Business Models for Free and Open Source Software: Insights from a Delphi Study

Full Papers

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Abstract

This article describes a Delphi study that consulted leading FOSS experts to identify the most important business models for FOSS. We employed the Delphi method to consult leading experts in FOSS, asking them to identify existing business models; describe potentially feasible models that are not currently implemented; identify specific categories of stakeholders involved; and identify the various goals and priorities of these stakeholders. The experts, who included software developers, corporate and individual users of software and members of leading software development industry organizations, highlighted 10 particularly important business models for FOSS which they analyzed and commentated in detail. Among other issues, the experts discussed the sustainability of various models and the extent to which they upheld users' software freedoms.

Keywords

Business models, free software, open source software, Delphi method.

Introduction

It is somewhat ironic that free and open source software (FOSS), software that can legally be distributed with no requirement that users pay the owners for it, has become a significant source of revenue that supports the livelihood of many software developers (Carillo and Okoli 2008; Fitzgerald 2006; Raymond 2001). For example, Red Hat, the largest Linux vendor, earned over $US 1.7 billion in annual revenues in 2014 on a business entirely built on FOSS (Kerner 2015). FOSS has also secured its popularity not only in information technology but also in various fields including business, science, health care and education due to its concrete benefits for many stakeholders.

Despite such tremendous revenues from large FOSS corporations, the vast majority of FOSS projects are quite small, consisting of just one or very few individual developers (Schweik and English 2012). Whereas these developers are not always able to earn their living by giving their work away at no charge; numerous business models have be developed whereby many do just that—sustainably create, maintain and distribute FOSS. Several practitioners (Fogel 2013; Mardjan 2010; Wikipedia contributors 2015b) and scholars (Christl 2008; Fitzgerald 2006; Krishnamurthy 2005; Watson et al. 2008) have variously attempted to compile lists of FOSS business models. However, these lists suffer various shortcomings: sometimes they lack a unifying structure; sometimes they are too general without identifying clear models; most of them overemphasize the role of the project owner without giving adequate attention to the roles of software developers or users.

This article describes a Delphi study that consulted leading FOSS experts to identify the most important business models for FOSS based on a stakeholder-focused perspective that considers all stakeholders involved (Okoli 2015). Among other questions, we asked the experts about the sustainability of various models (by which we mean the ability of the models to sustain the FOSS project indefinitely) and about the extent to which they upheld users' software freedoms.

The very idea of free software originated with the vision that software users should have certain freedoms

or rights as explained in the Free Software Definition (Stallman 1996): mainly users' rights to "run, copy, distribute, study, change and improve the software" as they wish. Far from being an idealistic dream, since the 1980s when it originated, this vision has driven the ability of FOSS to become such a potent force in the software industry. Moreover, it has inspired the free culture movement in many other industries such as media, engineering, academia, and health care. FOSS has changed the face of the software industry with very successful products like Android, Apache, Firefox, MySQL, WordPress, etc. FOSS has also been a fiercely competitive force which even presses conventional proprietary software companies such as Microsoft, Oracle, VMware and Apple to have FOSS projects themselves.

Gartner reported that on average, 29% of deployed code was FOSS in 2012, and that by 2015 at least 95% of mainstream IT organizations would leverage FOSS solutions within mission critical software deployments (Yeaton 2012). As of 2014, over 50% of all enterprises are expected to contribute and adopt FOSS, with FOSS being the leading software license in numerous technology industries like cloud/virtualization (63%), content management (57%), mobile (53%), security (51%), and collaboration (49%) (Black Duck Software 2014).

As mature players in the IT industry, FOSS companies are required to effectively secure funding, resources, operations and clients. Thus, the future prospect of FOSS is largely dependent on well-grounded business models to maintain the competitiveness and achieve long-term sustainability (Chang et al. 2007). The more that companies depend on FOSS, the greater the need for sustainable business models (Krishnamurthy 2005). However, lack of understanding of sustainable business models for FOSS was one of the leading contributors to the fact that as of 2009, only 17% of the 174,000 projects hosted on SourceForge were successful; 46% were abandoned before the first software release (Schweik and English 2012). Even some FOSS projects with heavy investments nonetheless eventually failed, as with Xara or Symbian.

