

The business logic of open source software (check point 1)

Xiaolong Huang

1. Introduction

The concept of open source software (OSS) is developed from “free software”. In 1971, Richard Stallman firstly proposed the definition of “free software” and launched the “Free Software Alliance Program” (GNU Project) 13 years later. The goal of this program is to inspire software developers around the world to leverage their collective intelligence to identify and resolve problems in free software programs while avoiding unnecessary repetitive tasks. With the integration of free software and commercial activities, Eric Raymond, the founder of the Open Source Initiative (OSI), proposed to rename "free software" to "open source software", and this concept has gradually been recognized by the whole industry. In the era when many proprietary software vendors see source code as their important intellectual property rights, the launch and development of open source software is undoubtedly a subversive change (Kendall, Kendall, & Germonprez, 2016).

As the GNU organization expects, open source software has multiple advantages due to its openness, rapid error correction, and efficient resource allocation. With the development of Internet technology, open source software has become mainstream in various aspects such as operating system, compiler tools, database, Web server, mobile operating system, etc., such as Google's Android operating system. As early as 2005, a study in the European Union found that 78% of government agencies use open source software; a report from Optaros Consulting pointed out that 87% of organizations used open source software at the time (van Aardt, 2006a). According to Red Hat, at least 95% of mainstream IT organizations and organizations will use open source software directly or indirectly in their mission-critical programs (Driver, 2012). The application of open source technology in key industries is also increasingly widespread. The popularity and development of open source software is a huge business opportunity, but unlike the business model of proprietary software, where the company's profits are directly derived from the software products it develops, the code of open source software must be freely accessible to users and allowed to be used, copied, modified and redistributed free of charge, so the relevant business models are characterized by combination and complexity.

In order to explore the business logic of OSS in depth, this paper reviews the development history of open source movement and three research hotspots that have been widely concerned

by many scholars. Then, this paper (1) analyzes the commercial competitiveness of OSS and use long tail theory to explain why OSS can achieve such great commercial success. Next, this paper (2) uses game theory to explore and explain the motivation of enterprises to join the open source community. The unique characteristics of OSS and the strong motivation of commercial companies to contribute to the open source can lead to a unique business model for open source software. Therefore, this paper (3) discusses 3 widely used business models of OSS, including dual licensing model, selling professional services model and selling professional services model. The research results of this paper can make people better understand the business logic behind open source and promote the rapid development of open source industry. Moreover, the conclusions obtained may be useful for other industries.

2. Literature review

The prosperity of the OSS industry has attracted the attention and research of many scholars. The current researches primarily focus on three aspects: the first one is the commercial competitiveness of OSS compared to traditional software, the second one is the motivation of enterprises to join open source and third one is the modern business model of OSS. Overall, the characteristics and unique strengths of OSS make it a strong commercial competitiveness, which is an inherent or internal factor contributing to its commercial success. The participation of commercial companies has made the open source software industry more standardized and commercialized, which provides external motivation and driving force for the commercial success of OSS. Along with the commercial success of open source software, some modern open source software business models have emerged. This is the logical relationship between these three research hotspots.

In recent years, OSS has achieved great success in business, which has led many researchers to study the commercial competitiveness of OSS in business. Tu (2000) believe that the open source model and the traditional business model are significantly different, so the two models have different competitiveness. The aim of an open source project is to develop a system that is of interest or useful to its users, rather than filling the gaps in the commercial market. Compared to the traditional business model, the open source model usually has little commercial pressure to deal with the plan. West and Gallagher (2006) argued that the competitive advantage of co-production and low-cost development of open source software has forced companies to reconsider the effectiveness of the patent business model used by the

company over the past 25 years. Pénin (2011) believes it is quite difficult for companies, which continue to use old innovative methods to innovate over the past fifty to one hundred years, to change their deep-rooted culture of innovation. While for companies that dare to build an open source innovation culture, there will be an unparalleled competitive advantage for them. Ebert (2007) proposed the concept of open source driven business innovation, and pointed out that open source software has created new business models and intellectual property protection strategies. Today, open source innovation has become the main source of innovation in the seven dimensions of process, technology, quality, architecture, standards, business models and markets, and has shown a clear competitive advantage. Colombo et al. (2014) pointed out open source innovation is conducive to SMEs to make better use of the external resources owned by partners, which will help SMEs to develop more diversified products and enhance their commercial competitiveness.

