# Activity Patterns in Design Processes of IT Standards

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**Abstract.** Contemporary IT standards are *designed*, not selected. Their design enacts a complex process that brings together a coalition of players. We examine the design of the SOAP standard to discover activity patterns in this design process. The paper reports these patterns as a precursor to developing a micro-level process theory for designing IT standards.

**Keywords:** IT Standards, Design Process, DSN, Activity Patterns

## 1 Introduction

IT standards can be a source of cost consumption or revenue generation for corporations. They are anticipatory (yet-to-be implemented [1]) and open (allowing input from industry and citizenry [2]). These attributes make them different from *de jure* standards and also different from vendor-specific *de facto* (opaque and proprietary) standards. The process for designing these IT standards involves a large number of players who appear to "design by committee" (notorious for sub-optimal outcomes [3]). Despite this, many IT standards succeed - they are well designed, widely adopted, and even spawn new firms and industries. The objective of this research is to investigate the IT standard design process. A better understanding can help an organization shape its strategy about its participation in this voluntary process. It can also shed light on how IT design processes can work in the context of large groups where the individual participants may be in active conflict elsewhere in the marketplace. This paper examines the design process for SOAP (Simple Object Access Protocol), developed by the W3C [4] by investigating the proceedings of meetings of the technical working groups [5] through the design, sense-making and negotiation framework [6]. We describe the outcomes as a precursor to developing a micro-level process theory for designing IT standards.

## 2 Prior Work

Garud et al [7] define standards as: "codified specifications that detail the form and function of individual components and the rules of engagement among them." This definition emphasizes the role IT standards play in an increasingly connected world:

they provide rules for interoperability among devices, systems, and organizations. Moen defines a standard as: "an agreed upon response to a recurring problem, perceived, anticipated or real, that is codified for the purpose of communication" [8]. He emphasizes agreement among participants as more important than the specification itself. This emphasis is also reflected in the manner in which contemporary IT standards are created [9]. They are no longer *de facto* (e.g. Microsoft Windows) or even *de jure* (e.g. FAA reporting procedures). Instead, IT standards are consensus-based (e.g. XML), created by voluntary consortia. This makes the process of designing an IT standard an important research concern [10-12].

IT standards have a legal structure because they represent a form of regulation covering performances ranging from professional conduct to technical interoperability. OMB Circular A-119 [13] and the Standards Development Organization Advancement Act [14]) clarify the principles governing the formulation of standards e.g. open-ness, a consensus-based approach, and the importance of due process [15]. An alternative perspective that underlies IT standards is their anticipatory nature, which characterizes standards development as similar to new product development [16]. Scholars [17] describe it as cooperative, multi-actor R&D [similar to] collective engineering, where designers create new capabilities. Seen in this manner, the design of IT standards challenges the conventional trajectory (first R&D, then patents, and finally standards). Instead, participants combine individual R&D efforts and existing patents to design the new standards [18].

The IT standards design process is, thus, characterized by the interplay between these two perspectives: (a) one that values due process, participation, and open-ness, and (b) the other that values creativity and technical problem-solving. Organizations like the ISO [19] and the W3C [20] prescribe processes with a stage-gate structure to help technical committees navigate their work. However, these structures cannot account for the reflective and iterative elements inherent in the IT standard design process. Our concern in this research is this descriptive (instead of prescriptive) perspective of the IT standards design process.

## 3 Conceptualizing the *Design* Process

Scholars (e.g. [21]) have argued that IT standards are artifacts that need to be "designed." Although tautological, the view is important because it emphasizes that standards-making is designing, not simply picking the best from the available alternatives. This view characterizes standards-making as a process of "designing the specification," similar to software engineering [22]. Standards design, then, involves communication among team members through face-to-face or virtual meetings and design specification reviews [23]. Standards design, however, differs from (software) product design because it is designed by members who belong to different organizations who may be competing in the marketplace. Lyytinen et al. [6] suggest a more nuanced perspective, acknowledging this context. Their framework recognizes design as central but complements it with two further components: sense-making and negotiation.

In the DSN framework, the first component, Design [24] describes a cognitive process carried out to solve wicked problems. It includes tasks described as design steps, and strategies such as divide and conquer. This component presupposes substantial technical input from participants and integration of contributed ideas. The second component, Sense-making [25] is the process participants engage in to interpret changes in the environment. It includes predictive sense-making, i.e., attributing meaning to not-yet-invented technologies by assessing potential benefits or threats. The third component, Negotiation, involves the recruitment of actors to create and sustain a network in which the new technology will be introduced and stabilized [26, 27]. Here, actors bargain the distribution of future outputs to reach an agreement [26]. The DSN Framework [6, 28] integrates the three elements to describe standards development as an emergent, recursive process that reaches closure with the creation of the final specification.

