Introduction to JAIS Special Issue on Empirical Research on Free/Libre Open Source Software

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Over the past decade, the Free/Libre Open Source Software (FLOSS) phenomenon has revolutionized the ways in which organizations and individuals create, distribute, acquire and use information systems and services, making it an increasingly important topic for information systems researchers. Taken literally, the term FLOSS refers simply to software that is released under a license that allows for the inspection and reuse of the source code. The use of such licenses has significant implications for the distribution and use of FLOSS. As well, the use of FLOSS licenses is often accompanied by distinctive open and distributed approaches to the development and distribution of the code that are of great interest to researchers. While there are important differences between free software and open source software, their software development practices are quite comparable, hence our use of an umbrella term. In recent years, FLOSS has moved from a curiosity to the mainstream: it has become a useful instrument for educators and researchers, an important aspect of e-government and information society initiatives, and a key consideration in many technology business plans (e.g., Fitzgerald, 2006).

The success of FLOSS development has challenged the conventional wisdom of the software and business communities about the more effective ways to develop and acquire software. The research literature on software development and on distributed work more generally emphasizes the difficulties of distributed software development (e.g., Herbsleb et al., 2000), but the success of FLOSS development presents an intriguing counter-example. Characterized by a globally distributed developer force and a rapid and reliable software development process, effective FLOSS development teams somehow manage to benefit from the advantages and to overcome the challenges inherent in distributed work (Alho and Sulonen, 1998). However, the diversity of FLOSS work practices makes it difficult to identify exactly what is special about FLOSS development.

FLOSS also presents challenges to researchers. FLOSS is a complex phenomenon that requires an interdisciplinary understanding of technical, economic, legal and socio-cultural dynamics. It overlaps with many other phenomena – e.g., virtual teams, user innovation, distributed software engineering, voluntary organizations, social movements – but remains distinct from all of them, thus making it difficult to identify and apply relevant theories. Indeed, the FLOSS movement includes groups with a wide diversity of participants and practices, with varying degrees of effectiveness. Empirically, the study of FLOSS is blessed with an abundance of certain kinds of "trace" data, generated through the everyday actions of developers. However, these data are limited to particular aspects of FLOSS work and are often difficult to connect to constructs of theoretical interest. As a result, research on FLOSS is in critical need of careful conceptualization and theorizing, with particular attention to delineating the boundaries of theories in useful taxonomies of project types.

This two-part special issue provides a snapshot of empirical information systems research on the topic of FLOSS. A special issue of JAIS on FLOSS research is timely for several reasons. First, FLOSS development is an important phenomenon deserving of study in and of itself (Feller, 2001). FLOSS is an important commercial phenomenon involving a large variety of software development firms. Millions of users depend on FLOSS systems such as Linux, Firefox or Android, and the Internet is heavily dependent on FLOSS tools like Apache. These systems are an integral part of the infrastructure of modern society, making it critical to understand more fully how they are developed. Furthermore, FLOSS has become an increasingly important avenue for students learning about software development. However, researchers are just beginning to understand how people in these communities coordinate software development and the work practices necessary to succeed. Information systems researchers can contribute to closing this gap by developing a better understanding of the work practices of effective FLOSS teams and the impacts of FLOSS on the larger software ecosystem.

Second, many organizations – traditional and emerging – have taken note of the successes of FLOSS projects and have sought ways of leveraging FLOSS methods for their own distributed teams. More broadly, FLOSS development provides a commonly referred to model for open collaboration, increasingly seen as a viable approach to community-based development of systems and information resources more generally. Thus, while in many ways unique, the distributed and self-organizing

nature of FLOSS teams represents a mode of work that is increasingly common in many organizations. As a result, information systems research can contribute by understanding how and to what extent FLOSS practices can be generalized to other settings and to different collaborations. While most of the papers in this special issue focus on FLOSS specifically, one paper addresses the question of transfer to commercial practice.