This article is structured as follows. Following this introduction, we briefly review the literature related to FOSS business models. Next, we describe the Delphi study we carried out to identify business models and we present a profile of the participating experts. Next is the major contribution of the study: a presentation of the top ten business models identified by the experts. We end the article with general discussion on the models and the implications of the study.

Literature Review

A number of practitioners as well as some scholars have attempted reviews of different kinds of FOSS business models. Among the practitioner surveys, Mardjan (2010) described six "direct" FOSS business models, where the company creates software directly, and seven "indirect" models, where revenue is generated from activities related but secondary to FOSS. Various Wikipedia articles (especially "Business models for open-source software") list and briefly describe many models (Wikipedia contributors 2015a, 2015b, 2015c). Fogel (2013) discussed the "Proprietary relicensing" model, which we describe below as "Dual-licensing/Selling exceptions".

A number of scholarly reviews have also identified and listed FOSS business models. However, rather than listing specific models, they instead identified categories of models. Krishnamurthy (2005) identified four types: the distributor, the software producer (non-GPL), the software producer (GPL), and third party service provider. Fitzgerald (2006) generally classifies models into four categories, as those that: enable value-added services, create markets, leverage community development, and leverage the FOSS brand. Watson et al. (2008, p. 42) "distinguish five models of software production or distribution: proprietary, open community, corporate distribution, sponsored OSS, and second-generation OSS." Christl (2008) particularly contrasted FOSS business models with proprietary software models.

Both the practitioner and scholarly approaches to identify FOSS business models have their respective merits and shortcomings. On one hand, the practitioners are often well in touch with the rapidly changing landscape, and pick up on new types of business models that arise. However, they often lack clear distinctions between what distinguishes one business model from another, and their identified business models often lack any common structural basis of comparing one model against another. On the other hand, scholarly perspectives are often more rigorous in identifying the key structural commonalities among and differences between models—they are often compiled for the explicit purpose of distinguishing and comparing models. Unfortunately, in the search for structure, they often simplify some models and

fail to recognize the rich diversity of models that might differ in some structural details that are apparently minor, yet might have significant impacts in the execution or sustainability of the models.

Another limitation of the existing practitioner and scholarly listings is that they predominantly consider business models from the perspective of the organization that organizes the FOSS project or distributes the software. In contrast, we adopt a stakeholder-focused perspective on business models that considers the interests of creators and consumers, in addition to those of distributor enterprises (Okoli 2015). Some of the existing studies do give high consideration to the goals of software developers (Bonaccorsi et al. 2006; Fitzgerald 2006; Hemphill 2006; Watson et al. 2008) and of the software users (Krishnamurthy 2005), but our approach considers them all.

In order to benefit from the best of the practitioner and scholarly approaches, we adopt the Delphi method which solicits information from qualified expert practitioners, and yet does so under a rigorous scholarly framework. In our case, we had 34 contributors, each of which was an expert from a unique perspective of FOSS business models, thus ensuring the richness of a very broad range of inputs and feedback. The rest of this article describes the Delphi study and its results.

Research Methodology

To identify the business models, we consulted experts in FOSS using the Delphi method, a rigorous methodology with mixed qualitative and quantitative elements for research questions whose answers are not easily scientifically discernible, but are rather best answered by expert opinion. We have generally followed the methodology prescribed by Okoli and Pawlowski (2004), with adaptions for our specific research question. We followed a similar methodology as was used for a similar Delphi study on business models for online education and open educational resources (Okoli and Wang 2015).