This conceptual move, from a linear, stage-gate model to one that emphasizes cycles and closure holds significant promise. Although early empirical analyses [29] following this framework have not yielded definitive accounts, recent work [6] shows that techniques such as event grammars and process logic [30, 31] hold considerable promise [6]. This desire to contribute further to understand standards design is at the core of our research.

## 4 Research Method

We study the design of Simple Object Access Protocol (SOAP) [32] over three years. Figure 1 shows the timeline and the data gathered.

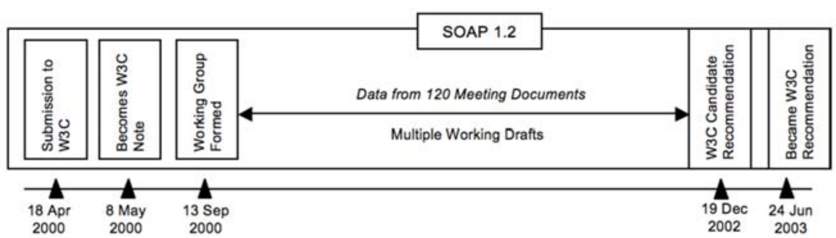


**Fig. 1.** SOAP standard development: Timeline and Data gathered

The data consists of meeting transcripts from the working group (in-person or remote, one or multiple days). Figure 2 shows the data analysis process.

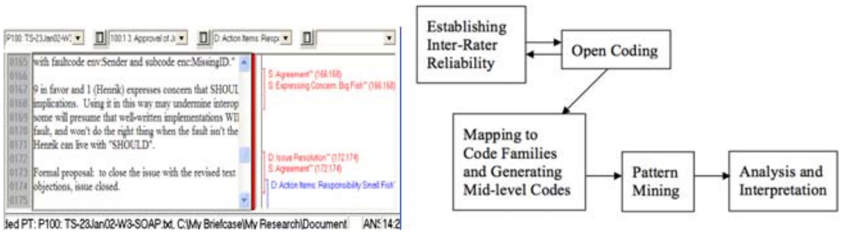


**Fig. 2.** The Data Analysis Process and an Example

The transcripts capture a precise record, i.e. they provide a faithful account of what transpired during each meeting. They cannot reveal personal agendas, informal communication or any secret caucus results. However, they do provide a rich source of data that has been shown by organizational scientists as valuable in spite of the above caveats [33]. We used an open coding process to analyze the documents [34, 35]. First, multiple raters delineated and coded text fragments, treating the transcript of each meeting as a distinct unit. Consistency across raters was achieved (81%) via comparison and negotiation, which produced primary codes (98), clustered into mid-level codes (28), and finally mapped to the top-level (3) (see Table 1).

**Table 1.** Illustrative mid-level codes generated from data coding

| **Mid-level Code - Description** |
|---|
| For code-family: "Design" (12 mid-level codes, examples shown) |
| - action item to be performed; D3 - voting to select a design alternative<br>- providing a design alternative; D7 - rejecting a design proposal |
| For code-family: "Sense-making" (10 mid-level codes, examples shown) |
| S4 - expressing concern; S5 - expressing confusion and frustration<br>S8 - expressing individual interests; S10 - questioning a design proposal |
| For code-family: "Negotiation" (5 mid-level codes, examples shown) |
| N2 - requesting or assigning participants to address a design issue<br>N3 - accepting responsibility to address a design issue |
| Z - behaviors that could not be captured in any code family |

The event grammar technique [30] was then used to locate permutations of codes with a customized software program.

## 5 Findings

The frequencies of binary grammars of the top-level codes (see Table 3) provided first clues about the standardization process (see Figure 3 below).

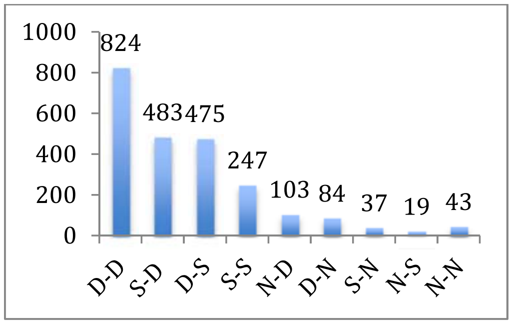


**Fig. 3.** Frequencies of binary grammars for top-level codes

Even this gross level of analysis shows the intensive design effort (DD grammars), accompanied by the efforts to assess potential design outcomes (SD, DS and SS grammars). Although efforts to recruit partners in future networks were fewer (ND, DN, SN, NS and NN grammars), they point to the mediating role of negotiation. We examined these further via mid-level codes. For example, the DS grammar (475 occurrences) contains 70 occurrences of D5-S1 (resolving a design issue-followed-expressing agreement). Tables 2 through 4 show these mid-level binary grammars and their interpretation.

