders, and subcontractors. The overall study focuses on setting the metadata for regulatory requirements and usage of the metadata after setting is carried out. The study is carried out as a case study [11] to capture an account of the initiative as well as generalize experiences to more prescriptive knowledge about good practices to manage such metadata for communication purposes.

The data collection relies on observations and produced documentation. We participate in most of the steering group meetings of VAHA as well as the other events. The data about the events were captured merely as personal notes and experiences. However, all events also resulted in minutes for the meeting as well documents. Additionally, several other documents such as guidelines for setting the attributes were available for the analysis. Because we developed the tools, we are also able to get certain data about the usage of the tool, such as for how many requirements the attributes were set, and other quantitative metrics. However, the initiative for setting the attributes is still in early phases so we did not consider it reasonable to make any further analysis yet.

On the basis of the collected data, we provide descriptive accounts about the defined metadata; the tool development and usage; the process of setting the metadata; and finally discuss the preliminary experiences.

V. Metadata and Attributes Used to Annotate the Requirements

The metadata has been defined in a way that is completely industry-driven, without intervention by academia by the steering group. A preliminary version of the metadata classification was formulated at the start of the initiative, and has been refined in piloting and some values have even been added since the start of the actual work.

The regulatory guides contain 8995 numbered items, of which 6599 were initially classified as requirements. Hence, 2396 items are titles, headings and document references. Initially, all other items are considered to be requirements.

The metadata used to annotate items can be classified into two main categories. The first is fixed, static data used to identify individual items and provide for management and version control the identification of different requirements. The second category is the attributes, which are to be set by the working groups for each requirement during the course of the initiative. Figure 1 illustrates the two different metadata types.

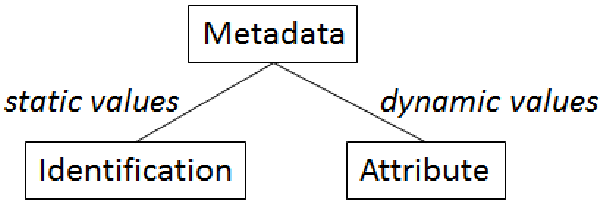

Fig. 1. Metadata categories.

All numbered items were pre-annotated by STUK with the following static identification:

- ID-location, human readable identification
- ID-version, date time stamp
- ID-YVL, unique identifier

The attributes listed in TABLE I. are used to annotate the items identified as requirements. The document object class attribute is set for all items.

TABLE I. ATTRIBUTES USED TO ANNOTATE REQUIREMENTS

Attribute	#	Values
Document Object Class	7	Title, Heading, Definition, Requirement, Description, Document reference , Requirement for STUK
Source Government Decree	38	36 specific decrees, YEA (general decree), YEL (law)
Reference to Related Information		Free form
Category	6	Functional, Technical solution, Work process, Deliverable, Actor, Tool
Licensing Step	4	DiP, CL , OL , DL
Lifecycle Phase	6	Preparation for CL, Construction, Plant modifications, Commissioning, Plant operation, Decommissioning
SAR Classification	26	Chapters pertaining to engineering disciplines
Target Level	5	Plant, System, Structure, Component, Spaces
Functional Safety Class	4	2, 3, EYT / STUK , EYT
Structural Safety Class	4	1, 2, 3, EYT
Target Documentation for STUK	31	Different document types as defined by STUK
Verification Phasing	3	Single, Stepwise, Continuous
Licensee's Verification Type	4	Analysis, Audit, Review, Testing
Regulatory Verification Type	4	Review/Assessment, Inspection, General oversight

Values additionally include “not applicable” for all attributes. As a general rule, it is mandatory to set some value (N/A is fine) for all attributes, and the attributes are multivalued. Exceptions to the rule and the meaning of the attributes are briefly explained as follows.