Delphi Study of FOSS Experts

The study was conducted in two major phases: the first one is the process of selecting experts for the study and the second is the process of administrating three rounds of questionnaires. The details of the steps we followed are explained in Table 1 and Table 2. Specifically, we asked experts: to identify existing business models; describe potentially feasible models that are not currently implemented; identify specific categories of stakeholders involved; and identify the various goals and priorities of these stakeholders. We surveyed experts drawn from the ranks of software developers, both individual and corporate; corporate and individual users of software; members of leading software development industry organizations; and other relevant experts. At the beginning of Round 1, we presented the experts many business models drawn from several sources (Fogel 2013; Mardjan 2010; Wikipedia contributors 2015a, 2015b, 2015c); in that round the experts proposed many more, and in subsequent rounds, they reviewed all the models.

Step 1: Prepare KRNW	✓ Identify relevant disciplines or skills: developers, users, distributors and other stakeholders ✓ Identify relevant organizations: non-profit and commercial ✓ Identify relevant academic and practitioner literature, as well as relevant websites

⬇

Step 2: Populate KRNW with names	✓ Write in names of individuals in relevant disciplines or skills ✓ Write in names of individuals in relevant organizations ✓ Write in names of individuals from academic and practitioner literature

⬇

Step 3: Rank experts	✓ Create four sub-lists, one for each discipline ✓ Categorize experts according to appropriate list ✓ Rank experts within each list based on their qualifications

⬇

Step 4: Invite experts	✓ We invited a total of 198 experts ✓ In addition, we invited 183 expert users from 5 forums of important FOSS software ✓ Ask contacts to nominate other experts ✓ A total of 38 experts agreed to participate (34 eventually did participate)

Table 1. Phase 1: Selecting Experts for the Study

Round 1: Brainstorming of business models, stakeholders and goals	✓ Present existing FOSS business models identified by research team for experts to evaluate ✓ Ask experts to list other existing business models not mentioned ✓ Ask experts to list new business models not currently in existence but potentially sustainable ✓ Present relevant stakeholders and their goals and priorities from research team regardless of business models ✓ Ask experts to list other relevant stakeholders and their goals and priorities ✓ Consolidate the lists from research team and all experts, remove duplicates, and unify terminology
Round 2: Narrowing down top ten business models	✓ Include consolidated lists of business models in the beginning of the second round for experts to validate ✓ Ask the experts to rank the business models according to the level of their significance ✓ Ask the experts to associate various stakeholders and their goals and priorities with relevant business models ✓ Ask the experts to evaluate the degree of support of users' software freedoms of each business model ✓ Retain top 10 business models with the highest rating of the experts ✓ Retain the stakeholders and their goals and priorities selected by at least 3 experts
Round 3: Matching stakeholders to goals and priorities	✓ Refine top 10 selected business models with detailed association of various stakeholders with their goals and priorities ✓ Ask the experts to validate the association of various stakeholders with their goals and priorities in the top 10 models

Table 2. Phase 2: Three Rounds of Questionnaires

Profile of Expert Participants

We had a total of 34 experts from a wide variety of backgrounds who participated in the study. Around half of them were expert FOSS developers, half were experts in FOSS-producing companies, and almost all were experts in FOSS advocacy organizations. Almost all were expert users of FOSS. Most of the participants identified with the open source software movement, and most also identified with the free software movement. They had an average of 19.1 years of active experience with FOSS. 15 of 23 respondents had gained their FOSS experience in the United States; others had gained it in Europe or other countries. 19 of 22 respondents were male. 15 of 23 respondents were aged from 35 to 54. Full demographical details are available in the full report (Okoli and Nguyen 2015).

In Table 3, we list 18 participants who kindly agreed to permit us to publish their names. As can be readily seen, these are world-class experts in some of the leading FOSS organizations. Those who chose to keep their identity confidential are equally diverse and equally distinguished. Thus, the results of this study reflect the input of some of the most qualified people in the world on this subject. That said, their participation cannot be taken as an endorsement of the results, in whole or in part, since the Delphi process gave rise to many opposing viewpoints.

