STEFAN GEIS

Regulatory Environment for Software Engineering

A Study on Standardization Efforts and Decision Making

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1. Summary

Software engineering modifies the backbone of business. Its outcomes have to be integrated into a corporate IT landscape and its processes have to be matched to the business environment. In order to enable transparency, repeatability, and quality control of these business-critical tasks, standards, rules, and regulations[1] of various types are available. Given their individual complexity and their complex interdependence, businesses that provide software engineering services face the challenge to select standards or review selection processes for a standard during a software project.

However, the vast majority of companies[2] lack insight into the regulatory, environmental, and operational rules that affect their products and services. Nearly 80% of them have no organizational infrastructure to track, audit, or manage standard compliance [Aberdeen Group, (2006)]. Correspondingly, insufficient literature data is available that provides template approaches on standard selection and evaluation or that reflect on appropriate standards from a project or business oriented perspective.

For a sample business use case of a small consulting business to dedicated sectors of the energy industry, this work collects, categorizes, and analyses applicable standards for software engineering. Analysis of collected standards (and a correspondingly derived typology and categorization) enable their understanding within the business context. Two template approaches for their selection - or for their critical evaluation after selection - are one result of the research. Both selection strategies are based on the standard analysis and the market position of the sample business. In order to allow validity and practicability beyond the concrete use case at hand, specific data on e.g. the market position is analyzed to arrive at generalized goals and requirements of a standard selection process.

Collected literature evidence is outlined as introduction to the complexity of standards. This complexity is reduced by an overview on typical standardization

[1] For simplicity, all three (standard, rules, and regulations) are called “standards” in the following, regardless their binding character or the nature of their development processes. For a definition of this term, see also section 10.2 in the appendix.

[2] Geography: A majority of study respondents (78%) were from North America. Remaining respondents were from Europe (9%), Asia-Pacific (9%), Central and South America and the Caribbean (3%), and the Mideast and Africa (1%).

processes on various regional levels (international, European, etc.). In order to understand software engineering, its processes and corresponding standards, the various process areas are described and established engineering methodologies are reviewed as standards to manage software projects.

Next is an analysis of the small consulting business, its customers, and its project portfolio. Based on a typology of customers within the energy industry, nuclear power plant construction companies are identified as one of the most relevant customers. Together with literature data, corresponding projects are the basis for the following research.

Standards are collected and presented according to the typical software engineering processes and, as a second approach, according to a typology that is developed from literature and research data. A map illustrates the relevance of each standard type for the various stakeholders of the software engineering process. Together with an analysis of benefits and risks associated with the identified types, this data provides background for the following standard selection exercise. Here, the stakeholder's requirements and goals are especially considered.

Two sample selections are exercised. One has a very detailed scope and is based on collected SDO standards and their metadata. This detailed approach is only feasible in case of SDO standards, where comprehensive data is more easily available. The other is based on the typology of standards, hereby widening the scope to all identified standard types. At this level, the types are evaluated by contrasting them on the background stakeholder data. For both approaches, practicability and extensibility are demonstrated and outlined, respectively.

In total, best practices to categorize and order standards and to deal with their complexity are outlined, tested, and improved. Hereby, standard selection and evaluation become more transparent, and businesses can leverage the economic power of standards more easily. An outlook on extensions and improvements of the methodologies is given as conclusion and as critical reflection on the results of this work.

2. Introduction

2.1. A Quagmire of Standards?

Several academic papers coined the term “quagmire” to deal with the multitude of standards that fall - for a given subject matter - into the same category [Paulk, (2004)] [Sheard, (2001)] [Sheard, (1997)].. One example of such a standard category is documentation for software life cycle processes. This topic is subject to numerous standards, like ISO/IEC-12207, IEEE 12207, and ISO/IEC TR 15504 (SPICE), etc.[3] In absence of in depth knowledge of subtle differences, the papers only explore the complexity and the contradictions between software process standards. With such issues far from being solved by now, outdated standards remain in use in wide areas. One example is the US Army software development standard MIL-STD-498 [ETNews, (2009)] [Gray, (2006)], which was officially replaced by IEEE 12207 in 1998[4]. Not only in case of software or process standards is standardization influenced by irrational trends[5].

Hence, it is no wonder that the complexity of standardization can drive industry decision makers away from official standards. A recent study showed that companies search for “competitive advantage more through company standards than through industry-wide or private industry standards” [Knoop, (2006)]. Additional benefits of standards developed by accredited SDO processes are not seen or underestimated[6].

2.2. Motivation

Especially small consulting businesses with limited research capabilities face the challenge to identify, customize, and implement the most beneficial standard for

3 The research as presented in the chapter on Standard provides almost 30 standards that deal with documentation for software and its life cycle. Note also, that the IEEE and the ISO/IEC version of standard 12207 are not identical.

[4]At that time, another joint standard (J-STD-016) replaced MIL-STD-498 [Gray, (1999)]. Today, J-STD-016 itself became integrated with IEEE 12207 and ceased to exist officially.

[5]A good example is the market competition and breakthrough of the VHS video standard in the early 1980s, e.g. at the expense of the Betamax standard [Moulding, (1996)]. [Moulding, (1996)].

[6] “Companies are generally unaware of the strategic significance of standards”, “80 % of the businesses surveyed do not know the exact cost of adapting to foreign standards”, and “Only 9 % of the businesses surveyed were prepared to give actual figures for costs and savings” [Knoop, (2006)].

themselves and for their customers. Here, the two following major issues have to be considered:

- As outlined in the previous section, a multitude of standards is usually relevant for the same specific need. In absence of a mapping schema of project- and process specific needs to selection criteria and selected standards, little transparent methods to identify the most relevant or the most suitable standard(s) have to be used. However, this is in contradiction to the transparency usually in focus during standardization processes.
- For given business contexts[7], a typology of standards is missing. Correspondingly, the relevance of standard types in a given business scenario are little transparent. A standardization strategy to streamline corresponding efforts cannot be developed and corresponding consulting requests remain unanswered. Especially in highly regulated industries like the energy industry, a clear understanding of standard types is a crucial success factor of small consulting businesses.

2.3. Research Approach

This work focuses on software development in the energy industry as background of standard use cases. From the viewpoint of a small consulting company, practical knowledge on how to navigate the quagmire is provided. As practical use case, two routes to arrive at recommendations for appropriate standards are given. This means that most parts and many details of the vast quagmire will not be visited and analyzed. However and at least for the limited background, a distant view in form of statistics on the number of standards on relevant topics will be given. Figure 1 is a schematic illustration of the research approach and its goals. The inserted figure at the bottom right of the next page maps this approach to the sequence of chapters as detailed in the following.

[7] Like the one used as background for this work, i.e. SMBs within the energy industry.