Document object class. Describes whether the item is a requirement, description, definition, document reference or a heading. Also, it distinguishes whether the requirement pertains to the license holder, or to the authority. Setting other attributes is only mandatory for items which have been identified as requirements by this attribute. This attribute is single-valued.

Source government decree. Describes which decree or law section the regulatory requirement is based on. It enables traceability to higher levels of abstraction.

Reference to related information. Describes any references to other regulatory guides or possibly applicable standards as freeform text. This attribute is not mandatory.

Category. Describes the general target category of the requirement. Examples are functional, actor, work process.

Licensing step. Describes the main licensing step that the requirement pertains to.

Lifecycle phase. Describes the lifecycle step of the plant that the requirement pertains to.

SAR (Safety Analysis Report) Classification. Describes the chapter of a generic SAR under which the requirement should be considered, and additional attributes “security” and “safeguards”.

Target level. Describes which level the requirement pertains to in the plant hierarchy.

Functional safety class. Describes the functional safety class of the target of the requirement.

Structural Safety Class. Describes the structural safety class of the target of the requirement.

Target Documentation for STUK. Describes the licensing document where this requirement should be considered.

Verification Phasing. Describes how the regulator phases the verification of the requirement.. This attribute is single-valued.

Licensee's Verification Type. Describes how the license holder is to verify the requirement is met.

Regulatory Verification Type. Describes how the regulator will verify the requirement has been met.

VI. The KLAD Tool

A. *Description of tool*

The tool supporting the attribute documentation process, named KLAD, had three principles of design. Firstly, the fast-paced prototype development and deployment cycle excluded more complex, dynamic solutions. In order to keep a constantly working prototype for user interface evaluation purposes, the implementation was kept fairly simple and straightforward. Secondly, the tool was required to store the set requirement attributes reliably and in a structured way in order to facilitate data export at later process stages. Thirdly, the tool lifecycle did not require the initial requirement data to be altered during the course of the documentation phase.

The tool was designed as independent from the rest of the requirement specification process. That is, it offers no automated communication with other organizational requirement management tools; after attribute documentation is finished and the data has been exported to STUK YVL database, the tool is decommissioned. Figure 2 illustrates this relation of KLAD to the different actors and systems. The requirements are exported manually from STUK's system to KLAD where attribute setting takes place.

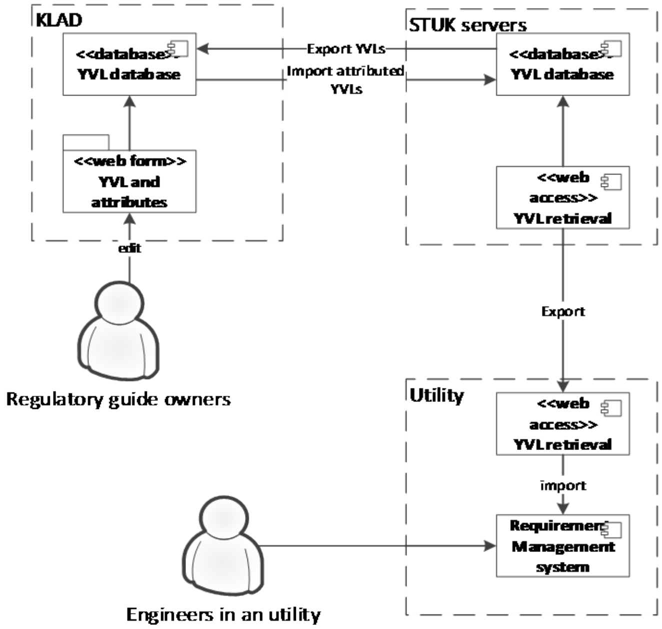

Fig. 2. The context of the KLAD system amongst other systems.

After all attributes are set in KLAD, the metadata is transferred to STUK, where the requirements and associated metadata is stored and maintained permanently. After the data is transferred, utilities can then query and export STUK's database to fetch the annotated requirements to their own requirements management systems according to their specific needs.