Top Ten FOSS Business Models

Over the course of the three rounds of the Delphi study, we made extensive revisions to the business models that we originally presented and also to those proposed by the experts. Even after the study was officially ended, we again solicited feedback from the participating experts, based on which we made still further revisions in the model. The final result was 28 business models (24 existing and 4 potential) with extensive comments from experts, particularly focusing on the stakeholders of the business models and their goals and priorities.

In Round 2, the experts narrowed down the business models from Round 1 to the top ten, of which eight are existing models and two are potential ones. In this study, it is important to note that "top ten" does not necessarily mean the most recommended or favourable; it rather means the most important or significant. (Indeed, one of the top ten, "Selling user data", was widely decried with comments like, "This sounds horrible", and yet, most experts felt that it was significant enough to merit detailed examination.) Here is the exact question we posed for the experts to rate the studies to narrow them down to ten:

> *In order to reduce the number of models for detailed evaluation, please specify for each of the models here whether or not the model is sufficiently important, significant, feasible or noteworthy for experts to take the time to evaluate in detail. Only the significant business models chosen by most of the experts will be evaluated in the third round of this study.*

Expert	Affiliation *(Note: Experts speak only for themselves; their participation or responses do not necessarily reflect the opinions of any of their affiliated organizations)*
Deborah Bryant	Senior Director of Open Source and Standards at Red Hat
Mark Charlebois	Director of Engineering of Open Source Software Strategy at Qualcomm
Dr. Daniel Frye	Vice President of Open Systems Development at IBM
Zak Greant	Catalyst/Community Manager at Magnolia International (open source CMS)
Dr. Benjamin Mako Hill	Board member of Free Software Foundation
Dr. Fabio Kon	Researcher at University of São Paulo FLOSS Competence Center
Guy Martin	Senior Open Source Strategist at Samsung Research America
Patrick Masson	General Manager of Open Source Initiative
Michael Meeks	Principle developer of GNOME, OpenOffice.org and LibreOffice
Kent Mein	System administrator of Computer Science Department, University of Minnesota
Mike Milinkovich	Executive Director of Eclipse Foundation
Allison Randal	Founder of Onyx Neon (FOSS books and consulting)
Doc Searls	Senior Editor of Linux Journal
Bruno Souza	Founder of SouJava (Brazilian Java users group)
Ronnie Tucker	Editor in Chief of Full Circle (magazine for Ubuntu family of Linux distributions)
John Weathersby	Director of Open Technology Center and founder of Open Source Software Institute
Michael Widenius	Co-founder of MySQL and MariaDB
Dr. Stefano Zacchiroli	Former Debian Project Leader

Table 3. Participants in the Delphi Study Who Agreed to Publish their Names

We purposely made sure that at least two of the top ten were potential models not currently in existence so that experts were given the opportunity to make forward-looking comments in Round 3 of the study. Here we describe each of the top ten models. In addition, we summarize the experts' comments about the sustainability of each model as well as their comments about the models' support of users' software freedoms. Full details about all 28 models are available in the full study report (Okoli and Nguyen 2015), including exactly how exactly the top ten were selected.

Concerning software freedom, we specifically asked the experts, "Does this business model respect or uphold users' software freedoms (as defined in the Free Software Definition)?" For those who responded to that question, we report how many agree (partially or strongly) or disagreed (partially or strongly); we do not count "neutral" responses here.

Top Eight Existing FOSS Business Models

We alphabetically list here the top eight existing models selected by the experts. In addition to a brief description and examples, we summarize experts' comments regarding the sustainability of each model and its respect of users' software freedoms.

Advertising

Advertisements are displayed directly (in the functioning software or in the installation process) or indirectly (in the website or manuals) which generate revenue. The software owner contracts the ads either directly or through an advertising network, perhaps using a provided software development kit. In the mobile app variation of this model, the app store provider is also involved. **Examples**: Mozilla Firefox (revenue from Google as default search engine); SourceForge (ad-supported repository); AdBlock Plus

(revenue to grant "acceptable advertising" status); WordPress.com (advertising on hosted websites); MoPub; mAdServe.

