On organisational influences in software standards and their open source implementations

Jonas Gamalielsson [a,*], Björn Lundell [a], Jonas Feist [b], Tomas Gustavsson [c], Fredric Landqvist [d]

[a] University of Skövde, P.O. Box 408, SE-541 28 Skövde, Sweden
[b] RedBridge AB, Kista, Finlandsgatan 64-48, SE-164 74 Stockholm, Sweden
[c] PrimeKey Solutions AB, Anderstorpsvägen 16, SE-171 54 Solna, Sweden
[d] Findwise AB, Ullevigatan 19, SE-411 40 Göteborg, Sweden

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ABSTRACT

Context: It is widely acknowledged that standards implemented in open source software can reduce risks for lock-in, improve interoperability, and promote competition on the market. However, there is limited knowledge concerning the relationship between standards and their implementations in open source software. This paper reports from an investigation of organisational influences in software standards and open source software implementations of software standards. The study focuses on the RDFa standard and its implementation in the Drupal project.

Objective: The overarching goal of the study is to establish organisational influences in software standards and their implementations in open source software. More specifically, our objective is to establish organisational influences in the RDFa standard and its implementation in the Drupal project.

Method: By conduct of a case study of the RDFa standard and its implementation in the Drupal project we investigate organisational influences in software standards and their implementations in open source software. Specifically, the case study involved quantitative analyses of issue tracker data for different issue trackers for W3C RDFa and the Drupal implementation of RDFa.

Results: The case study provides details on how and to what extent organisational influences occur in W3C RDFa and the Drupal implementation of RDFa, by specifically providing a characterisation of issues and results concerning contribution to issue raising and commenting, organisational involvement over time, and individual and organisational collaboration on issues.

Conclusion: We find that widely deployed standards can benefit from contributions provided by a range of different individuals, organisations, and types of organisations either directly to a standardisation project or indirectly via an open source project implementing the standard. Further, we also find that open processes for standardisation adopted by W3C may also contribute to open source projects implementing specific standards.

1. Introduction

Many organisations are currently restricted in their choice of software because of restrictions imposed by existing systems, which often results in a lack of interoperability and a risk for different types of lock-in. Use of open standards and open source software (OSS) implementations of standards is a means that can reduce the risk of lock-in, improve interoperability and also stimulate innovation [45,25]. It is also widely acknowledged that there

are challenges in implementing open standards [23,36] and that standardisation has significant impact in the IT market and is subject to review within the digital agenda in the EU [21]. Open standards, especially when implemented in open source software, have the potential to address challenges such as promoting a healthy and competitive market, reducing the risk for organisations of being technologically locked-in, creating a basis for interoperability, and offering a basis for long-term access and reuse of digital assets [45].

Open source software implementations of software standards have contributed significantly to the establishment of standards [1], and it has been stressed in that "the formal specification is inherently incomplete and the actual standard is defined both through the written specification and actual implementations"

* Corresponding author.
  E-mail addresses: jonas.gamalielsson@his.se (J. Gamalielsson), bjorn.lundell@his.se (B. Lundell), jfeist@redbridge.se (J. Feist), tomas@primekey.se (T. Gustavsson), fredric.landqvist@findwise.com (F. Landqvist).

[35]. We also note that use of work practices involving issue tracking, which has a strong legacy from open source software development, has been adopted by major standardisation organisations including W3C, IETF, and OASIS. Hence, utilising open source software implementations and associated work practices is important for improved standardisation.

Earlier research has primarily focused on different aspects of IT standardisation (e.g. [38] or alternatively open source software (e.g. [7], but there is limited knowledge concerning the relationship between software standards and their implementations in open source software [23,38]. A contributing reason for this may be that "OSS developers and standards people – do hardly share any common background" [38]. Further, development of interoperable software systems need to account for that many different standards are being provided and maintained in a complex ecosystem involving a "multi-vendor, multi-network, multi-service environment" [17].

This study considers how software standards and software implementations of such standards are related. The overarching goal of the study is to establish organisational influences in software standards and their implementations in open source software. More specifically, our objective is to establish organisational influences in the RDFa standard and its implementation in the Drupal project. There are several reasons that motivate a study of organisational influences. It has, for example, been claimed that "companies are the most important and typically the most power stakeholders in (ICT) standards setting" [39] and that "the absence of important players may lead to inadequate standards" [38]. Further, previous research shows that some companies "aim to control the strategy of" a standardisation organisation, whereas other merely participate [39]. It has also been noted that "sometimes companies intentionally introduce deviant standards' implementations as aggressive market strategy" [19]. It is important to counter such strategies, and we note that "formal standards bodies strive for standards that do not favour certain companies, technologies or markets" [19].

