

A business model for commercial open source software: A systematic literature review

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ABSTRACT

Context: Commercial open source software (COSS) and community open source software (OSS) are two types of open source software. The former is the newer concept with the grounds for research such as business model. However, in the literature of open source software, the revenue model has been studied as a business model, which is one component of the business model. Therefore, there is a need for a more complete review of the COSS business model with all components.

Objective: The purpose of this research is to describe and present the COSS business model with all its components.

Method: A systematic literature review of the COSS business model was conducted and 1157 studies were retrieved through search in six academic databases. The result of the process of selecting the primary studies was 21 studies. By backward snowballing, we discovered 10 other studies, and thus a total of 31 studies were found. Then, the grounded theory coding procedures were used to determine the characteristics and components of the COSS business model.

Results: The COSS business model was presented with value proposition, value creation & delivery, and value capture. This business model includes eight components: COSS products and complementarities, COSS clients and users, COSS competitive strategies, organizational aspects of COSS, position of COSS producers in the value network, resources and capabilities of COSS business, COSS revenue sources, and COSS cost-benefit.

Conclusion: This study provides a complete illustration of the COSS business model. Identifies COSS generic competitive strategies. By cost-benefit component, we have considered both tangible and intangible components. This business model is especially effective in developing countries. In future research, it is necessary to review the management of the COSS community, the organization, the new revenue models for disruptive ability of open source software, and the localization of open source software.

1. Introduction

Open source software is divided into two types of COSS and OSS [1]. COSS compared to OSS is characterized in a way that a single legal entity owns and controls it, carries out most coding by in-house developers, decides on it, and directly makes money from it [1–3]. It is important for open source software companies, entrepreneurs, and companies that intend to produce open source software in-house or those who wants to open the source of their software to know how to create and capture value, when they start this business. This referring to COSS business model can be described through several main constructor components [4].

While researchers [3,5–10] have been trying to provide open source

software business model, a major disadvantage is that in the literature of open source software, the revenue model has been considered as the business model. This is so while the revenue model is just one and the main component of the business model, which shows how to capture value [11]. This indicates the existence of a gap previously mentioned by Feller et al. [12].

The above-mentioned gap has led to an imperfect vision of COSS business model and has caused to be separate and thus scattered studies on one or more components of COSS business model have led to lack of serious research activity on some components of the open source software business model. As a result, a systematic literature review of the COSS business model helps ensure that the activities performed in this area are integrated in the form of components of the business model

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and provide the basis for future research activities in this aspect of COSS.

The contributions of this study include 1) amassing and organizing scattered elements of COSS business model in the literature, 2) providing a reference for researchers of COSS value proposition, COSS value creation and delivery, COSS value capture, and COSS business model, and 3) providing a vision and points for practitioners setting up and managing a business around COSS.

The rest of this study is organized as follows. In Section 2, we provide the research method. The results of features of COSS business model are reported in Section 3. In Section 4, a discussion is presented. Finally, conclusions and future research are presented in Section 5.

2. Research method

The method of research is a systematic literature review. To review the literature for presenting the COSS business model, we used the guidelines provided in the field of software engineering [13,14]. This includes defining the purpose of the research, offering systematic literature review, searching and selecting appropriate articles, extracting information from articles, analyzing and combining findings from studies, controlling quality, and presenting the findings.

2.1. Research questions

The business model has various components that illustrate the logic of how to create, deliver, and capture the value. Since COSS studies have sparsely examined those components for the purpose of creating or delivering or gaining value, we therefore aim to outline literature in the following research question:

Research question: What are the characteristics of a COSS business model?

To answer this question and to consider the fact that the revenue model is one of the components of the business model, we have considered all components of the business model of open source software. To identify those components, studies that focused more on this subject, as well as studies in some of which there is reference to one or more components, were investigated and information was extracted. The search and selection of the primary studies were done as follows.

2.2. Search and select appropriate studies

In this section, the process of searching and selecting related studies is described.

2.2.1. Selection criteria for studies

This article seeks to explore the COSS business model. Since the business model contains several components, the studies that cover each component of this business model are included. Hence, we considered the following criteria for selecting studies. Studies are written in English, have full text access, have addressed components of COSS business model, and have been published in journals, conferences, and books of academic databases.

2.2.2. Search in academic databases

According to recent guidelines [13,15], the type of research method, as a criterion for the search and selection of studies in the systematic literature review of software engineering, has been less considered.

Based on such recommendations, without limiting the fuller components of society, intervention, comparison, outcomes, and the context [14], in this article, we searched for studies that examined the COSS business model or its components.

Initially, we did a few preliminary searches to identify basic, general, and important information about the keywords, the number and type of studies, and the criteria for choosing them. Early explorations signaled the broadness of “open source” studies and the inappropriateness of the “business model” keyword for obtaining business model studies of COSS, resulting in the retrieval of a large number of irrelevant, yet incomplete studies. Consequently, we made use of the term “commercial open source” and its corresponding “commercial OSS”, “commercial OS”, “commercial FOSS”, and “commercial FLOSS” in the whole text because it separated a large number of scattered and incomplete articles and made us get to more relevant articles, and then we had to choose the primary studies according to the selection criteria.

To select academic databases, they should index articles related to COSS research which were written in English and provide access to the full text of the article. We checked six academic database Emerald, IEEE, Sage, Sciencedirect, Springer, and Wiley.

2.2.3. Related study selection

In the process of selecting relevant studies, there emerged some reasons for eliminating some of them. In particular, in some articles, the term “commercial open source” refers to a kind of software which in dual licensing is in contrast to community open source software. In other words, a software which is more complete and which is made available in exchange for money is also called commercial open source software. This is so while Riehle [1] considers the term “commercial open source” as a misnomer because a ‘community open source’ can also be commercialized. As previously defined, and is intended by the study, a software is COSS which has a single entity behind the project and chooses it and generates direct revenue streams out of it. Examples of these projects include Openbravo ERP, JBoss, MySQL. Of course, we didn’t remove all papers related to dual licensing. In fact, in some of those studies, there were some points related to aspects of COSS business model which made them be placed among the primary studies.

Or, by commercial OS is meant commercial operating system in some studies. This was another reason to remove some of these studies. Or the search for the key phrase “commercial open source” would retrieve studies in which the above phrase was consistent with the phrase “... commercial, open source ...” that these studies were essentially irrelevant with what was under consideration. This was another reason for the removal of a number of other retrieved studies. Fig. 1 shows the steps of selecting the primary studies.

As Fig. 1 shows in Step 1 through searching keywords in the academic databases, 1157 non-repetitive studies were identified. In step 2, according to the criteria for selecting studies, 104 studies were identified by reviewing the titles and abstracts. In step 3, by analyzing the introduction and conclusion, 37 related studies were selected. In step 4, the studies were read in full and 21 of them were considered as the primary studies. In the 5th and the last step, by backward snowballing, 10 studies were added and the total number of main studies was 31.

2.3. Quality assessment

The quality of the papers identified was evaluated using the nine criteria of Hauge et al. [16]. These criteria are as follows: Explaining or



Fig. 1. The process of study selection.

not explaining the research method, the question/goal/purpose of the research, the motivation of research questions, the limitations or validity of the article, the context of the research, data collection, data analysis, sampling or selection of studies, and the presentation of data. These criteria were evaluated with binary yes/no values.