Although there are special cases like Mozilla Firefox, it is very difficult to fund development with advertising within the application. This is even more so in FOSS where any advertising functionality can be easily removed. 3 experts agreed that this model upholds users' software freedoms; 3 experts disagreed. Software freedom depends on the specific advertising model. In any case, it would require users having the ability to remove the ads from the source code. Thus, software as a service variations of the advertising model generally do not respect freedom, whereas advertising in fully distributable FOSS does.

Auxiliary services

Revenue is generated from paid professional services provided along with the software rather than the software itself. These services may include implementation, support, maintenance, consultation, training, books, conferences, localization (translation) to other languages, or providing of compiled binaries for a fee (rather than source code only). **Examples**: Red Hat (enterprise FOSS operating system distribution); IBM (consulting and hardware for FOSS operating system ecosystem); Revolution Analytics (enterprise version for R statistical software).

This is considered one of the most classic and sustainable ways to make money from FOSS. However, this model is often combined with others, as it usually is not sufficient on its own (major examples like IBM and Red Hat notwithstanding). 9 experts agreed that this model upholds users' software freedoms; 0 experts disagreed. An expert called it, "one of the most valid and widespread ways of 'making money' with FOSS".

Corporate development and distribution

Organizations (both non-profit and commercial) pay full-time or part-time developers to customize and extend FOSS for their own organizational needs; then they distribute some or all of their modifications at no charge to the FOSS community for the continued improvement of the original FOSS product. This is distinct from the model where they make such modifications and keep them internal without distributing them. **Examples**: IBM; Raspberry Pi; system-on-a-chip vendors; smartphone manufacturers.

6 experts agreed that this model upholds users' software freedoms; 0 experts disagreed. The only concern expressed was that Contributor License Agreements that might give the corporation rights over contributed software that other community members do not share would not respect software freedoms.

Crowdfunding

The project owner or even an individual developer proposes a defined amount of development work and a budget for implementation. Interested parties contribute any amount they want, and if the budget target is reached, then the developer commits to complete the defined work. **Examples**: Various websites like Kickstarter, AppBackr, Backr.App.net, and others that provide the infrastructure to interface between developers and users.

While crowdfunding can be used to launch a product or infuse funding, this is not a long-term stable source of funding. For contributors, there is no guarantee that the project owner will deliver on their promises. 6 experts agreed that this model upholds users' software freedoms; 0 experts disagreed. However, software freedom depends on the license selected.

Dual-licensing/Selling exceptions

The software is available under a typical FOSS license. Users (normally organizational) who want to modify the software and distribute it without adhering to FOSS licensing terms pay to obtain such authorization. **Examples**: MySQL; Qt; Asterisk; MongoDB; Java.

Also called proprietary relicensing, this model is mainly suitable for infrastructure products that can be embedded into other products. The revenue from the model is not sufficient for long-term sustainability, and as the model is somewhat controversial (since it is not pure FOSS), it discourages some potential

community contributors from participating. 6 experts agreed that this model upholds users' software freedoms; 2 experts disagreed. MySQL's use of this model has been controversial. Although endorsed and encouraged by Richard Stallman of the Free Software Foundation (Stallman 2009), some experts perceive that Dual-licensing/Selling exceptions is subject to abuse, especially in the hands of untrusted stewards such as Oracle, who acquired MySQL.

Memberships and donations

This group of models involve requesting financial contributions from individuals or organizations, where the organization that develops the FOSS products retain control in deciding how to allocate the contributions towards the development and distribution of its products. Some organizations offer various levels of memberships with different fees; some projects explicitly ask for donations to support the FOSS development. Another variation involves selling of branded merchandise (such as t-shirts) to raise funds. **Examples**: Mozilla Foundation; Apache Foundation; Eclipse Foundation; Wikimedia Foundation (MediaWiki platform); Perl Foundation; Tor Project; GNU LilyPond

Although there were positive comment such as that this is "perhaps the purest form of [a FOSS] business model", there was a strong consensus that FOSS projects cannot survive on donations. However, for major projects with a dedicated foundation to support them, this sometimes might work. 6 experts agreed that this model upholds users' software freedoms; 0 experts disagreed.

