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Author	Luis Enrique Gutiérrez Burboa	Student number	515944
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Supervisors	D.Sc. Johanna Raitis & D.Sc. Birgitta Sandberg		

Abstract

Online communities are crucial for the survival and success of companies using the open core model, as they rely on attracting developers to use their open-source software (OSS) and converting some of those free users into paying customers. Current research focuses on the success factors of OSS projects, motivations to contribute, and the sustained participation from the community perspective. This thesis provides the company's point of view and adds the concept of sustainability to the growth of online communities, which makes this topic very relevant. The main objective of thesis is to uncover the characteristics of successful communities that propitiate sustainable growth, and what are the main challenges that stand in the way by finding answers to following questions, in the context of OSS.

- What is the nature and relevance of online communities of OSS?
- What are the main factors that drive sustainable growth in online communities of OSS?
- What are the barriers for sustainable growth in online communities of OSS?

To achieve this understanding, the literature review widely covers the phenomenon of open-source software communities from what they are to why are they relevant, and how can the success of these online communities be measured. Finally, the current research on sustainable growth in online communities and its success factors and barriers are covered. To expand the current knowledge on the sustainable growth of OSS communities, a case study is conducted by interviewing six key members that work with the community in an open core company by using the standardized open-ended interview approach and a six-phased thematic analysis.

The findings of the study identify four areas to look after when planning for sustainable growth: member's activities, communication platforms, company involvement, and product & marketing. Among the success factors, support, engagement, and recognition are brought up as some of the key drivers. On the other hand, the data suggests the main challenges are found in the form of communication barriers, inadequate resources, brand misconceptions, social issues, and challenges in product development.

Key words	Online communities, OSS, open core, sustainable growth, community building, developers, OSS ecosystem, sense of community, engagement, support.
Further information	-







UNDERSTANDING SUSTAINABLE GROWTH IN ONLINE COMMUNITIES OF OPEN-SOURCE SOFTWARE

Case: Open Core Business

Master's Thesis
in International Business

Author:
Luis Enrique Gutiérrez Burboa

Supervisors:
D.Sc. Johanna Raitis
D.Sc. Birgitta Sandberg

16.5.2021
Turku

The originality of this thesis has been checked in accordance with the University of Turku quality assurance system using the Turnitin OriginalityCheck service.

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1 INTRODUCTION

1.1 Background

Online communities are groups of people who interact with each other through a digital channel; usually sharing one or more common goals. (Stanoevska-Slabeva & Schmid 2001, 2 - Iskoujina et al. 2017, 401). They have existed since the creation of the internet, though on more primitive and limited versions of what we see today. For the sake of this research, I will examine online communities of open-source software (OCOSS), where members are programmers who overall share the common goal of learning and using an open-source software (OSS) project, with the desire of becoming proficient to carry out either personal or professional projects.

Nowadays there exist more and more online communities because of the rapid increase of the accessibility to internet in the world, the consequent expansion of e-commerce and the increase of popularity of social media platforms that propitiate the creation of such communities (Posey, Lowry, Roberts, & Ellis 2010). For OSS projects, this has translated into a 33 billion USD industry, with over 30 million developers contributing to community projects through platforms like GitHub (CBInsights 2019, 3).

Online communities are the foundation for the survival and growth of companies using the open core model, as they rely on attracting developers to use their open-source software and converting some of those free users into paying customers (CBInsights 2019, 11). In the software context, this business model is similar to the well-known free-mium model, and it is currently used by the giants of information technologies like Google, which makes most of its software tools open and available to the public, Dropbox with its data storage services and Microsoft with products like Skype.

According to Schwab, Gold, Kunz & Reiner (2017, 85) the definition of sustainable growth is broad and extended from financial to also non-financial parameters that represent growth. It also needs to be extended further to the other economic, social, and environmental performance objectives. Only when these factors have been considered, the sustainable business growth can be defined as the company's appropriate pace of growth that is adding to its social, economic, or environmental capital without decreasing any of the mentioned pillars. Instead, Loimukallio (2012, 50--51) describes sustainability in the context of OSS as the ability to get enough contributions to the project, so that the risk of

another project or product becoming a better substitute and getting a hold of the market share is reduced.

In my experience, building a sustainably growing community is the key to succeed in the open core business. There are several reasons for this, the sales process can be substantially scaled when it comes to selling intangible products and services from software, as there are no limits on the number of people you can reach on the internet. In turn, building an online community becomes the highest priority for building a sales leads funnel. An online community is, however, much more than a sales opportunity; it represents the success of the OSS project itself by promoting knowledge sharing, improving the product with contributions to the existing software, providing help and support to other community members, and increasing the visibility of the project. When it comes to the business advantages of community growth, the bigger the number of developers using the free and open sides of the software, the more potential paying customers of the commercial software additions and the companies' services. Identifying which factors are more relevant to developers to become happy members of a community is one of the main goals for the marketing department in open core companies, whose job is both focused on creating awareness amongst the developer community (user-oriented), and on having a steady funnel of potential customers (business-oriented) for the sales department. Moreover, understanding the decision-making process of developers when they are evaluating the technology for a future adoption is crucial, as it gives the company the necessary tools to improve the experience to newcomers and to comprehend their level of involvement needed in the community to ensure its prosperity.

The business justification for online communities comes from both tangible assets, which is the revenue produced from the sale of products (usually subscriptions) and services, as well as intangible assets, that include but are not limited to word of mouth, brand awareness, higher quality support and customer service among community members, and a channel to share information. In online communities of open-source software (OCOSS), the intangible assets become more evident as the community collaborates directly by providing feedback, reporting issues, and sharing solutions related to the software, and even by making code contributions to improve the OSS project. (Iskoujina, Ciesielska, Roberts & Li 2017, 405-407)

Therefore, we should understand better how they work and what makes them successful, especially in the long term, that not only was identified as a gap in the literature but also plays into the sustainability of growth of these communities.