As for the motivation for companies to take part in the open source, Wichmann's survey (2002) shows that the main motivations for large enterprises to participate in OSS projects include the establishment of open standards, cost reduction, strategic considerations and compatibility. Fleming et al. (2007) proposed that large companies participate in open source innovation often because they want to combine internal resources and external resources to find more innovative opportunities to meet the company's development momentum, they hope to increase the operating income and profits by focusing on open source, not just trying to do new things. Lerner and Tirole (2002a) proposed that some proprietary software companies adopt an open source-based collaborative R&D strategy, mainly to grasp the development status of competing software and to seize technical standards before competitors take action. Dahlander et al. (2015) proposed that if a software company can encourage the voluntary participation of outsiders through open source projects, the company's development costs will decline, because in this case, the company does not pay for the contribution of outsiders, so more and more companies will not only take part in existing open source projects, but also are beginning to try to develop their own open source projects.

At present, scholars' research on the business model of open source software mainly focuses on the two aspects of intellectual property and business model competition. In terms of intellectual property, Lerner et al. (2002b) questioned the assumptions of traditional intellectual property theory from the perspective of innovation motivation. They believe that even if people don't

give intellectual property to software products, software developers have the incentive to innovate. For example, developers of Linux software conduct free software development for various purposes (such as reputation incentives, sales of complementary products, etc.). They even need to give innovators “anti-IP” (such as the GPL) to limit private profits from innovation, and inspire innovators to open up their innovations to better develop and utilize innovative products; Bessen (2006) questioned the assumptions of traditional intellectual property theory from the perspective of product standardization. They pointed out that when considering the customization of software, if manufacturers reduce the degree of software protection or adopt software business models such as Linux, they can make up for the deficiencies brought about by the production of standardized products in the traditional Windows mode, thus expanding the software market. In terms of business model competition, Dalle et al. (2003) pointed out that the business model of open source software gives it a special competitive advantage. For example, the Linux open source model inherently has the advantage of network externality, making the network externality of Linux software stronger than the network externality of Windows software, so Linux can become an effective economic mechanism to correct the inefficiency caused by Microsoft monopoly. Dhir et al. (2017) explored the reasons for choosing open source software and proprietary software from various aspects (cost, stability, security) by comparing open source software proprietary software, and pointed out that the popularization of open source software business model will become more and more widely.

3. Commercial competitiveness of OSS

In general, the participants in the open source community are mostly independent developers who have different backgrounds and technical levels. However, these volunteers who have not been standardized trained have made great achievements, open source software is rapidly spreading and has achieved great commercial success. The long tail theory can accurately explain the power of the majority, which is the first important reason of its success. In addition, the paper also indicates that the participation of commercial enterprises is another important reason of the success of OSS.

3.1 The Long Tail Theory

In 2005, Chris Anderson's best-selling book, *The Long Tail Theory*, had an impact on the traditional 20/80 law. The 20/80 law stems from the statistical conclusion that the 20% of the population enjoyed 80% of the wealth of the Italian economist Pareto in 1897 (Koch, 2011). It

shows an imbalance phenomenon, that is, a few mainstream people (or things) can have major and significant impacts. So in marketing, in order to improve efficiency and profit, merchants focus on 20% of customers or best-selling products, while ignoring 80% of general public consumers and a large number of non-selling products.

The long tail theory points out that the neglected "80%" can also generate enormous energy. Like a vast and scattered area, if you can grasp this site, the harvest will not necessarily be less than the concentrated hot region, that is, as long as the storage and circulation channels are large enough, the demand is not strong or the sales are not good. The market share shared by the products can match or even exceed the market share occupied by a few hot products. Many small markets have gathered into market energy that rivals the mainstream big market. The market share of products with weak demand or poor sales can match or even exceed the market share of those few hot products. Many small markets have gathered into market energy that rivals the mainstream big market.