The implementation of KLAD follows the Model-View-Controller (MVC) architectural pattern. The initial requirement data, as well as defined metadata, are stored in a SQL database. The frontend is implemented as a simple web-application with Django web development framework running on top of a generic Web-server. The services are deployed on a Linux-based operating system.

The user interface application has views for editing and viewing attribute values, as well as generic reporting and oversight of the requirements attributes' state. Figure 3 presents the main editing view of a requirement with work-in-progress attribute definitions. The main view also contains means for searching and filtering the visible requirements. The requirements are color-coded according to their process status.

Each organization taking part in the documentation phase has access to their respective, independent application with independent back ends. Thus, requirement data is protected from unintended corruption by another organization activity. Furthermore, the attribute changes are traceable to the extent of author, timestamp and content of all saved changes for recovery purposes.

The requirements are classified according to their status and document object class. When entered, the following validation rules are applied:

- Requirements that have status "Done" or "Reviewed" must contain no empty attribute values

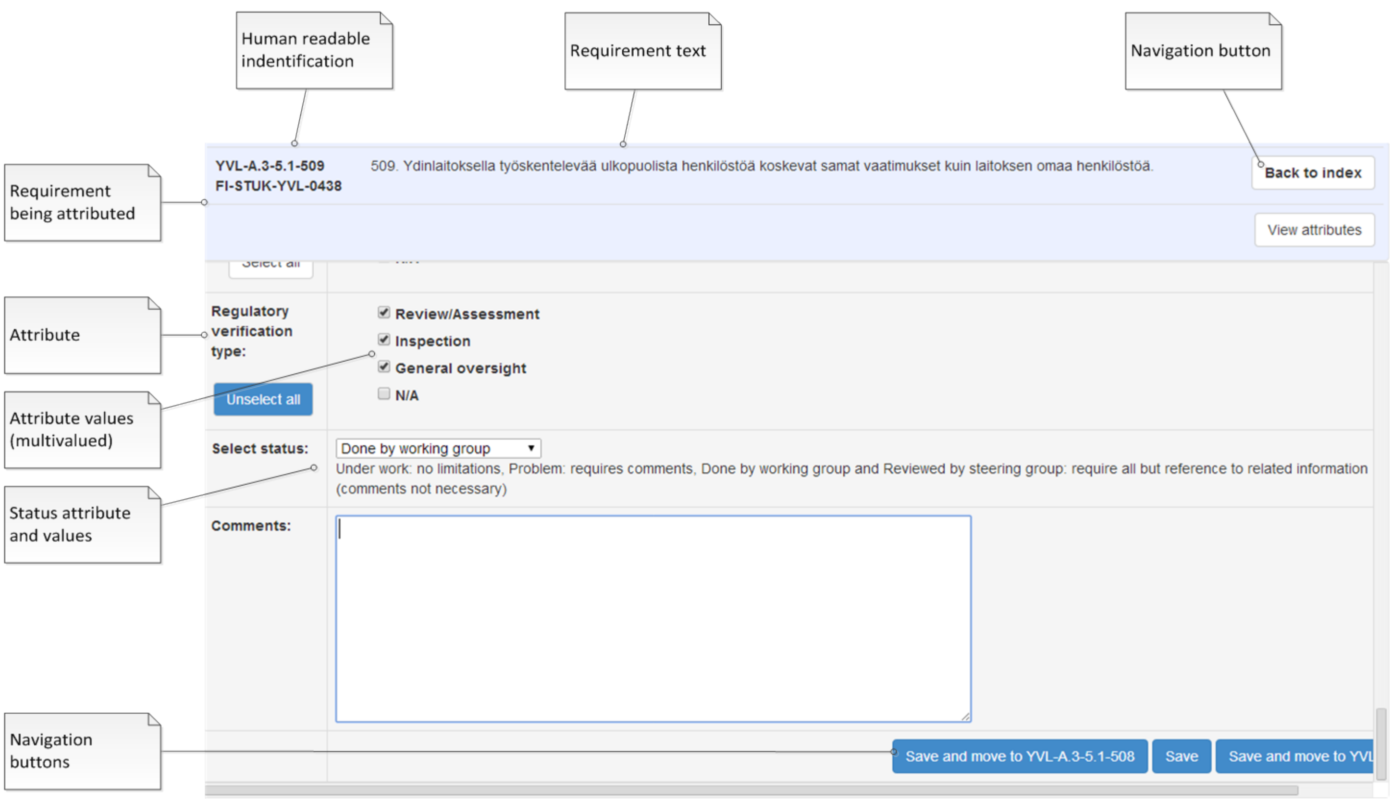

Fig. 3. KLAD attribute edit view screenshot.