To do so, the first author as a Ph.D. student performed the quality assessment by checking each of the mentioned items in each study and evaluated them by 0 or 1 values. The second author as supervisor verified the results and provided his opinion to revise the results by the first author. Then, the second and third authors as advisors examined the results and any differences were resolved through discussion between the first and the second authors.

2.4. Data extraction

To extract the data, we first read all the articles, identified important and relevant paragraphs, and highlighted, coded, and inter-linked key points within each paragraph, and then changed them into concepts and categories. Noori and Mehrmohammadi [17], based on the coding procedure of Strauss and Corbin [18,19], Glaser and Strauss [20], Glaser [21], and Allan [22] introduced a simple and flexible model for data encoding, which was used in this study. In this way, after identifying key points, the data was coded, then the assigned codes with shared axes were converted to a set of concepts and thus, categories were extracted using concepts grouping.

The above steps essentially were performed by the first author. The results of each step were presented to the other authors for verification. They examined the results and provided their opinions. Finally, the first author concluded the results.

2.5. Synthesis

In literature, different business model frameworks have been presented or used by different researchers [23–35]. A review of these studies shows that the business model framework consists mainly of three categories of value proposition, value creation, and value capture. In this paper, the COSS business model and its components were presented with regard to the three components mentioned above.

3. Results

3.1. Literature characteristics

3.1.1. Number of publication per year

Figs. 2 and 3 display studies distribution based on year and the type of document (journal, book section, and conference proceedings) for primary studies from 2000 to August 2017. In terms of the type of

documentation (Fig. 3), the largest publication belongs to journal articles with 74%, followed by sections of the book and conference proceedings each with 13% of the publication.

3.1.2. Quality assessment of the research on COSS business model

As mentioned in Section 2.3, we used nine indicators of quality assessment. Each study was evaluated based on whether those indicators were covered or not. This was indicated by assigning a value of 1 (covering) or 0 (not covering). Most studies had a high score in this quality assessment (Table 1). The average score for this assessment was 6.23.

3.2. Research on COSS business model

In this section, the COSS business model is introduced. The main objective of this systematic literature review is to identify and present the features and components of the COSS business model based on literature. For each primary study, we analyzed the features of the COSS. Identifying and categorizing those features was done using the coding approach based on the grounded theory procedures as described in Section 2.4. We provide 8 components for the COSS business model that are grouped into three categories of value proposition, value creation & delivery, and value capture.

COSS products and complementarities, COSS clients and users, and COSS competitive strategies are three components that show how a COSS company bundles its value proposition. By resources and capabilities of COSS business, organizational aspects of COSS, and the position of COSS producers in the value network, the company is capable of creating and delivering value. Finally, COSS revenue sources and COSS cost-benefits show how it decides to capture value. Subsequently, each of these components is examined in detail.

3.2.1. COSS products and complementarities

What COSS business models release can be divided into four categories of free core software product, monetary software complementarities, monetary service complementarities, and monetary hardware complementarities; we call them COSS products and complementarities.

Free software product is made available to users unrestrictedly and is used indefinitely by an approved or even unapproved license [2]. Monetary software complementarities are provided for the purpose of direct revenue-generating and contain some closed source codes [2]. In other words, these software complementarities include the commercial version [2,41,42] and optional and compulsory proprietary enhancements [1].

Monetary service complementarities include services [2,43,44], provision [45], maintenance [41,45], support [1,41,45], and open

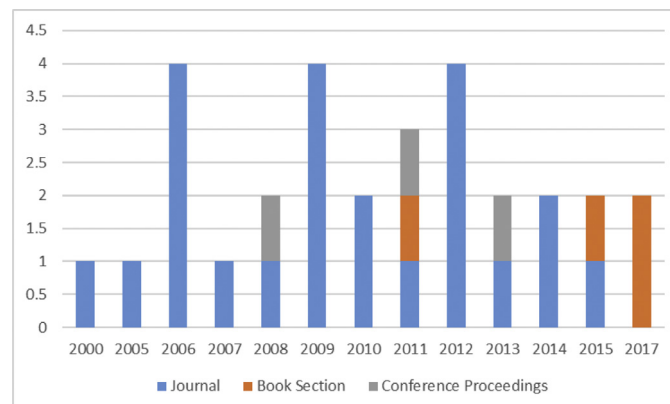


Fig. 2. Studies distribution based on year.

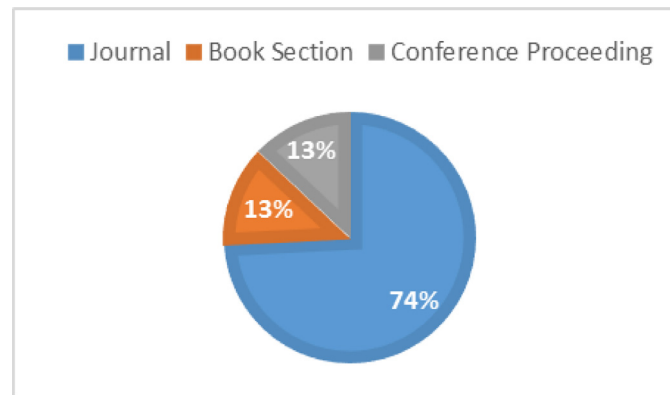


Fig. 3. Studies distribution based on the type of document.

Table 1

The result of quality assessment of studies.

Quality assessment score	0	1	2	3	4	5	6	7	8	9	Total
Number of papers	0	0	6	5	0	0	0	1	12	7	31

source cloud computing [46]. And, the monetary hardware complementarities include goods and software which contain embedded systems [47].

In this regard, something which COSS producers for paid and free products should pay attention to, is “what features do customers want to pay for, which generally include legal, intellectual property and service features” [48]. See Fig. 4.

3.2.2. COSS clients and users

COSS products and complementarities are supplied to three groups: (a) small, medium and large public and non-public sectors in the new (emerging) markets; (b) Small and medium public and non-public sectors in established markets, and (c) large public and non-public sectors in established markets, on the condition of enough disruptive-ness of open source solution. We call them COSS clients and users.

The public sector is one of the COSS clients both in emerging markets and in established markets [44,49], as proprietary software costs are high and public sectors, especially in developing countries, may have difficulty providing them [44,49]. The same is true for the private and non-public sector [44,49], especially for small and medium-sized enterprises [44]. Thus, through COSS, both small and medium-sized public and non-public sectors in new and established markets, as well as large public and non-public sectors in new markets with saving on costs can provide their needed software. In addition, if it is “disruptive” enough in established markets, COSS can be competitive and attract large public and nonpublic sectors as its customers [1,44,49]. See Fig. 5.

3.2.3. COSS competitive strategies

COSS producers use different strategies to attract customers and markets. We call these strategies COSS generic competitive strategies.

We hold competitive strategies are embedded in what the firm

proposes to the outside and also are related to value creation, value delivery, and value capture. On the other hand, Kessler et al. [50] didn't find any statistically significant relationships between sourcing method and development cost. For example, when the source of software is opened, the cost of preserving knowledge is reduced while the cost of disclosing knowledge will arise [51]. In addition, researchers [11,52,53] argued that in order to comprehend value creation & delivery, and value capture in the context of open source, value calls for definition in terms of non-monetary as well as monetary. So, we present the first type of competitive strategies according to value creation, value delivery, and value capture, and also according to two types of value i.e. monetary and non-monetary. It implies that “value” for COSS is underlined.