3.2 The power of the majority

Although the long tail theory mainly reveals an economic law, it is equally applicable in software development. A comparative study of 12 closed-develop commercial software and 12 community-based open source software proves that closed development is similar to 20/80 theory in terms of developer's contribution to product, while community development is similar. In the long tail theory. In a closed development environment, 20% of developers contribute 80% to the product, but the remaining 80% are inefficient.

In the community development environment, because there are thousands of volunteer developers, the work is not assigned, but the volunteers choose their own. No one has designed the system architecture level, there is no project planning, no engineering tables, no one sets the delivery date, any small defects or errors will be discovered and modified immediately, so the development efficiency is much higher than in the closed development environment.

It is precisely because of the energy and wisdom gathering of many individual developers in the OS community that we have seen the achievements of open source software growing today, and in the fields involved in traditional commercial software, we can find open source software that can be applied. Moreover, this trend will not stop in the near future.

3.3 The joining of commercial enterprises.

The participation of enterprises is another important reason for the success of OSS in business. Commercial enterprises are increasingly involved in the development of OSS. Currently, more than half of open source software projects involve commercial enterprises (Kendall et al., 2016). The involvement of business enterprises is critical to the success of OSS for two reasons: first, they directly participate in and contribute to the development of OSS projects; second, unlike most individual developers, commercial enterprises are interested and intent to provide reliable services and add-on products, which are critical to the inexperienced average consumer.

“Traditional innovation theory includes two innovation models: private investment model and collective action model” (Osterloh & Rota, 2007). The private investment model believes that more and more people are innovating because innovators can take the return on their investment. Therefore, innovators strive to avoid the leakage of creative results, and society needs to protect the intellectual property of inventors through patents, copyrights and trade secrets. Under the collective action model, some public institutions, such as universities, have received some financial incentives and reputation incentives (Olson) to invest in research and development. However, neither of these theories can explain the reasons for the commercial success of OSS. Key features of open source software are: (a) it is a digital product, product and innovation are almost identical; (b) there is user innovation, the user is the developer itself; (c) highly modular design make it a decentralized product. These features enhance the so-called “low cost situation” and reduce the difficulty of such innovation (Osterloh & Rota, 2007). Hippel and Krogh (2003) argue that OSS reflects a novel innovation model: a private-cooperative model in which an “economic man” invests in his own private resources to produce public goods. Osterloh and Rota (2007) believe that OSS reflects the continuation of the "collective invention" model. The open source licensing system allows OSS to exist as a shared property, and these mandates are primarily enforced by motivated developers. The characteristics of OSS, open source licensing systems, and the interaction of various prosocial motives are key to the success of OSS in business.

4. Motivation to join the open source movement

After understanding the reasons for the commercial success of OSS, we need to know the source of motivation for commercial enterprises to take part in the open source movement. In general,

the motivation of enterprises to participate in the open source movement is mainly divided into two parts: external motivation and internal motivation.

As for external motivation, Mustonen (2005) proved that most private companies support the development of open source software, and some software companies provide financial support and excellent programmers for open source projects of interest to them (Lerner & Tirole, 2002c). The goal of expecting to benefit from the new business model directly affects the decision of the company to participate in the open source movement. An empirical study by Rossi et al. demonstrates that the fundamental purpose of companies involved in the open source movement is to profit from new business models.

As for internal motivation, open source companies generally claim to support the concept of the open source movement and follow the responsibility and non-written specifications of the open source movement. This behavior is to demonstrate its image as a good "responsible citizen of the open source movement" (Osterloh, Rota, & von Wartburg, 2001). Considering the company's goal of making profit from the open source movement, we need to re-examine the internal motivation of the company. Although many scholars believe that the purpose of the company is to gain a better reputation, this internal motivation is ultimately to win the trust and goodwill of individual developers and shareholders, and to get support and help from these talented employees and investors to finally win business competition and get profit faster.