- Requirements marked with the status "Problematic" must contain written comment as status attachment.

The size of the tool is 3.5 KLOC, and according to our estimation it took approximately 2 man-months to develop and deploy the tool.

VII. Work Process for Setting Attributes

The work process for setting the attributes of requirements is designed to take place as follows (Figure 4). The requirements of YVL guides are initially imported to KLAD along with the static metadata and preselected document object class attribute, which at this stage only differentiates headings and document references from other statements in the regulatory guides. This data is provided by STUK and imported by KLAD administrator.

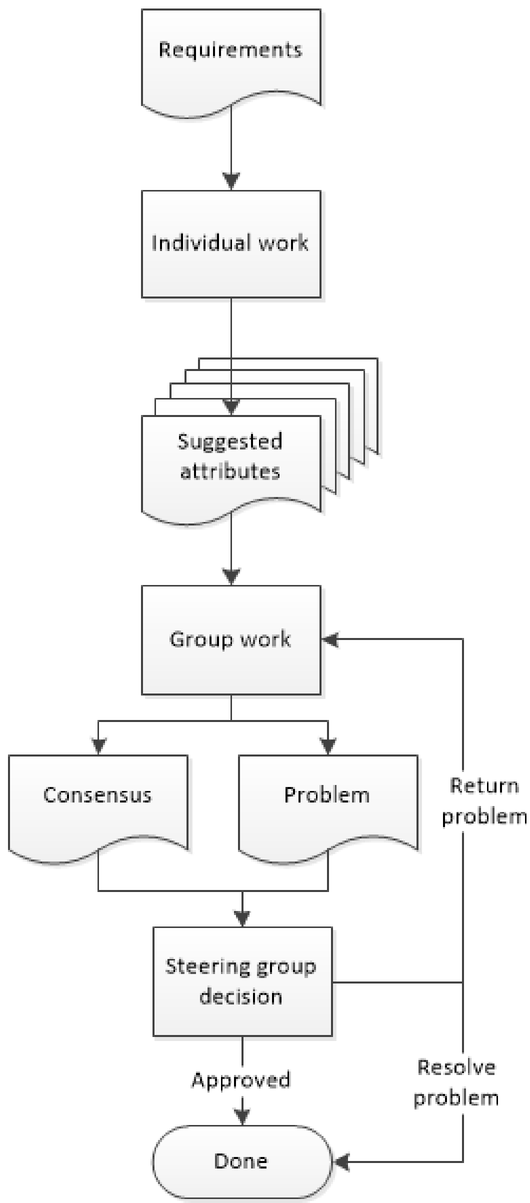

Fig. 4. Work process for setting attributes.

The stakeholders of each organization use their own instances of the tool to make preliminary selections of attributes and comment on the attributes. The status for processed requirements is set to be “Under work”. Next, a workshop is organized where the guide owners agree on attribute values of all the requirements of the respective guide. Preliminary attributes set by STUK are used as the starting point. The tool does not provide for conflict analysis or resolution for differing preselected attributes of different stakeholders, though such an implementation could be feasible. However, this feature was decided not to be included due to the needed extra effort.