For value creation, using technologies developed primarily by external IT resources meant that outsiders had the most undisclosed knowledge of some software components [51]. But COSS producers employ full-time developers which means less dependence on external IT resources. This provides them with competitive advantage. The recruitment of these developers implies more resources and inputs of these projects in comparison to OSS projects [1] that bring products and outputs of a higher quality and credibility [44]. Also, according to Kessler et al. [50], ideally, in a COSS producer firm, internal developers, by developing COSSs that make core competency and also by developing and using tacit and complex knowledge, create competitive advantage and produce COSSs faster. In addition, hiring key developers and participants in upstream communities is a strategy to mitigate cost of giving up control [51]. Similar to using backward integration [54] in cost leadership as one of the generic competitive strategies [55], we employed backward integration in value leadership utilized by COSS producers.

For value delivery, by opening up source of some components of in-house developed software, the firm gains some other values. Stuermer et al. [51] confirmed such values include cheaper knowledge protection, increased cheaper innovation, cheaper manufacturing, learning achievements, reputation accomplishment, adoption of innovation, and faster time-to-market. In addition, they argued COSS costs are mitigated by appropriate strategies. Firms by partial revealing of source code mitigates cost of imitation and replication by competitors. They

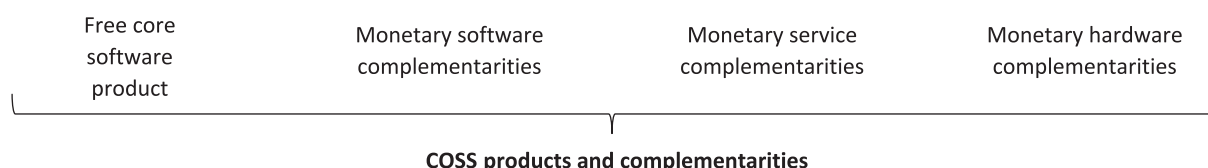


Fig. 4. Constructing the component “COSS products and complementarities”.

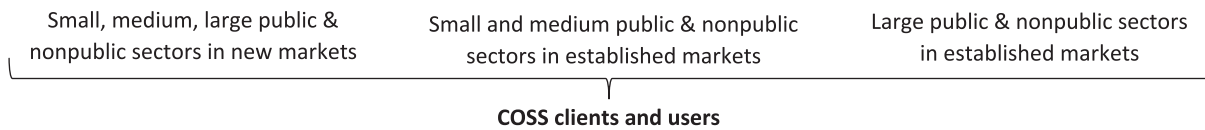


Fig. 5. Constructing the component “COSS clients and users”.

mitigate cost of guarding business secrets by selective revealing of future plans and protection of information through signing an agreement with possessors of unique knowledge which is critical to the development. They could mitigate cost of reducing community entry barriers by sharing the costs with other actors in the community. And by adapting and opening up processes, they mitigate cost of organizational inertia.

For value capture, COSS producers possessing copyright of codes and intellectual property [2] have revenue sources such as service complementarities and other complementarities [1,43,56]. This means that any company cannot easily enter that COSS market and monetize its revenue sources. In other words, contrary to the OSS, there are barriers to entry into the COSS market [57]. Similar to using forward integration [54] in cost leadership as one of the generic competitive strategies [55], we used forward integration in value leadership utilized by COSS producers.

In addition, using a focus strategy [55], COSS producers by market penetration [54] through faster acceptance, user's free and fast feedback, as well as voluntary code contribution to COSS [1], try to better identify and improve the quality of software, and increase their market share. Also, in a focus strategy [55], by market development [54], companies are trying to enter the new geographic areas. Meanwhile, developing countries with their emerging markets provide significant opportunities for the development of COSS markets [58]. This is because open source software in these countries has a number of aspects of great interest. The cost of open source software decreases along with reduction in licensing costs [44,59]. The open source of these types of software causes the development of native technology [59] and thus reduces the technological gap between those countries and developed countries [60]. In addition, open source software producers can enter into developed markets with their product and even compete with the leading closed-source product of the established market [1].

Open source software producers also use a differentiation strategy [55] with product development [54]. Fundamentally, innovation is a powerful incentive for companies to address open source [43], which can provide a distinct, but rather disruptive opportunity. Moreover,

with the increasing acceptance of open source software both on the supply side and on demand side and with their contribution to open source software projects, open source and proprietary software have become more and more similar [42]. This, in turn, has caused reliability, changeability, quality, security, access to support, and the cost of using open source software to be equal to or better than proprietary software [44,49]. The possibility of better customization of open source software compared with proprietary software [61] is one of the hallmarks of the distinction of open source products. Also, companies use the community to help their research and development, and actually use a differentiation strategy to quickly develop competitive products [43]. Fig. 6 shows these competitive strategies. The above components are shown in Fig. 7 with respect to the component of the value proposition.

3.2.4. Organizational aspects of COSS

The type of business in an open source software organization is divided into four profit (or) commercial, nonprofit, educational, and public categories [62]. COSS business as the profit one has several organization-related features related to development focus, structure, licensing, and sustainability [62]; we call them organizational aspects of COSS.

Development focuses are on software, service, and/or solution [62]. And, the COSS producer uses a “limited production and limited filtering model” (LPLF) [44] where it carries out all in-house coding and development activities and, in some cases, makes use of community contribution [3,63].

Some considerations are related to the COSS business structure. Unlike OSS in which a community of volunteers are determinants and committers are decision makers, in COSS, a company is a determinant [1]. The core business functions of that company include sales, marketing, product management, engineering, and support, as well as the new function of community management [3]. The importance of community management depends on a number of factors, such as the existence/absence of the community, the type of license, and the