**Table 2.** Selected D-event-initiated binary grammars with mid-level codes

| Grammar | Description | Frequency |
|---|---|---|
| DD event grammars (Total 824) | | |
| D1-D1 | action item to be performed-action item to be performed | 219 |
| D1-D5 | action item to be performed-resolving a design issue | 61 |
| D1-D2 | action item to be performed-cooperation for problem solving | 47 |
| DD grammars describe how the group works to decompose and specify a solution as well as test and evaluate it. It also demonstrates behaviors such as traversing across abstraction levels [36]. | | |
| DS event grammars (Total 475) | | |
| D5-S1 | resolving a design issue-expressing agreement | 70 |
| D10-S1 | suggesting a design alternative-expressing agreement | 63 |
| D3-S1 | voting to select a design alternative-expressing agreement | 57 |
| DS grammars describe how sense-making follows design, e.g. by justifying design feature [6]; evaluating use scenarios [37]; and imagining new contexts for using technology [38]. | | |
| DN event grammars (Total 84) | | |
| D8-N5 | reporting progress on action items-discussion of w3c process | 15 |
| D1-N3 | action item to be performed-accepting responsibility to address a design issue | 13 |
| The DN grammars aim at creating or restricting networks of participants, e.g. by compromising between designs, and reaching final agreement on designs [21]. | | |

Table 3. Selected S-event-initiated binary grammars with mid-level codes

| Grammar | Description | Frequency |
|---|---|---|
| SD event grammars (Total 483) | | |
| S1-D1 | expressing agreement-action item to be performed | 155 |
| S7-D10 | raising a design issue-suggesting a design alternative | 54 |
| S1-D5 | expressing agreement-resolving a design issue | 32 |
| S1-D10 | expressing agreement-suggesting a design alternative | 31 |
| SD grammars signal a return to design considerations after an attempt to reach agreement on a particular issue [21]. | | |
| SS event grammars (Total 247) | | |
| S1-S1 | expressing agreement-expressing agreement | 20 |
| S7-S1 | raising a design issue-expressing agreement | 23 |
| S1-S7 | expressing agreement-raising a design issue | 26 |
| S6-S7 | discussion on design issues-raising a design issue | 20 |
| SS grammars describe the behaviors as they attempts to reach agreement about a design issue, e.g. by using scenarios to trigger sense-making [39]. | | |
| SN event grammars (Total 37) | | |
| S1-N5 | expressing agreement-discussion of w3c process | 6 |
| S1-N2 | expressing agreement-assigning participants to address a design issue | 5 |
| SN grammars describe actions that lead to a new design cycles by turning to new issues or assigning responsibilities to smaller groups or by changing context to negotiate options [40]. | | |

**Table 4**. Selected N-event-initiated binary grammars with mid-level codes

| Grammar | Description | Frequency |
|---|---|---|
| ND event grammars (Total 103) | | |
| N5-D8 | discussion on w3c process-reporting progress on action items | 35 |
| N5-D1 | discussion on w3c process-action item to be performed | 21 |
| N3-D1 | accepting the responsibility to address a design issue-action item to be performed | 11 |
| ND grammars suggest moving from closure on an issue to the next design cycle, including the search for a negotiated solution, or a solution to counter an existing solution [7, 39]. | | |
| NS event grammars (Total 19) | | |
| N5-S1 | discussion on w3c process-expressing agreement | 4 |
| NS grammars capture a possible closure on a recursive cycle [6] by engaging in predictive sense-making [7] including attempts to make sense of technology evolution. | | |
| NN Grammars (Total 43) | | |
| N2-N3 | requesting or assigning participants to address a design issue-accepting responsibility to address a design issue | 13 |
| NN grammars elaborate how participants may be co-opted into a network, manifested as negotiation rules [21], actor composition [7, 38] and entering into new negotiation cycles after disagreement. | | |

We are investigating additional analyses with longer grammars at this time. The first set (tables 2-4 above) provide a glimpse into possible interpretations that our (confirmatory and exploratory) analyses are likely to provide.

## 6 Implications and Next Steps

This paper contributes to research on standards design by providing initial findings about activity patterns during design. Our work builds on the DSN framework from prior research. Studies like ours can be undertaken to identify core vocabulary that can complement design science efforts. The efforts in this paper are meant to provide such a bridge, to contribute design theories for new classes.

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