Therefore, through the above discussion, we believe that the motivation of companies involved in the open source movement is mainly external. As a result, this paper will use game theory to discuss external motivation for commercial companies to embrace open source.

4.1 Game theory

When it comes to game theory, people may first think of the prisoner's dilemma game. The Stag Hunt game is a special type of prisoner's dilemma game in game theory (Fang, Kimbrough, Pace, Valluri, & Zheng, 2002). Unlike the classic Prisoner's Dilemma game where those who don't collaborate will be punished, the Stag Hunt game has no penalty mechanism for those who don't cooperate. This is consistent with the fact that software companies or individuals who only request from the open source community but do not give back to the open source community will not be punished (Baldwin & Clark, 2006). Therefore, the Stag Hunt game is

more appropriate than the classic Prisoner's Dilemma game to explain the motivation of commercial companies to participate in open source activities.

The Stag Hunt game is a collaborative game where every player strives to achieve a common goal of finding food to feed the entire community. In this game, the stags are high-quality food, but players need to spend more time and energy to find them. If all the players work together and cooperate with each other, they will hunt to the stags, and the hunted stags can be eaten by all players. Everyone understands this and works hard for the same goal, but occasionally some changes happen, causing players to choose different strategies. Assume that one or two players will be distracted by the hare when looking for the stags. If many players turn to chasing hares (simple rewards) instead of stags (high quality food), they may find that the remaining hunter groups may not have enough numbers to capture the stags and eventually return empty-handed. Unlike the prisoner's dilemma, there is no motive for deception in the Stag Hunt game. But even in the Stag Hunt game, people realize that all players may end up working alone, because simple rewards (hare) will motivate players to act alone.

4.2 Motivation for companies

As many people worry about, there is a tension between maintaining intellectual property and contributing to the open source community for software companies. For these companies, open source their source code is equivalent to giving competitors a chance to catch up with themselves quickly, and open source software products will reduce the commercial value of these software to a certain extent. Although almost all software vendors understand that encouraging all companies to open source will gather the wisdom of everyone and create tremendous value for this society, just like the hunters who are distracted by the hare when chasing the Bucks, some companies are eager to pursue short-term value, wanting to quickly turn their proprietary software into profit.

However, why are there so many companies still insisting on chasing the Bucks? Overall, embracing open source is the most effective decision made by these companies to improve their profits after making multiple trade-offs and comparing advantages and disadvantages. For these software companies, participating in open source will greatly reduce their development costs. For example, open source can make some companies do not need to develop their own operating system, otherwise these companies need to hire a large number of employees to

develop their own kernel. However, in the open source community, there are thousands of developers and engineers working on the development of operating systems. Their development progress is so fast that any single company cannot keep up with this progress. In contrast, spending a lot of time and money to develop an internal operating system that is not as good as an open source operating system is obviously not a wise choice. Moreover, for some big companies, they value their reputation and they don't want to be considered only ask for the open source community to create their own profits and never giving back to the open source community. The attitude of the embracing open source will make these companies more attractive to potential talented employees and a team of more outstanding employees will create more wealth for their company. In addition, open source will help some companies become market leaders to make standard in certain areas. As mentioned in Kendall's study (2016), "if you are a market leader that has a first mover advantage and you're really in a greenfield environment where there is nothing, then you are open source standard or your open source implementation can become the standard."

5. Business models of open source software

Today's open source movement has brought together individual volunteers, software developers, large hardware equipment providers, institutional and individual users, various non-profit organizations and public institutions, and governments through the open source software community and it has generated a brand new business model. In this part, we will briefly discuss 3 widely used business models of OSS, including dual licensing model, selling professional services model and selling professional services model.

5.1 Dual licensing model

The dual licensing model is one of the most common open source software business models, meaning that developers not only provide software under open source licenses, but also provide software under proprietary software licenses. In this model, the source code of the product is mainly from the open source community or software vendors, and the source code of these two parts together constitute the core product. Then, this product is separately licensed to free users and paid users through two types of licenses (open source copyleft license and exclusive license). Copyleft is proposed by the GNU Project and refers to a general method of turning a program into free software. The profit of the proprietary version of the software will be used in the development of the next version of open source software (Popp, 2011).