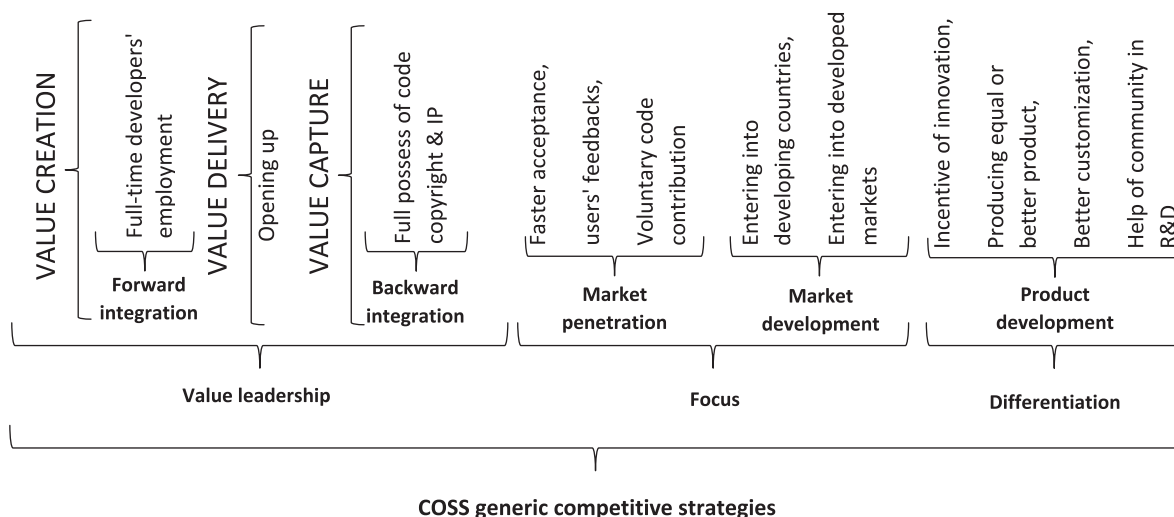
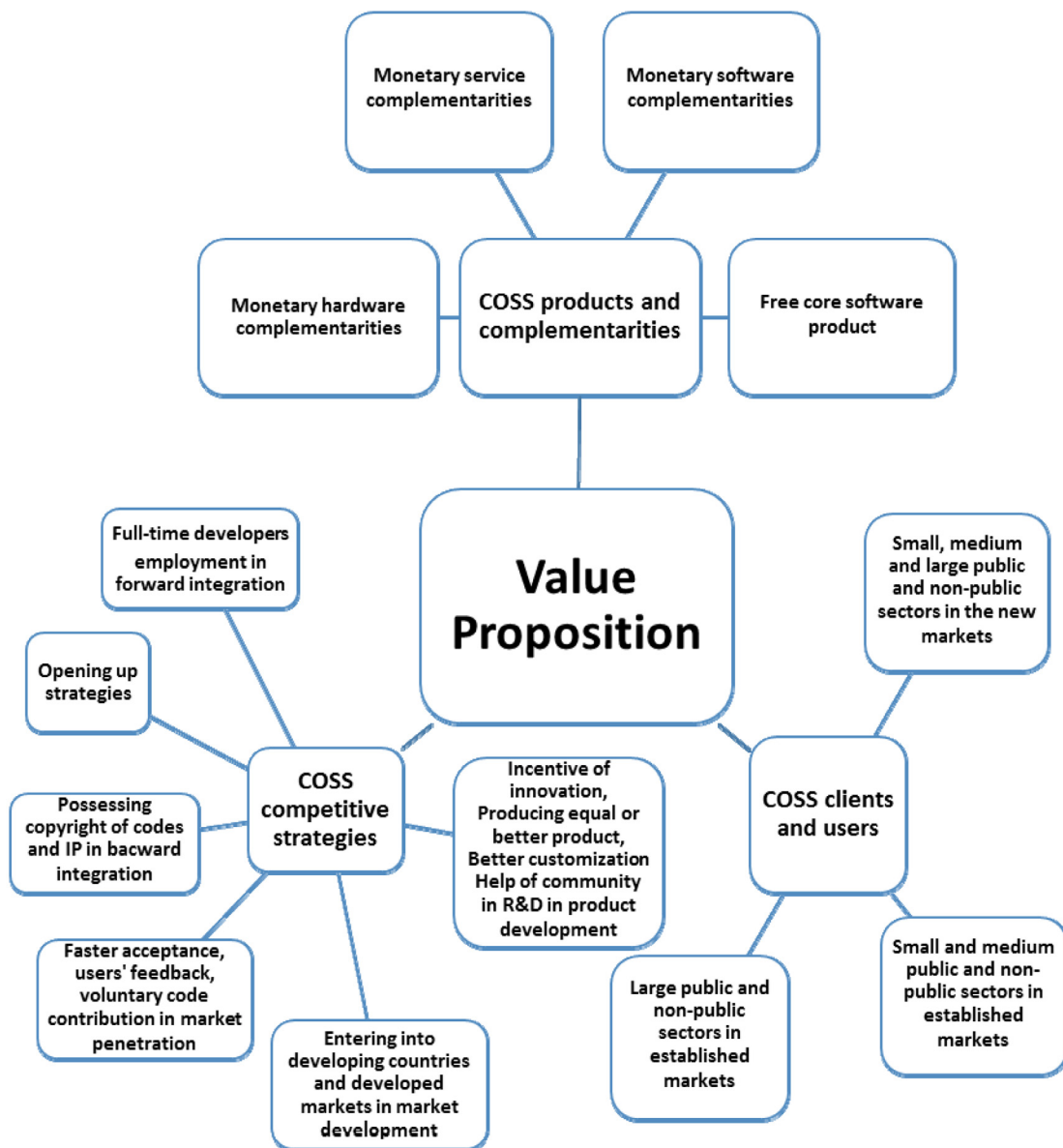


Fig. 6. Constructing the component “COSS competitive strategies”.



open source software with proprietary software is possible [49].

Fig. 7. The components of value proposition category in COSS business model.

business model [42]. In addition, community volunteering will be carried out in a five-step process of communication, understanding, counseling, helping, and guiding [64].

Licensing plays an important role in the monetization of the product or service in the COSS business [65]. For this purpose, open source software producers can use existing and approved OSI licenses or new licenses like Microsoft Reciprocal License (Ms-RL) that are compatible with their requirements [42]. The existing licenses generally include two types of General Public License (GPL) and Berkely Software Distribution License (BSD) [49]. Under the GPL, all derived products must be licensed under the same license, while under the BSD license, no restrictions are placed on the selection of the license for derivative works [66] and combining open source software with proprietary software is possible [49].

The adoption and implementation of the open source software development approach causes some changes that affect the nature, responsibilities, and technical and managerial processes of the personnel [67]. In this case, the personnel's acceptance and support of open source

is affected by the severity of the change in the technical and managerial nature of their job role, as well as the level of organizational commitment and their individual level factors [67]. Therefore, for the success of such hybrid business models, organizational measures need to be taken. For example, Openbravo has implemented three stages of transition to open source licensing, transition to modular architecture, and adoption of centralized distribution platform [68]. Furthermore, Samoladas et al. [69] show that certain types of COSS such as “software development” category survive with high probability. They also show by increasing developers the probability of project success increases.

Fig. 8 shows organizational aspects of COSS.

3.2.5. The position of COSS producers in the value network

COSS producers hire developers from the job market, or universities and training centers, or open source communities, and, with the developer's access to available open source software codes built by others, generate their own COSS and offer it for free or paid to users and customers [1–3,49,56]. In other words, open source software producers

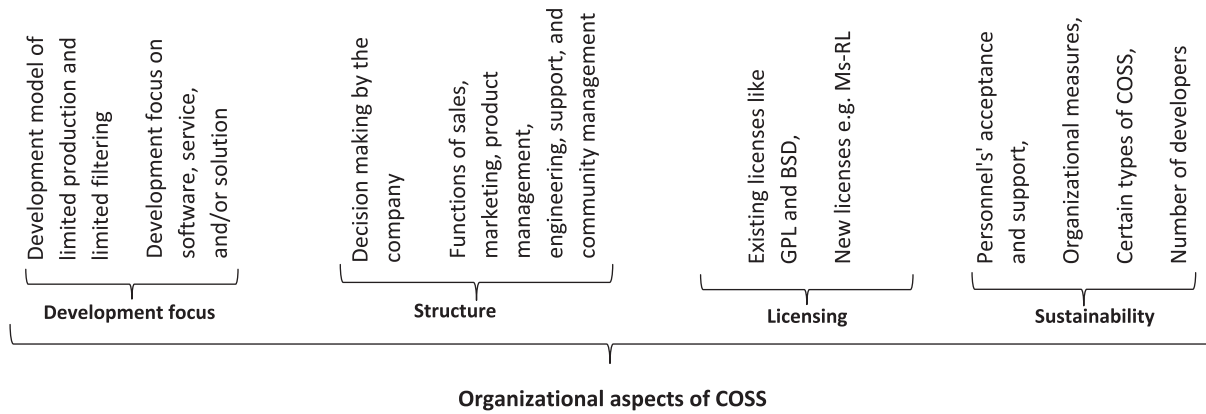


Fig. 8. Constructing the component “organizational aspects of COSS”.