Software as a service (SaaS) with distribution of server software

The core software is server-based. Customers subscribe to the online service often with freemium pricing, that is a free offering plus one or more paid offerings with added features. There might or might not be a FOSS desktop or mobile component. A generic FOSS "community version" of the core server-side software is distributed with baseline features. **Examples**: Wordpress; SugarCRM.

SaaS providers implement this not as a primary business model, but as a way to add value to their service offering when they release part of their functionality as FOSS. 5 experts agreed that this model upholds users' software freedoms; 2 experts disagreed. The consensus was that software freedom is respected if the generic FOSS "community version" is identical to the server-side version, it is reasonably easy to install a local server instance, and user data is portable between the provider's servers and local servers.

Update subscriptions

Users are required to subscribe (usually annually) in order to obtain updated versions, bug fixes and technical support. This model is often employed for niche products with small user bases (which limits widespread distribution by others at no charge) where frequent updates and rapid bug fixes are important. It is often employed for extensions to core FOSS products, which themselves use other business models. **Examples**: Website software ecosystems (e.g. extensions to WordPress or Joomla, not the core software itself)

Other than the example given for website extensions ecosystems, this model is not widespread. However, it is notable as a means for users to voluntarily contribute towards development, even when gratis alternatives are available. 4 experts agreed that this model upholds users' software freedoms; 0 experts disagreed. It is respected even if users are required to pay for the latest version, as long as they are permitted by the FOSS license to redistribute the updates once they obtain them.

Top Two Potential FOSS Business Models

We alphabetically list here the top two potential models proposed by the experts. Since they are potential, they do not feature examples.

Selling user data

Collecting data about usability, user feedback, user preferences, etc., developers can leverage that knowledge to develop better applications and features. Developers could instrument applications like they

do today with advertising frameworks to provide data. FOSS applications could use the framework to use the provided data to fund applications development.

This notorious model was described in terms ranging from "distasteful" to "horrible", and yet because it is increasingly common, most experts considered it worth further investigation. To be successful, it would require a large base of users who are willing to share their data. Web of Trust is one (non-FOSS) example where this has been successful. Experts were divided on whether this model upholds users' software freedom (3 experts agreed and 1 expert disagreed). One comment captured what seemed to be the common sentiment: "Yes, but it's evil."

Software Certification

Software can be provided under a FOSS license, but requires certification to use a branding mark or claim to be interoperable. In one variation, original equipment manufacturers (OEM) might use the certified software in their hardware devices. In another variation, the project owners register service marks (for example "Moodle") around the world, then create a trust- and royalty-based scheme where only licensed partners can use the software or project name in their promotions and service descriptions. The mark becomes a standard for those looking for support services (e.g. hosting, development, training, etc.).

This can be used to enhance an offering, but is not a sustainable source on its own. 2 experts agree that this model upholds users' software freedoms; 1 expert disagrees. Both the Free Software Foundation and the Open Source Initiative explicitly consider trademark protection consistent with FOSS.

Discussion

In this article, we described a Delphi study that identified ten important business models for FOSS. We first introduced the importance of business models for FOSS. Next, we described the research methodology that we employed in our Delphi study, and presented a profile of the participating experts. The major part of the article followed with a presentation of the top ten important existing and potential business models for FOSS. We end the article with a brief discussion of the results and its implications.

Sustainability and Freedom in FOSS Business Models

A striking feature of the results of this study is that none of the models was found to be universally sustainable. Although most models have poster child successes, the experts indicated that the vast majority of FOSS projects and FOSS-enabled corporations need to apply multiple business models in order to survive long-term. Even models such as Corporate development and distribution and Memberships and donations, which were hailed as the purest or most classic FOSS business models (largely in terms of maintaining users software freedoms), were considered insufficient on their own for most organizations.