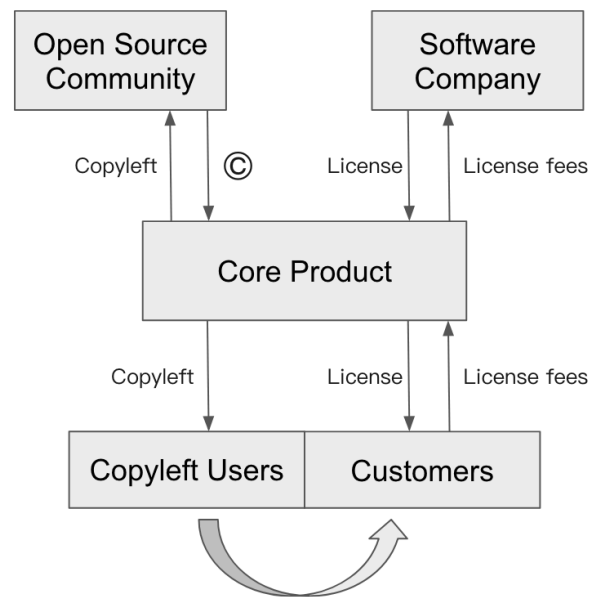


Figure 1. Dual licensing model

As shown in figure 1 (Valimaki, 2002), in the dual licensing model, users are attracted to the free open source version at the beginning, and these users continue to understand the commercial technical support and services that vendors can provide in the process of using the software, and thus become customers who purchase paid versions. Take the MySQL database as an example, Oracle launches two versions of MySQL database at same time, which are an open source version for individuals and a proprietary version for the enterprise (Valimaki, 2002). The business model used by MySQL database is the dual license including the open source copyleft license (GPLv2) and proprietary software licenses.

5.2 Selling professional services model

The sales professional service model refers to profiting by providing professional services for open source software, such as training, technical support or technical consultation. Many enterprises have no resources or the ability to maintain their own IT systems, so there are some emerged companies providing IT services based on open source software for these enterprises. The characteristics of open source software make it accessible to any company. Therefore, engineers in the IT service companies who are proficient in this open source software technology can use their expertise to provide services for other companies (van Aardt, 2006b). In this mode, free users can only get the source code of open source software without executable binary code, but paying users can get executable binary code, physical installation media and commercial services including software compilation and packaging.

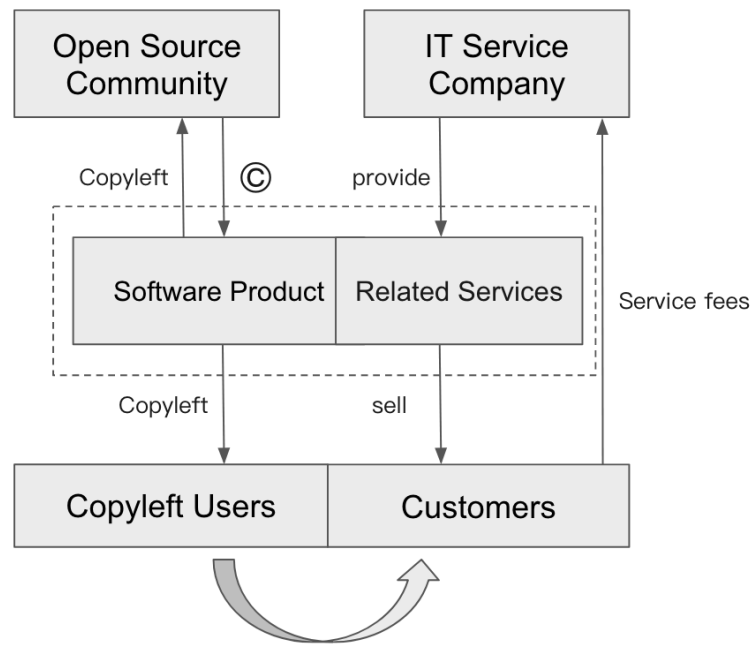


Figure 2. Selling professional services model

As shown in the figure 2, open source software is free and easy to obtain for users. However, in the process of using these open source software, users may encounter some technical problems or need some technical training. They can purchase the open source software support services, including technical support, as well as related training certification, installation and technical consultation. Redhat (Redhat.com) is a typical open source solution provider that sells professional service models and is the member of the S&P 500 Index. The company provides mission-critical software and services for critical IT technologies such as operating systems, storage, middleware, virtualization and cloud computing.