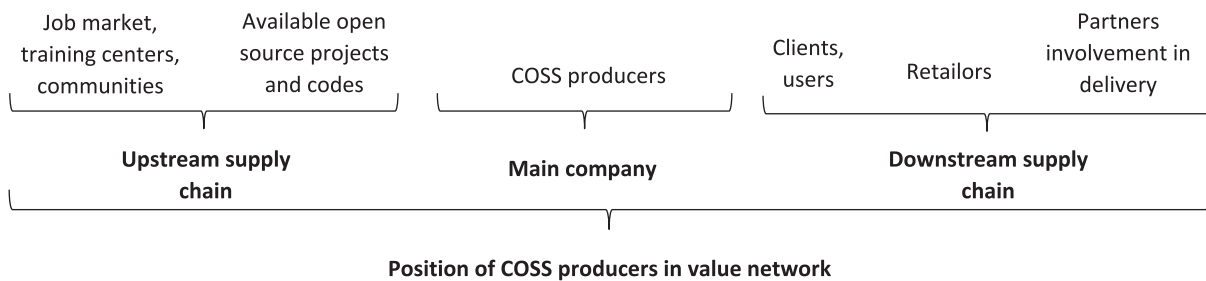


Fig. 9. Constructing the component “position of COSS producers in value network”.

are in the middle of the value network. Thus, we introduce the component of the position of COSS producers in the value network.

The functions of open source software business depend on both the factors related to the internal supply chain, including the development style, governance, revenue mechanisms, and on the factors related to the external supply chain, including the number of participating companies and volunteers [42]. Nevertheless, Riehle [3] noted in his review of the functions of open source software business that the first step among all functions is to create and maintain a user community. The user community is required to be managed on the grounds of offering rapid feedback enhances quality of software, and on the grounds of facilitating marketing and sales, as well as lowering support costs [3]. In addition, partners in most cases come from the open source community to provide service and delivery services [41].

In this position, the open source software development process is something like “limited production process, limited filtering process” [44]. In addition, the distribution of open source software with dual licensing is presented as two free software with less functionality, and paid-for-money software with advanced functionality [41,42]. Distribution of open source software is also done using cloud computing services, where most open source cloud computing services are at the infrastructure or platform level [46]. In addition, its embedding in other systems is another form of open source software distribution [47]. See Fig. 9.

3.2.6. Resources and capabilities of COSS business

COSS business controls the upstream and downstream supply chain, attracts diverse customers and partners, manages a user community, and imports knowledge to Organization. Thus, we've added the component of resources and capabilities of COSS business.

There are full-time developers that are available to the organization and develop software. The presence of these full-time developers determines the direction of the organization's move, and provides a competitive advantage to the organization in comparison to OSS

projects that lack such full-time developers [1].

The ownership and full control of the COSS code is another of the resources and capabilities of COSS business that demonstrates the development of open source software by the owner company [1–3], which retains this ownership for itself and does not provide it to others [2]. Hence, it also has distribution channels and revenue sources [1,45].

Attracting diverse customers is another of the resources and capabilities of COSS business. Since COSS producers own full copyright code, they determine various licensing so as to be tailored to the needs of customers [3]. Thus, they are able to attract diverse customers.

The attraction of partners is another of the resources and capabilities of COSS business. The open source product enables partners to create their own specific business around the COSS through receiving suitable license [41].

Attracting a user community [64,65] is another of the resources and capabilities of COSS business so much so that building up, sustaining, and managing the user community comprise the centrality of a successful COSS company [3]. The existence of such a user community will help COSS and contribute to its business and its competitive advantage [3,60,64,65,70]. Within the community, there are complementary assets that contribute to prevention of the emergence of competitors from that community, faster entry into the market, the creation of superior products, easier sales, construction at less than reasonable cost for competitors, the provision of a highly valued professional product by the company for the benefit of the community, facilitation and increase of sales through domestic advocates and lower customer risk, marketing effectiveness, easier customer service, benefiting from user innovation through product management, making superior product engineering faster and cheaper, and reduction of support costs [3]. Instead, future corporate employees may come from within this community [70], and also open source software may be offered to community for free [3].

Absorption of knowledge is another of resources and capabilities of COSS business. COSS producers have tacit knowledge for internal development that keep it for their own use [51]. On the other hand, in

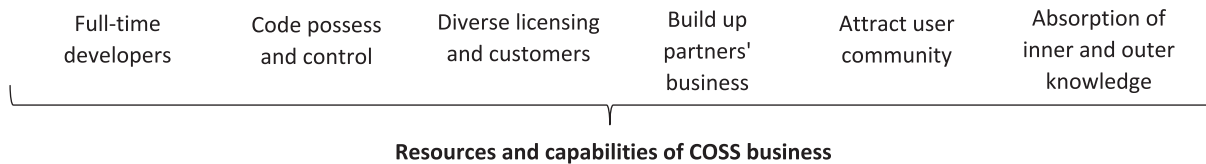


Fig. 10. Constructing the component “resources and capabilities of COSS business”.

return for using open source software codes of others, they will be involved in code contribution processes and, therefore, in collaborative knowledge processes outside the organization, and will gain valuable knowledge and information [49]. The ability to acquire and retain this knowledge both within the organization makes it easier to carry out tasks, and also outside the organization gives the company the ability to compete [71]. See Fig. 10.

The above components are shown in Fig. 11 with respect to the component of the value creation and delivery.

3.2.7. COSS revenue sources

COSS business makes money in two ways of product sale and complementarities sale; we call them COSS revenue sources.

Sale of the product includes the sale of core COSS and the sale of complete COSS. Concerning core COSS sell when customers do not want or cannot accept open source licenses, they buy core COSS [3]. For

example, by this way sellers of proprietary closed source software can get the specific functions of a core product and add them to their products and sell the obtained product [44,62]. On the other hand, customers buy full-featured COSS when they want to get the full benefits of the software [3].

Companies also earn money by selling complementarities [1,2,41,45,62,72] that include sales of service complementarities, sales of software complementarities, and sales of hardware complementarities. The service complementarities that these companies sell [2,43,44] consist of operational convenience [3], consultancy [3], provision [45], maintenance [41,45], and support of open source software [1,41,45], sales of subscriptions [2], and open source cloud computing services [46].