If the stakeholders in the workshop can come to consensus on the attribute values of a given attribute, they set the attributes and mark the status of the requirement as “Done”. However, if consensus cannot be reached, the requirement is marked with the status “Problematic” and comments need to be added as to what the problem is. In order for this phase of the work to be finished, all requirements of a single YVL guide need to have either the status “Done” or the status “Problematic”. For requirements that have the status “Done”, all attributes need to be set.

As the next step, an appointed member of the steering group reviews the attributes set by the guide owners. If he/she finds discrepancies in the attributes, the requirement is commented on and sent back to the working group. Additionally, if there are requirements that are marked as problematic by the working group, the steering group member attempts to resolve the problem.

After all requirements have attributes associated to them and the attributes are approved by a steering group member, the data is extracted from the KLAD tool and exported into a database administrated by STUK. KLAD is then decommissioned, and any further changes of requirement attributes or changes to the requirements themselves are the responsibility of STUK.

VIII. Discussion

A. Otto and Anton’s Management of Regulatory Requirements Compared to VAHA

In [1], Otto and Anton describe 9 different elements of regulatory requirements management that should be considered for any system supporting the analysis of regulatory requirements, system design and compliance monitoring. In TABLE II. , we list the elements and briefly describe how each element is facilitated by the results of the work performed in the VAHA initiative, in the context of regulatory requirements in the nuclear domain. The key difference is that the work of VAHA is performed with a generalist approach for all regulation and considering all stakeholders, i.e. dealing with regulatory requirements as output; whereas [1] seems to focus on the specific needs a specific organization has for regulatory requirements, i.e. dealing with regulatory requirements as input. Hence, the perspectives seem to be different to each other.

TABLE II. MANIFESTATION OF THE 9 ELEMENTS OF REGULATORY REQUIREMENTS MANAGEMENT IN VAHA RESULTS

Element	Description
Identification of relevant regulations	Attributes enable filtering of requirements based on context. Related information reference-attribute provides guidance.
Classification of requirements with metadata	Main focus of VAHA initiative is classification with metadata
Prioritization of regulations and exceptions	-
Management of evolving regulations and law	Static metadata provides unequivocal identification and effectivity date for regulation
Traceability between references and requirements	Document references are identified
Data dictionary and glossary to ensure consistency	Glossary effort is done in the context of guide rewriting work, outside of VAHA
Semi-automated navigation and searching	-
Annotation of regulatory statements	-
Queries comparing legal concepts and compliance	-

B. *On Developing a Software System for the Initiative*

The experiences from developing and maintaining the KLAD system indicate the effort has been worthwhile. Initial feedback from the users has been mostly positive. The overhead spent in administrative tasks has been manageable, and approved change requests to the system have been relatively few. Specifically, some regulatory requirements have been added, as all the guides have not been completely finalized even at the time of writing. Furthermore, some attributes have been modified and feature requests have been mostly limited to various simple reporting functions. A case where already attributed requirements were changed caused a major challenge, as the system design assumed the regulatory requirements themselves do not change during the VAHA initiative - the life cycle of the system. Even though this assumption may seem naïve, the developed system is planned to have a relatively short life cycle as compared to the regulatory requirements, which were just finalized before the start of VAHA.

There have been a number of rejected change requests to the system, typically such ones where the system would be used for a different purpose than the original one. This includes setting various metadata not in the scope of the VAHA initiative for the use of other specific needs, as well as export functions which would enable the immediate application of metadata. Keeping complexity low and the focus on current work has meant that these features have not been added.

At the end of the initiative, the system's life cycle will end and KLAD will be decommissioned, thus ensuring there is no burden of a legacy system. So far, we are satisfied with the reception of the system, the perceived usability advantage over Excel and the future prospects of analyzing quantitative requirements data.