5.3 Advertising-supported model

The embedded advertising model refers to a business model that allows embedded advertisements in software to be spread by relying on the rapid promotion of open source software.

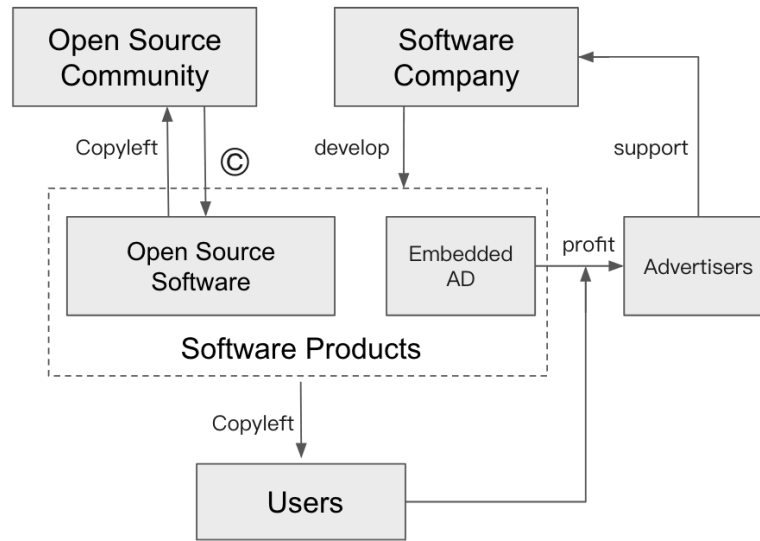


Figure 3. Advertising-supported model

As shown in the figure 3, software companies embed advertisements into the software products they develop. The software products consist of the software itself and the ads embedded by the companies. The entire software product is provided to the vast number of users as open source software. The promotion of open source software will bring more and more customers, which makes the embedded ads in the software have commercial value. Advertisers have achieved the effect of product promotion, so they are more willing to advertise to software vendors, and software vendors will continue to invest in the development of open source software after making profits from the advertisers, thus forming a virtuous circle. Most open source software companies tend to adopt a business model of embedded advertising to generate revenue and maintain operations. For example, in the first quarter of 2014, the Android platform accounted for 42.8% of all mobile ad traffic sources, surpassing iOS for the first time.

6. Summary

In order to explore the business logic of OSS in depth, this paper reviews the development history of open source movement and three research hotspots that have been widely concerned by many scholars. Then, this paper (1) analyzes the commercial competitiveness of OSS and use long tail theory to explain why OSS can achieve such great commercial success. Next, this paper (2) uses game theory to explore and explain the motivation of enterprises to join the open source community. The unique characteristics of OSS and the strong motivation of commercial companies to contribute to the open source can lead to a unique business model for open source software. Therefore, this paper (3) discusses 3 widely used business models of OSS, including

dual licensing model, selling professional services model and selling professional services model. The research results of this paper can make people better understand the business logic behind open source and promote the rapid development of open source industry. Moreover, the conclusions obtained may be useful for other industries.

References

- Baldwin, C. Y., & Clark, K. B. (2006). The architecture of participation: Does code architecture mitigate free riding in the open source development model? *Management Science*, 52(7), 1116-1127.
- Bessen, J. (2006). Open source software: Free provision of complex public goods. *The economics of open source software development* (pp. 57-81) Elsevier.
- Colombo, M. G., Piva, E., & Rossi-Lamastra, C. (2014). Open innovation and within-industry diversification in small and medium enterprises: The case of open source software firms. *Research Policy*, 43(5), 891-902.
- Dalle, J., & Jullien, N. (2003). 'Libre' software: Turning fads into institutions? *Research Policy*, 32(1), 1-11.