Selling software complementarities involves the sale of optional and compulsory enhancements [1], and the sale of a dedicated copy in the dual licensing [2,41,42]. Finally, the sale of hardware

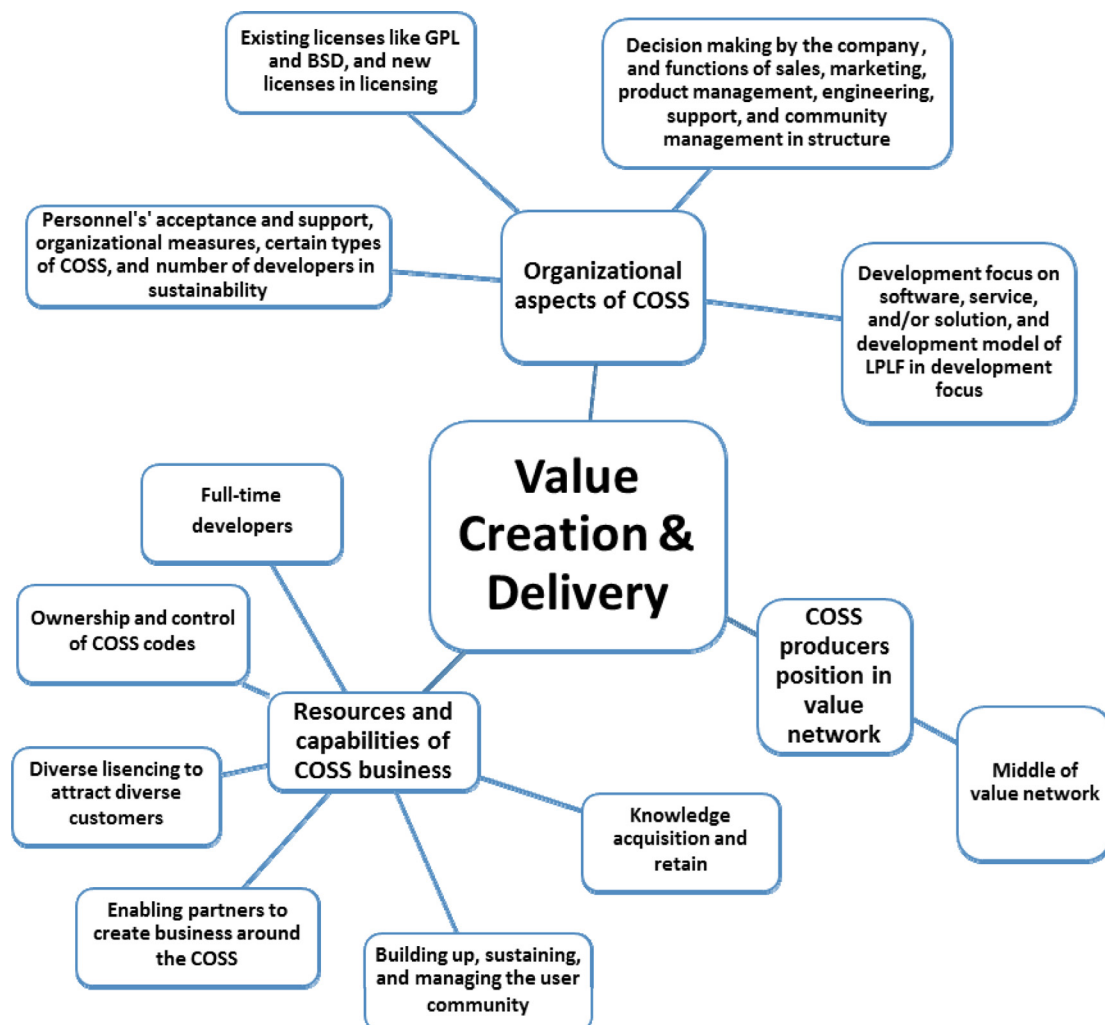


Fig. 11. The components of value creation and delivery category in COSS business model.

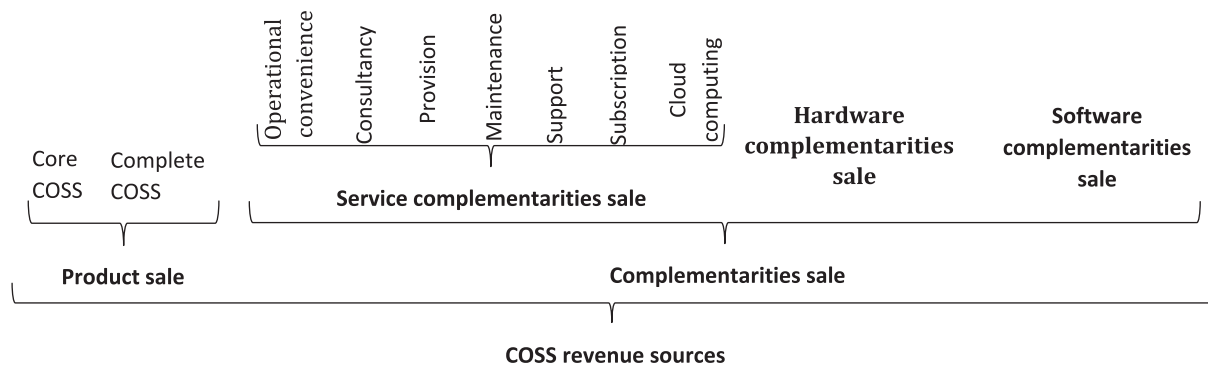


Fig. 12. Constructing the component “COSS revenue sources”.

complementarities refers to the sale of goods and hardware that include embedded open source software and the revenue streams related to them include volume increases, recurring sales, direct sales of add-on software, subscription fees, and revenue sharing [47]. See Fig. 12.

3.2.8. COSS cost-benefit

With regard to the four categories of tangible revenues, tangible costs, intangible benefits, and intangible costs we added another component of COSS cost-benefit to COSS business model.

Tangible revenues for COSS producers are obtained by: Customer pay for software based on the market attitude [1], inevitable payment of users for support [60], increase of offered service fees [1], profit increase [1], users learning costs [73], installation costs [73], maintenance costs [73], the possibility of more support costs of open source software compared to proprietary software [73], displaying more software products as a result of open sourcing and increasing the size of the market which will result in more sales of complementary products and more profits through lower maintenance and management costs of software code [61], the potential profitability of open source software through venture capital investment in open source software [42].

The intangible benefits of COSS development include faster development [74], faster distribution [74], faster acceptance [1], free and fast user feedback [1], volunteer code contribution [1], recruitment of software developers in the early days of an open source project [1], cost reduction of innovation by reusing existing technology [51], investors satisfaction and to become a successful open source business if not the market leader [1], the use of the closed source market leader by open sourcing instead of not enjoying at all [1], getting help from other open source projects with suitable license [1], getting access to more customers through the flexibility of pricing [1], private keeping of tacit knowledge [51], learning in creating innovation process [51], positive image acquisition [51], boosting competition due to being open source [61], gaining experience in emerging open source markets [44], offering value to more customers through open source vendors and consultants [44], acquisition of valuable skills in open source implementation for potential small and medium enterprises and nonprofit organizations as potential employers [44], the direct cost savings with open source [1], cheaper software development using open source [1], the necessity and cost of integrating goods with services for customers [44].

The tangible costs for these companies include the salary of in-house developers and the cost of running the organization [1]. Also, reducing the return of overall market capitalization if not the market leader, and reducing the utilization in the old closed source world if market leader [1].

Finally, apropos of the intangible costs in the primary studies, the followings are pointed out: the employment of software developers at the time of project maturity [1]; lack of reception of open source software by corporate executives on account of unreliable or unsustainable support sources [75]; lack of reception of open source

software by corporate executives on the grounds of lack of available resources, or the unnecessary need for open source technology in the business, or intensive undertaking of migration toward open source software, or its long or steep learning curve [75], the campaign against open source with non-technical and irrational arguments as part of the strategy of certain IT companies to maintain their own market shares [49], use of third-party services for support [60], indifference to paying the manufacturer or third parties [60], the company's being forced to help to promote public goods innovations through the reuse of open source software [51], ambiguity of the total cost of the open source project for users [44], time-consuming and painstaking development of open source software [60], the COSS business model may not be beneficial for all software production organizations [76]. See Fig. 13.