The study reveals novel findings which detail how and to what extent organisational influences occur in W3C RDFa and the Drupal implementation of RDFa. Overall, findings show that widely deployed standards can benefit from contributions provided by a range of different individuals, organisations, and types of organisations. Further, we show that processes for standardisation can contribute to an open source project and processes for open source development can contribute to a standardisation project.

The paper makes **four novel contributions**. First, we establish a characterisation of issues for different issue trackers for W3C RDFa and the Drupal implementation of RDFa using different metrics. Second, we report on contribution to issue raising and commenting for the different issue trackers. Third, we provide details on organisational involvement over time. Fourth, we present findings on individual and organisational collaboration on issues.

Issue tracker was chosen as a data source since it is available both for W3C RDFa and for Drupal RDFa, and is therefore useful in order to get comparable data. Further, it is a structured and formal data source addressing topics that are important for both standardisation- and open source projects, and therefore contains less noise than for example mailing lists. Issue tracker data has also been used in closely related work which our study extends [32,46]. Issue trackers have been used in analyses of open source projects in previous studies, and it has been claimed that "an issue tracking system (ITS) is necessary to collect user feedback in FLOSS (and other) projects." [66] RDFa was chosen since it constitutes a representative exemplar of a software standard that has been widely adopted in numerous open source licensed (as well as proprietary) software systems. Further, it has been shown that the RDFa (and the related MicroData) format has been widely deployed on the web [2]. The Drupal project was chosen since it constitutes a representative exemplar of an open source project that has been widely deployed in both commercial and public sector contexts [16,12]. In fact, by October 2013 Drupal has recorded more than one million users in 228 countries speaking 181 languages [10]. The combination of RDFa and Drupal constitutes a relevant combination since semantic web standards (such as RDFa) are essential in content management systems (such as Drupal) for modern web solutions. Since RDFa is recognised as an open standard [44] in national policy in several countries, the standard is possible and attractive to implement in an open source project such as Drupal. Another motivation for focusing on RDFa and Drupal is to extend previous knowledge established in earlier studies that explored Drupal and its use of the software standards RDFa, CMIS and OpenID [32] and explored (non-organisational) influences between W3C RDFa and the Drupal implementation of RDFa in different issue trackers [46].

The rest of this paper is organised as follows. First, we provide a background to and position our exploration of RDFa and its implementation in Drupal in the broader context of previous research on standards and implementation of standards (Section 2). We then clarify our research approach (Section 3), and report on our results (Section 4). Thereafter, we analyse our results (Section 5) followed by discussion and conclusions (Section 6).

2. Background

2.1. RDFa

RDFa (Resource Description Framework in Attributes) is a standard model for interchange of data on the web by embedding of rich metadata within XML based web documents [63]. This is achieved through provision of attributes with associated syntax and processing rules for in-line embedding of RDF in XML-based web documents. Hence, RDFa is related to RDF, which became a W3C recommendation in 1999 [53]. RDFa originated from a W3C note [54], which in 2004 was integrated into a working draft of XHTML 2.0 [55]. Eventually RDFa 1.0 in XHTML became a W3C recommendation in 2008 [57]. RDFa Core 1.1 became a W3C recommendation in 2012 [58]. This version of RDFa was also compatible with HTML, which is described in a W3C working draft document [59]. A second and third edition of RDFa Core 1.1 was released in 2013 and 2015, respectively [62,63]. There is also the reduced RDFa lite specification, which contains a subset of the functionality in RDFa Core 1.1 [61]. The RDFa standard is licensed under royalty-free conditions [60], which allow implementation in GPL licensed OSS projects such as Drupal [23].

RDFa is governed by the W3C (World Wide Web Consortium), which is "an international community where Member organizations, a full-time staff, and the public work together to develop Web standards" [64]. Individuals and all types of organisations can become members (including commercial, educational, and governmental entities). Funding stems from membership fees, research grants and other types of public and private funding, sponsorship, and donations. There are some key components in the organisation of the standardisation process. One of these is the advisory committee, which has one representative from each W3C member and performs different kinds of reviews in the process of standardisation, and also elects an advisory board and the technical architecture group (which primarily works on web architecture development and documentation). Further, the W3C director and CEO assess consensus for decisions of W3C-wide impact. There is a also a set of charted groups (working groups, interest groups, and coordination groups) consisting of member representatives and invited experts, which assist in the creation of web standards, guidelines, and supporting materials.