C. *On Metadata and the Work Process*

The setting of static metadata is immediately found to be the cornerstone for reasonable requirements management. Previously, with the old regulatory YVL guides, finding individual requirements was challenging at best due to the prose form of the guides themselves. Currently, the revised guides feature individually numbered requirements. In the VAHA initiative, setting static metadata for these requirements makes it possible to have consistent identification of individual requirements of the guides, even if the requirements themselves are often not atomic at all and change management is also much simpler.

The atomicity of requirements itself presents a challenge for setting the attributes. When the requirements are lengthy, a lot of attributes need to be selected. Too many attributes mean that the data is not useful, and requirements authors themselves have noticed this issue. It has been reported that thinking about the attributes has made the authors of the requirements understand how the requirements should have been authored in the first place.

Due to the varied topic of the guides, there have been requests for additional attributes. As a general rule, it appears that specific attributes that are essential for a single domain of work are often hoped for. An example is seismic class of equipment – this classification only concerns a very limited set of guides and a relatively limited set of people.

The setting of the attributes in the working groups seems to be feasible. Contrary to the initial planning, it appears that as a general rule the stakeholders of the utilities are not using KLAD to do preliminary work before the workshops. However, at STUK, the regulators spend considerable effort in coming up with a suggestion for the attributes.

Setting the attributes in the working groups has also been reported to fulfill a secondary objective: The content and meaning of the guides becomes clearer to the key stakeholders of the utilities who participate in the working groups.

Formal expression of the "Reference to related information"-attribute was discussed and ultimately rejected by the steering group. It was found that as the reference could have been any other regulatory guide, law, or standard, it was too much effort to manage such a design.

Whether attributes in general should contain only the information that is explicitly stated in the regulatory text or any other information was an important issue that the steering group decided on. Eventually, the choice was made that due to the informative nature of the metadata, any useful metadata guiding towards commonly accepted interpretation and usual state of practice should be selected.

According to our initial observations, there are two factors that have made the initiative succeed so far: Firstly, there is buy-in from all relevant stakeholders in the industry as well as the regulator. Secondly, each organization has at least one champion promoting the project and enabling the practitioners to understand how metadata will eventually make the daily work with regulatory requirements easier, thus alleviating change resistance. Specifically, the industry was active in the early phases of initiative.

At this stage of the initiative, it is still unclear to what extent the eventual attributed requirements can help in the daily work of all parties. The current expectations are high.

The informal nature of the requirements metadata may pose a challenge for future maintainability. Formal, ontology-based approaches could help in this regard. However, even the cumbersomeness of the current informal approach was seen to be a major risk, considering the required participation levels from various parties.

IX. Conclusions and Future Work

In this paper, we gave an account on the Finnish nuclear industry-wide initiative to annotate regulatory requirements with metadata in an effort to help both utilities and the regulator use and understand the requirements. The specific focus was on the metadata used, the work process to set metadata for requirements, and the design and development of necessary tooling for the initiative.

The initiative has reached its halfway point in terms of requirements processed. So far, our experiences indicate that it is feasible to agree on useful metadata for annotating requirements across all different stakeholders, as well as reach consensus about the metadata values for most individual requirements. Despite the fact that the work is still in progress, the initial reports of the stakeholders already indicate that the effort seems to already be useful from the point of view of forming a common understanding of the content and meaning of the recently renewed regulatory requirements. Setting attributes for requirements has also made some authors of regulatory requirements understand characteristics of good requirements, as setting attributes has often been challenging due to the nature of the written text.

The experiences from the development of tooling were that it was possible to specify, develop and maintain a simple tool that fulfilled the necessary functional and non-functional requirements. The development itself required relatively few resources, as it was foreseen that the originally proposed Excel alternative would have caused the stakeholders to spend much more effort, and all requirements such as status tracking would not have been reached.

In the future, we plan to perform a postmortem on the project which describes the experiences and results from the initiative from both the points of view of the stakeholders and the requirements metadata. Additionally, whether the metadata can be applied in a useful manner in the work of both the utilities as well as the regulator is a key question when considering the success of the effort.

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