The above components are shown in Fig. 14 with respect to the component of value capture.

4. Discussion

The discussion of this study is organized as follow. We will present report on results and commentary on results in the first and second sections. Then, a discussion about limitations of the study is provided. Finally, we will suggest some directions for the future research.

4.1. Report on results

This study identified characteristics of the business model of commercial open source software. The results of this study are important because scattered aspects of COSS business model have been collected and organized. Those results are important for established proprietary companies to open up some of their software, start-up companies to begin their business around open source software, and also companies addressing COSS to better manage their business. They are also important because quite complete features have been provided to enhance different aspects of COSS research by future researchers based on these results.

According to the findings of this study, the proposed value refers to what products and complementarities the company offers to customers and with what competitive strategies it does so. The COSS organization itself and its resources and capabilities should be identified, and its link to other entities present in the value network to create and deliver that value. It should be made clear how the company makes money in exchange for its creation and delivery. Since the COSS business model is the focus, it is necessary to consider, in addition to the monetary benefits, the non-monetary benefits, that is to say, the cost-benefit of the business.

Accordingly, this study identified eight components for COSS business model. Those are COSS products and complementarities, COSS clients and users, COSS competitive strategies, COSS organization, the position of COSS producers in the value network, resources and capabilities of COSS business, COSS revenue sources, and COSS cost-

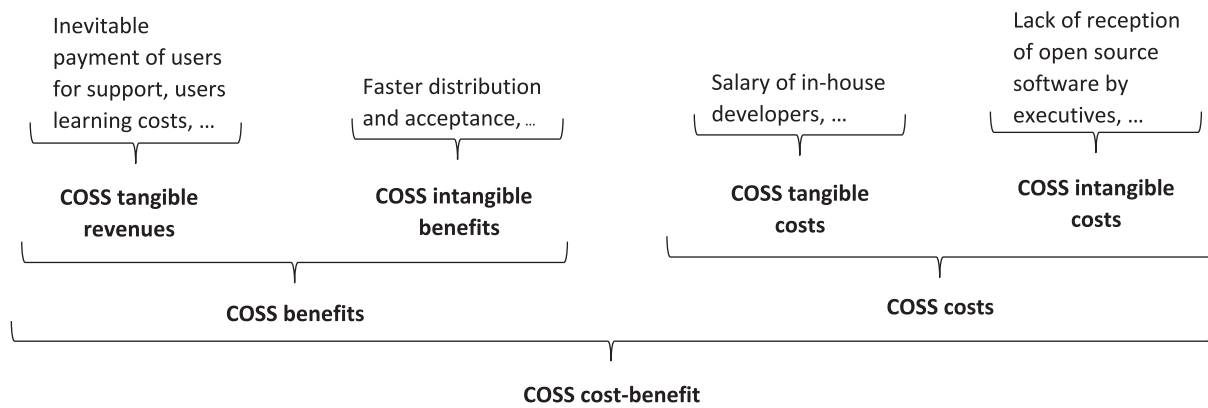


Fig. 13. Constructing the component “COSS cost-benefit”.

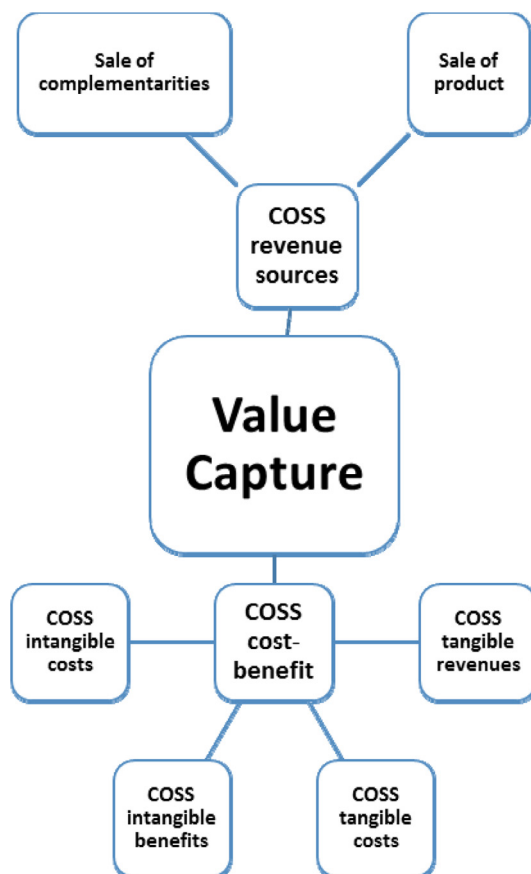


Fig. 14. Components of the value capture category in COSS business model.

benefit. These components are more complete than just revenue sources reported by researchers as business model.

4.2. Commentary on results

Business model is defined as creation and delivery of value by a firm for customers and also capture of value by that firm [23,24]. For business model, different frameworks have been presented or used by different researchers [25–37]. A review of these studies shows that the business model framework consists mainly of value proposition, value creation & delivery, and value capture. However, it is shown that there is a lack of consensus about the components of each of them [38].

For example, Morris et al. [38] by summarizing business model components existent in the business model literature presented six most frequently cited components. These components are the firm's value

offering, economic model, customer interface/relationship, partner network/roles, internal infrastructure/connected activities, and target markets. Then, by six questions, they identified the essential of a business model in terms of an *integrative framework*. These questions are about offering, market, internal capability, competitive strategy, economic, and ambitions.

Or, one of the most widely used business model framework i.e. Osterwalder et al.'s [4] *business model canvas* consists of nine components. Those components are value proposition, customer segmentation, customer relationships, channels, key resources, key activities, key partners, cost structure, and revenue sources.

However, since in this paper, ‘commercial’ OSS is the subject, there is a need to present *organization* as a separate component while there is no clear place for this component in integrative framework of business model and business model canvas. And, there is no clear and separate place for *competitive strategy* in the business model canvas to win the market. Hence, these are two components of our business model.

Batocchio et al. [39] showed overlapping of nine components of business model canvas with four perspectives of balanced scorecard. They showed overlapping of customer segments, customer relationship, and channels with “customer” perspective. For COSS, in addition to customers, there are users that just use the firm software product but necessarily aren't its monetary customers. So, *clients and users* is another component including customer segments. The other overlapping components of customer perspective inevitably would be presented in other components of our COSS business model.

In integrative framework of business model, Morris et al. [38] introduced component offering addressing “the nature of the product/service mix, the firm's role in production or service delivery, and how the offering is made available to customers”. Since our business model is presented around different aspects of value, we put them as separate components. The first above-mentioned element is about our *products and complementarities* component. For the second and third one, we have defined *firm position in value network* component that would be placed in a package different from offering one.

Also, via cost structure and revenue sources, Osterwalder et al. [4] present cost and revenue sources. But, in addition to the sources, there is a need to produce a component for economic factors in terms of tangibles and intangible cost-benefits so that sometimes in addition to tangibles, intangibles are used as factors for decision making. And, Morris et al.'s [38] under economic factors combined revenue sources with operating leverage related to costs, volumes related to internal capacity and market opportunity, and margins. But, since the kind of revenue sources is different from cost and profit and capacity, we separated them: one category for *revenue sources*, another category for *cost-benefit*, the other category for *internal resources and capabilities*. In addition, we assumed the market opportunity is something embedded in customer segment.

