The Evolution of IETF Standards and their Production

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ABSTRACT

This paper reports the results of an exploratory study on the Internet Engineering Task Force (IETF) specifications corpus in relation to the changes in volume, structure, and production of Internet standards. Using data spanning three decades, the authors examine changes in the production volume and type composition of IETF documents, their interdependency, and the level of collaboration involved in their production. Longitudinal changes in the standards corpus exhibit an increasing trend in interdependency, number of refinement steps, and number of authors, and additionally reveal that standards production is of an episodic nature with regular peaks in output volume. Complementary analysis on the network structure of dependencies highlights a trend toward compartmentalization of the system over the years involving the emergence of relatively isolated subsystems of related standards. The authors suggest that a perspective which considers a system like IETF as an organization itself, rather than a constellation of extra-organizational activities, is needed to understand and manage standardization processes like this one.

Keywords: Internet Engineering Task Force, Production, Standards Collaboration, Standards Evolution

INTRODUCTION

Information and Communication Technology (ICT) industry is strongly dependent on standards and this dependency is increasing. Despite the wider debate on whether standardization is an obstacle to, or catalyst of, innovation, most actors in the Software and Internet technology industry seem to embrace standardization, and, in particular, open standards (Capek et al., 2005). Increasing numbers of industry consortia in the ICT industry are being formed in order to deliver the standards needed and these play a major role in the standardization process (Blind et al., 2010). While dominant firms’ attempts to impose their own technologies occasionally create conflicts in the standardization process, there is a general tendency in the ICT industry to embrace collaborative processes of standards creation in the public domain (Garcia, 1992; Bonaccorsi et al., 2006; Simcoe, 2006).

Driven by either industry consortia or formal bodies, participation in the standardization process seems to be becoming more widespread in the ICT and other similar industries. This is particularly true for Internet technologies, where mobility of digital information over the globe across a variety of hardware and software platforms demands a high level of compatibility and durable standards. Certain levels of this technology stack favor formal or semi-formal standardization bodies like

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the Internet Engineering Task Force (IETF), Institute of Electrical and Electronics Engineers (IEEE), or ISO. Despite extensive collaboration within these bodies, or perhaps because of it, the creation of standards is often delayed or even fails completely (Besen & Farrell, 1991); both outcomes are costly for the industries which rely on these standards.

Recently research on standardization is concerned with a variety of issues including motivations for standardization, its impact on, and diffusion into industry, legal issues and business strategies related to standardization. On the other hand, empirical studies concerning how standards are produced are rather rare. An understanding of how production takes place in standardization bodies, how systems of standards are organized, and how all these change over time, can contribute to our understanding of failures and delays in standardization.

This paper is an attempt to contribute in this direction. We present results of an empirical study building upon our previous work (Gençer et al., 2006) concerning Internet standards published by the IETF and the collaborative processes involved in their production. We follow these processes through several decades of IETF’s existence. In addition to conventional exploratory statistics, we borrow concepts, methods, and tools from social network analysis to examine production related features and referential relations of standards in relation with the ways in which a system of standards change over time. Our study (1) highlights long term trends in the volume, composition, and collaborative features of IETF output, (2) explores changes in the subject focus of the standardization community, (3) examines changes in the interdependency structures of IETF driven standards using social network analysis methods, and discusses the consequences of certain structural changes for the future of standardization work.

The next section summarizes the background literature and describes the research methodology adopted in the study. Then we present the IETF case and the data set used in this research, along with the analysis methods employed. In the following sections we first present findings regarding changes in the features of standards and the extent of collaboration in their production, then we summarize findings about changes in interdependency structures through the decades. Finally we discuss consequences of the findings for the standardization process, followed by a summary of our conclusions.

BACKGROUND AND METHODOLOGY

Existing research on standardization tends to focus on subjects such as the way in which standards diffuse into industries and affect innovation and their relation to the competitive strategy and performance of firms (Choi et al., 2011). While there are several studies which concern systems of standards as a whole and the processes within them (e.g., Egyedi, 2003), the majority of research take the firm/organization level as the unit of analysis. Similarly, a good portion of MIS research concerns standards to some degree, but its focus is on the business organization or intra-organization level and role attributed to standards is not explicit or clear (West, 2003). At the opposite end, research on technological systems (Allen & Sriram, 2000) focuses on the relation between standards and whole societies or industries. As a consequence our understanding of how the systems of related standards are produced at the intersection of organizations, and how such systems change over time, is both limited and fragmented.

Among the few exceptions is a study by Nickerson and Muehlen (2006) which uses institutional theory to study evolution of the bodies that form Internet standards. They note that “economic self-interest alone cannot explain all aspects of the Internet standard-making process... An approach that describes an ecology (a set of relations between different standards institutions, ideas, and participants) provides needed explanations” (Nickerson & Muehlen, 2006, p. 17). Using relational examination, Gamber et al. (2008) analyze the referential relations between clusters of standards in an
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Jean-Christophe Graz and Christophe Hauert (2013). Innovations in Organizational IT Specification and Standards Development (pp. 154-164).

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