Dhir, S., & Dhir, S. (2017). Adoption of open-source software versus proprietary software:

An exploratory study. *Strategic Change*, 26(4), 363-371.

Driver, M. (2012). Drivers and incentives for the wide adoption of open-source software.

Gartner Report, Sept, 13

Ebert, C. (2007). Open source drives innovation. *IEEE Software*, 24(3)

Fleming, L., & Waguespack, D. M. (2007). Brokerage, boundary spanning, and leadership in

open innovation communities. *Organization Science*, 18(2), 165-180.

Hippel, E. v., & Krogh, G. v. (2003). Open source software and the “private-collective”

innovation model: Issues for organization science. *Organization Science*, 14(2), 209-

223.

Kendall, J. E., Kendall, K. E., & Germonprez, M. (2016). Game theory and open source

contribution: Rationale behind corporate participation in open source software

development. *Journal of Organizational Computing and Electronic Commerce*, 26(4),

323-343.

Kendall, J. E., Kendall, K. E., & Germonprez, M. (2016). Game theory and open source

contribution: Rationale behind corporate participation in open source software

development. *Journal of Organizational Computing and Electronic Commerce*, 26(4),

323-343.

Koch, R. (2011). *The 80/20 principle: The secret of achieving more with less: Updated 20th*

anniversary edition of the productivity and business classic Hachette UK.

Lerner, J., & Tirole, J. (2002a). Some simple economics of open source. *The Journal of*

Industrial Economics, 50(2), 197-234.

Lerner, J., & Tirole, J. (2002b). Some simple economics of open source. *The Journal of*

Industrial Economics, 50(2), 197-234.

Lerner, J., & Tirole, J. (2002c). Some simple economics of open source. *The Journal of*

Industrial Economics, 50(2), 197-234.

Mustonen, M. (2005). When does a firm support substitute open source programming?

Journal of Economics & Management Strategy, 14(1), 121-139.

Osterloh, M., & Rota, S. (2007). Open source software development—Just another case of collective invention? *Research Policy*, 36(2), 157-171.

Osterloh, M., Rota, S., & von Wartburg, M. (2001). Open source-new rules in software development. *University of Zurich, Institute of Organization and Administrative Science (IOU)*. [Online] [Http://Www.Iou.Uzh.Ch/Orga/Downloads/OpenSourceAoM.Pdf](http://www.iou.uzh.ch/Orga/Downloads/OpenSourceAoM.Pdf),

Pénin, J. (2011). Open source innovation: Towards a generalization of the open source model beyond software. *Revue D'Économie Industrielle*, (136), 65-88.

Popp, K. (2011). *Advances in software economics: A reader on business models and partnering* BoD—Books on Demand.

Schaarschmidt, M., Walsh, G., & von Kortzfleisch, H. F. (2015). How do firms influence open source software communities? A framework and empirical analysis of different governance modes. *Information and Organization*, 25(2), 99-114.

Tu, Q. (2000). Evolution in open source software: A case study. Paper presented at the *Software Maintenance, 2000. Proceedings. International Conference On*, 131-142.

Valimaki, M. (2002). Dual licensing in open source software industry.

van Aardt, A. (2006a). Business models on open source software. Paper presented at the *19th*

Annual Conference of the National Advisory Committee on Computing Qualifications

(NACCQ 2006), Wellington, New Zealand,

van Aardt, A. (2006b). Business models on open source software. Paper presented at the *19th*

Annual Conference of the National Advisory Committee on Computing Qualifications

(NACCQ 2006), Wellington, New Zealand,

West, J., & Gallagher, S. (2006). Challenges of open innovation: The paradox of firm

investment in open-source software. *R&d Management*, 36(3), 319-331.

Wichmann, T. (2002). Firms' open source activities: Motivations and policy implications.

Free/Libre and Open Source Software Final Report, Part II, International Institute of

Infonomics, , 4.