Anderson et al. [40] discussed three kinds of value proposition. In

the first one, the firm simply lists all the benefits which it thinks its offering can have for the target customers, which requires the least knowledge about competitors and customers. However, the two other kinds of value proposition require richer knowledge about competitors. In one of them, the firm by asking the question that why customers should buy its offering instead of competitors' tries to differentiate its offerings. In the other one, the firm delivers its proposition by concentration on one or two aspects of difference compared to competitors to deliver the greatest value to target customers.

The above-mentioned kinds of value proposition highlights three components i.e. offering, target customers, and competitiveness. Accordingly, we packed our ensuing components of products and complementarities, clients and users, and competitive strategies into value proposition. It implies that unlike business model canvas, value proposition is in a higher level beside value creation & delivery, and value capture.

Amit and Zott [23] defined content, structure, and governance of transactions in a business model to create and deliver value. Content specifies deliverables or receivables and the resources and capabilities allowing the value creation and delivery. Structure specifies the parties taking part in the value creation and delivery and the ways of linking them, the sequence of value creation and delivery, and the mechanism for allowing value creation and delivery. By governance, the ways of control of content flows, the legal form of organization, and the incentives for the participants in value creation and delivery are specified. Accordingly, in our business model, we packed resources and capabilities, firm position in value network, and organization into value creation and delivery.

Chesbrough and Rosenbloom [24] noted that a firm needed to specify how it wants to capture some amount of that value to benefit from its business model. Value capture is to do with financial perspective i.e. revenue and cost [39]. Hence, in our business model, we crammed the revenue sources and cost-benefit into value capture.

In this way, the COSS business model and its components presented with regard to value proposition, value creation & delivery, and value capture.

The theory of commercial open source software is essentially based on an organization behind it which “controls the access to the code base, defines the evolution strategy of the project, and sets the implementation roadmap” [77]. But, this study showed there is a lack of in-depth research on the COSS organization. One reason may be laid in Schaarschmidt et al.'s [42] argument who linked differentiating COSS business functions to existence of inevitable different forms of COSS. Although Riehle [3] tried to introduce the COSS business functions, they are basically upon the user community that is one perspective to examine the issue. However, this is a crucial unexpected issue.

On the competition issue in the open source literature, researchers [78–81] examined the competition between OSS and proprietary software. They did it by constructing their own mathematical model and mainly by addressing network effects. It means the competition issue for COSS is excluded in the open source literature. However, Sen [81] with defining “OSS-SS vendors” as “vendors who sell usable OSS plus support services” noted a “very competitive environment” that those vendors confront (although, the OSS-SS is not precisely the COSS that is the subject of this study). In addition, Riehle [1] noted that the COSS business model is “likely to experience the same pressures as proprietary software”. Nevertheless, this study via introducing the COSS generic competitive strategies shows a good competitiveness for the COSS and cast light on the competition issue for the COSS.

On the other hand, Sacks [80] noted that the open source and closed source software compete in different markets according to the software sophistication based on investment in technology. It is worth mentioning they are not utterly separated as Sen [81] showed that the OSS-SS producers are determinant in their usability decision about being situated in between the OSS and proprietary software. In this way, the results of this study imply the competition among COSSs themselves

depends on factors such as the quality and the cost of recruited developers work, the number of contributors, the organization and its management, the creation, maintenance and management of the user community.

4.3. Limitations of the study

The COSS discussion was introduced by Riehle in 2007, which, according to studies, has so far been a new topic. Hence, disparate and incomplete studies have been conducted on its business model. This issue represents one of the limitations in examining literature, because it was necessary to examine studies that address other issues in order to extract the data from within them. This made the study process become longer.

In addition, because of the above problem in the resources, there may exist other studies with complementary points about different aspects of the COSS business model presented here. It is also because we used six academic databases.

And, since this study is a systematic literature review about business model with many aspects, precisely addressing some parts was not possible and also was out of the concentration of this study. So, they need to be extracted from this study and examined in future research.

Another limitation is related to quality assessment. Like Hauge et al. [16], we used a binary scale with slight sensitivity to assess the papers according to nine quality factors. It may inflate the scores. Of course, utilizing more comprehensive quality assessment guidelines like Kitchenham and Charters [14] is better but time and effort consuming with probably no new insight [16].

4.4. Directions for future research

COSS is comparable to opensourcing. In opensourcing, the companies outsource to the open source community outside of the company [82]. This lowers the cost of development, because on the one hand, volunteer developers code for free, and on the other hand, users report flaws in the software [43]. Hence, the existence of an open source community is vital to the success of the open sourcing company [82]. In COSS also exists a user community and somehow developer is effective and improving [3]. But, the problem is creating and sustaining such communities [41,43]. Therefore, it is imperative that the management of the creation and maintenance of the user community in future research be investigated; an issue which has not been seriously considered in the literature of COSS.

The next point is that, as Riehle noted, open source software can possess established markets, provided that it is sufficiently disruptive [1]. For this disruptiveness, we suggest working on the revenue model. In fact, since the business model is a system and every change in one component also affects the rest [4], the initiation of this disruption can be a revenue model. Therefore, it is suggested that future studies in helping to describe more revenue models examine the role of new revenue models in adding to the disruptiveness of the open source software. This is because the explanation of open source software revenue models has been difficult, especially because of free distribution [83]. In addition, this study suggests that the provision of complementarities has been an integral part of the COSS business model as a way of earning money. So, new disruptive revenue models can help new configuration of the COSS business model and probably possess established markets.

Due to the cultural, economic, institutional, geographic and other characteristics of developing countries with emerging markets [84], the use of business models of developed and matured markets is often unsuccessful [58]. Therefore, the logic of the creation and capture of import value of COSS may need to be adjusted. This implies the need to localize the COSS business model [85]. In addition, countries are demanding indigenous and localized software, but due to expensive licenses, some of them are looking for open source software [86]; a

localized open source software. But, in the literature of the COSS business model, not only the localization of open source software as a business model is not considered, but there are also few studies on the open source software localization. Therefore, it is suggested that future research consider localization of open source software as a business model.

Finally, there is not much research about the organization and about what is happening inside a COSS company. Therefore, one of the implications for future research is that it is suggested that future research examine the structural dimensions and content dimensions [87] of the COSS organization.

5. Conclusion

This study aimed to specify more complete characteristics of different components of the COSS business model partly hidden in papers. Therefore, a systematic literature review was apt to summarize and clarify them.

The findings of this study show that existence of many different characteristics that we packed into eight components permits different forms of COSS business model. Also, there is a good competitive ability for businesses evolving around the COSS.

The COSS business model with the backing of a single legal entity has significant things that makes it a competitive and profitable business model which can attract diverse customers. Generally, these are the use of generic competitive strategies and the use of in-house developers to produce high-quality, reliable and, at the same time, free-delivery products for a large number of users and using complementary ingredients as an integral part of the revenue model.

This study suggests some directions for future research. Disruptive COSS revenue models, organizational aspects of COSS, localization of COSS, and creation and maintenance of the user community are among them. On the other hand, practitioners should notice that the points of different aspects of the COSS business model presented here to improve the cost-benefit trade-offs of their business.

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