That said, many models do indeed provide sufficient livelihood for independent entrepreneurs (most notably Auxiliary services and Update subscriptions), but even these are insufficient to sustain corporations larger than even a handful of employees.

Contrary to what might be supposed, the models that had more proprietary characteristics, such as Advertising and Dual-licensing/Selling exceptions were found to not be particularly sustainable. Although gives caution to those who might try to "sell out" to more proprietary practices in order to increase revenue—not only do some such practices alienate companies from the FOSS community, but they often fail to attain the goal of sustainable revenue.

Implications of this Study

The results of this study have valuable implications for many stakeholders related to FOSS business models. First, entrepreneurs, businessmen and managers of FOSS projects can learn from these models to improve their own business models. They would thus be empowered to better secure funding, resources, operations and clients, and ultimately maintain competitiveness and achieve long-term sustainability. Second, investors and venture capitalists can reap higher profits by having their investments in FOSS

companies generate more revenue and reduce costs with the improvement in their business model. The investors may also assume generally lower risks by better understanding the sustainability of their investments. Third, by employing more sustainable models, creators and contributors of FOSS can better meet the needs of their customers or users, as they would be better funded to produce higher quality software. Among other results, their work could become more widely distributed and they may gain higher reputation. Fourth, based on the better understanding of business models, FOSS advocacy organizations and interested non-governmental organizations can devise more sound action plans and guidelines. They might thus be able to positively influence the development of the FOSS movement. Fifth, technology officers in institutions of any type—commercial, non-profit or governmental—may be able to choose the most suitable FOSS solutions for their own organizations implement more effective FOSS deployments.

This study also has implications for researchers. Although numerous studies have investigated FOSS business models from various angles, this is the first study that directly obtains information from practitioners who work with it day to day. Our approach began by identifying FOSS business models from both academic and practitioner sources, but it was validated by practitioners. Thus, the business models thus identified have high validity. For the general business model literature, our application of the Delphi method for provides a valuable template for identifying, validating and analyzing any type of business model.

Conclusion

Even though FOSS is a very promising field, it has not always achieved its full potential mostly due to the difficulty in finding sustainable business models. This article contributes valuable business models for FOSS with a balance of perspectives from all relevant stakeholders. Readers can have strong confidence in the results of the research as it employs a rigorous Delphi method that has effectively obtained valuable insights from qualified experts.

Acknowledgements

References

Black Duck Software. 2014. *2014 Future of Open Source Survey Results*, Slides, , avril (available at http://fr.slideshare.net/blackducksoftware/2014-future-of-open-source-survey-results).

Bonaccorsi, A., Giannangeli, S., and Rossi, C. 2006. "Entry Strategies under Competing Standards: Hybrid Business Models in the Open Source Software Industry," *Management Science* (52:7), pp. 1085–1098.

Brodkin, J. 2012. "How Red Hat killed its core product—and became a billion-dollar business," *Ars Technica*, February 28 (available at http://arstechnica.com/business/news/2012/02/how-red-hat-killed-its-core-productand-became-a-billion-dollar-business.ars; retrieved September 25, 2012).

Carillo, K., and Okoli, C. 2008. "The open source movement: A revolution in software development," *The Journal of Computer Information Systems* (available at http://proquest.umi.com/pqdlink?did=1641412741&Fmt=7&clientId=10306&RQT=309&VName =PQD).

Chang, V., Mills, H., and Newhouse, S. 2007. "From Open Source to long-term sustainability: Review of Business Models and Case studies,"V. Chang (ed.), Presented at the All Hands Meeting 2007, OMII-UK Workshop, , September 10 (available at http://eprints.soton.ac.uk/263925/).

Christl, A. 2008. "Free Software and Open Source Business Models," in *Open Source Approaches in Spatial Data Handling*Advances in Geographic Information Science, G. B. Hall and M. G. Leahy (eds.), Springer Berlin Heidelberg, pp. 21–48 (available at http://link.springer.com/chapter/10.1007/978-3-540-74831-1_2).