This special issue attracted a total of 39 submissions from 14 countries, reflecting the broad international interest in FLOSS. After exhaustive rounds of review and revision, 11 papers were accepted: 6 papers will appear in this issue and 5 in the next. The accepted articles span a range of topics and approaches and exemplify the best and most current research on FLOSS in information systems. Papers in this first part of the special issue address the sustainability and effectiveness of projects and the use and implementation of FLOSS; the second part comprises articles that examine the processes of FLOSS development in more detail.

The special issue opens with *A Comprehensive Review and Synthesis of Open Source Research* by Aksulu and Wade.[1] The authors analyze 618 peer-reviewed articles on FLOSS research and synthesize the concepts addressed into a framework that shows how FLOSS research is situated within a wider nomological network. The paper provides a snapshot of the current state of knowledge around FLOSS research in an organizational context. The framework presented in the paper also helps to identify gaps and areas of overlap in the current research, and suggests a path for future work. This review provides both an overview of the current state of FLOSS research and a guide for the rest of the special issue.

The next two papers address the success of FLOSS projects using project-level data. Project success has been a persistent topic of interest for FLOSS researchers. Many studies in this genre have been conducted at the project level, using available data about project-level measures. These studies are often limited by the data, which may only weakly reflect theoretical constructs of interest. A few studies have been done at the level of individual developers, though many of the same concerns apply. For example, co-membership in projects can be viewed as a social network (e.g., Méndez-Durón and García, 2009), but strong theory is needed to interpret the network. Conversely, since data are available longitudinally, there is an opportunity to perform stronger tests of theory (e.g, Subramaniam et al., 2009).

The first of the two papers, *Sustainability of Open-Source Projects: A Longitudinal Study* by Chengalur-Smith, Sidorova and Daniel, provides a good example of this approach to understanding project success. The authors draw on tenets of organizational ecology as a theoretical framework and take advantage of the available longitudinal data. Using 5 years of data about 2,772 SourceForge projects, the authors find that a project's ability to attract developer and user resources plays a mediating role between the demographic (size and age) and ecological (niche) characteristics of the project and its future sustainability.

The next paper, *Following the Sun: Temporal Dispersion and Performance in Open Source Software Project Teams* by Colazo and Fang, examines the impact of temporal dispersion on the effectiveness of 100 FLOSS development teams. The analysis indicates that temporal dispersion positively affects development speed and that software complexity moderates the relation between dispersion and software quality.

The next two papers address issues related to the use of FLOSS. In the first, *An Empirical Analysis of the Business Value of Open Source Infrastructure Technologies*, authors Chengalur-Smith, Nevo and Demertzoglou present a model of the business value of the popular open source database MySQL. Based on analysis of responses from 149 organizations using MySQL, they find that three factors explain about 20 per cent of the business value of the open source technology. These factors are: the organization's absorptive capacity for the database, ties with the technology's user/developer community-of-practice, and an open source IT infrastructure that facilitates MySQL utilization.

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[1] Kevin Crowston handled the review for this paper.

In the second of the two papers, *Software Licenses in Context: The Challenge of Heterogeneously-Licensed Systems*, authors Alspaugh, Scacchi and Asuncion note that systems are increasingly composed of components from different sources. These components might be licensed under different – and not always compatible – licenses, posing considerable compliance problems for organizations using the software. The authors present an approach for understanding and modeling software licenses, as well as for analyzing conflicts among groups of licenses in realistic system contexts. The paper provides guidance for achieving a "best-of-breed" component strategy while balancing license rights and obligations.

The final paper in this part of the special issue is *The Process of Introducing FLOSS in the Public Administration: The Case of Venezuela* by Maldonado. Implementation has been a central theme in information systems research, but to date only a few studies have focused on the implementation of FLOSS (i.e., Fitzgerald and Kenny, 2003). Interestingly, FLOSS has been widely adopted by public organizations for both political and economic reasons. Maldonado describes mandatory FLOSS policies in Venezuela and the initiatives associated with the adoption process. He finds that Venezuela's FLOSS migration process pursued agendas of social inclusion, sovereignty and freedom using FLOSS technology.

The special issue will continue next month with five articles that examine the processes of FLOSS development in more detail.

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