Fauscette, M. 2009. "Worldwide Open Source Software 2009–2013 Forecast," No. IDC #219260, , Framingham, USA: International Data Corporation (available at http://www.techdata.com/techsolutions/Softwareconnections/files/aug09/Open%20Source%20 IDC%20Forecast%20July2009.pdf).

Fitzgerald, B. 2006. "The Transformation of Open Source Software," *MIS Quarterly* (30:3), pp. 587–98.

Fogel, K. 2013. "Proprietary Relicensing Schemes," in *Producing Open Source Software: How to Run a Successful Free Software Project* (2013th ed.) (available at http://producingoss.com/en/proprietary-relicensing.html).

Hemphill, T. A. 2006. "A Taxonomy of Closed and Open Source Software Industry Business Models," *International Journal of Innovation and Technology Management* (03:01), pp. 61–82 (doi: 10.1142/S0219877006000661).

Krishnamurthy, S. 2005. "An Analysis of Open Source Business Models," *SSRN Working Paper Series* (available at http://papers.ssrn.com/abstract=650001).

Mardjan, M. 2010. *Open Source Business Models* (available at http://fr.slideshare.net/maikelm/open-source-business-models-4342089).

Okoli, C. 2015. "A Stakeholder-Focused Framework for Research on Business Models for Information Products and Open Content," *SSRN Working Paper Series* (available at http://papers.ssrn.com/abstract=2600341).

Okoli, C., and Nguyen, J. 2015. "Business Models for Free and Open Source Software," *SSRN Working Paper Series* (available at http://papers.ssrn.com/abstract=2568185).

Okoli, C., and Pawlowski, S. D. 2004. "The Delphi method as a research tool: an example, design considerations and applications," *Information & Management* (42:1), pp. 15–29 (doi: 10.1016/j.im.2003.11.002).

Okoli, C., and Wang, N. 2015. "Business Models for Online Education and Open Educational Resources: Insights from a Delphi Study," in *Proceedings of the 2015 Americas Conference for Information Systems*, Presented at the Americas Conference for Information Systems, Puerto Rico, August.

Raymond, E. 2001. *The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary*, Sebastopol, CA: O'Reilly.

Schweik, C. M., and English, R. C. 2012. *Internet Success: A Study of Open-source Software Commons*, MIT Press.

Stallman, R. M. 1996. "The Free Software Definition," (available at http://www.gnu.org/philosophy/free-sw.html; retrieved June 15, 2009).

Stallman, R. M. 2009. "Selling Exceptions," (available at https://www.gnu.org/philosophy/selling-exceptions.html; retrieved February 26, 2015).

Watson, R. T., Boudreau, M.-C., York, P. T., Greiner, M. E., and Wynn,Jr., D. 2008. "The business of open source," *Commun. ACM* (51:4), pp. 41–46 (doi: 10.1145/1330311.1330321).

Wikipedia contributors. 2015b. "Business models for open-source software," *Wikipedia, the free encyclopedia*, February 14 (available at http://en.wikipedia.org/w/index.php?title=Business_models_for_open-source_software&oldid=647162411; retrieved February 26, 2015).

Wikipedia contributors. 2015a. "Adware," *Wikipedia, the free encyclopedia*, February 22 (available at http://en.wikipedia.org/w/index.php?title=Adware&oldid=648275939; retrieved February 26, 2015).

Wikipedia contributors. 2015c. "Crowdfunding," *Wikipedia, the free encyclopedia*, February 25 (available at http://en.wikipedia.org/w/index.php?title=Crowdfunding&oldid=648728339; retrieved February 26, 2015).

Yeaton, T. 2012. "Inner-Sourcing: Adopting Open Source Development Processes in Corporate IT," *Open Source Delivers*, August 29 (available at

http://osdelivers.blackducksoftware.com/2012/08/29/inner-sourcing-adopting-open-source-development-processes-in-corporate-it/; retrieved February 26, 2015).