1.2 Purpose and research questions

The success of an online community translates to the popularity and usage increase of the open-source software in question. However, this study is more concerned about the business implications of such success, for this reason the focus chosen is the recent business model called open core, which combines the commercial interest from vendor-backed software with the practices of open-source software.

This research will attempt to broaden the current understanding of online communities of open-source software, which includes their characteristics and relevance, and identifying those factors that propitiate and hinder their sustainable growth. Therefore, I will seek to answer to the following questions:

- a) What is the nature and relevance of online communities of OSS?
- b) What are the main factors that drive sustainable growth in online communities of OSS?
- c) What are the barriers for sustainable growth in online communities of OSS?

These questions are especially relevant because the previous studies have mostly focused on the different perspectives on the success of open-source software projects. For example, success factors of commercial open-source software projects have been researched in a Master's Thesis in Turku School of Economics by Loimukallio (2012), who identified communities as one of the main success factors. Open-source software communities have also previously been studied from the roles, participation, and motivation points of view (see e.g., Barcellini, Detienne & Burkhardt 2014; Lakhani & Wolf 2005; Roberts, Hann & Slaughter 2006). When it comes to sustainability, for example Chang (2012) assessed a sustainable growth model. This study is pertinent because it brings all these perspectives together.

To grasp the understanding of online communities, this study will explore not only the concept but also the characteristics of these communities and how they are usually measured. Furthermore, it is crucial to fully understand the importance of these communities; what benefits they provide to the open core business, and what a functional community constitutes to its members. Altogether, it is necessary to investigate topics such as identification (what it means for developers to belong to a certain community) and motivations to participate, the value members get from these communities (such as support and knowledge sharing), and the members' journey that leads to adoption of the open-source software, and the subsequent membership status in the online community.

The study will be steered by going through the present understanding of sustainable growth in OCOSS from the literature review, and then interviewing experts in a company who work closely on building an online community, which will bring the company's point of view to contribute to the current knowledge in the subject and complement the existing ideas from previous studies focused on the community members' perspective (see e.g., Lakhani & Wolf 2005), as well as include the long term outlook that is called for in sustainable growth, a gap in the existing literature.

2 NATURE AND RELEVANCE OF ONLINE COMMUNITIES OF OSS

In this chapter it will be discussed what Online Communities of Open-Source Software (OCOSS) are, their characteristics, their relevance to open core companies and to the success of OSS projects in general, and several methods to measure and analyze the current state of such online communities, mainly in relation to their size (number of community members) and participation levels.

2.1 The nature and characteristics of Online Communities of OSS

Online Communities have long existed since the creation of the Internet, and while everyone has a different idea of what they are, the basic principle is that they formed by two elements; members (users) and a channel to communicate (platform) (Stanoevska-Slabeva & Schmid 2001, 2). Iskoujina et al. (2017, 397-401) further expand this by adding a third dimension, a shared purpose, or interests. They went on to include the main purposes of online communities; business networking, media-oriented, and brand communities. However, the authors missed the introduction of support communities, recreational communities, learning communities, and those focused on the development of OSS (Open-Source Software).

While it is impossible to pinpoint the start of online communities, some examples can be brought up such as online chat tools like ICQ, whose name means “I Seek You”, and MSN Messenger, created by Microsoft, with release dates of 1996 and 1999, respectively. While they no longer enjoy the same popularity as in the 90’s and early 2000’s, the former can still be found available. They were characterized by the need to download the client software and had a more ‘invasive’ experience due to the capabilities they had to disrupt the users’ activities on the computer, for instance the infamous option to send a buzz with MSN, that made the virtual window of the user shake and it produced a sound, trying to get the user’s attention.

Other examples are the introduction of social media websites, which had a heavy focus on sharing photos like MySpace, and a long list of failed social media platforms, such as Google’s Orkut and Google+, and Vine, amongst other online community platforms like chat websites and forums. On the winners’ side, it is easy to think of social media giants like Facebook, Twitter, YouTube, Instagram, WhatsApp and TikTok, which

have seen an exponential increase in the number of users since their launch (Ortiz-Ospina 2019).

When it comes to Online Communities of OSS, probably one of the oldest and most successful one is the Linux project. Created in 1991 by Linus Torvalds, a Finnish student (at the time) at the University of Helsinki (Kavanagh 2004, 10-11), Linux was a pioneer open-source operating system that set the foundation for the OS movement, as it proved they could be feasible and were able to reach corporate-level quality. The project has been very successful, and it has allowed the birth of companies like Red Hat, a company that promotes itself as “the world's leading provider of enterprise open-source solutions, including high-performing Linux, cloud, container, and Kubernetes technologies”. Founded in 1993, it is now one of the biggest software companies in the world, with a total revenue of \$3.4 billion USD in 2019 (Raleigh, 2019). More recently, this operating system was used in the manned SpaceX Dragon rocket that took two astronauts to the International Space Station in May 2020 (Christian, 2020).

The success of this example is the result of this thesis statement, sustainable growth of OCOSS. As defined by Figge, Han, Schaltegger and Wagner, sustainable in business means the ability to maintain one of the three dimensions; economic, social, and environmental in the long-term (Figge et al., 2002, 269-274). Hence, I define sustainable growth in online communities as the appropriate pace of growth and the ability to self-sustain that ensure the prosperity of the community in the long term.

Online Communities of OSS rely on platforms that allow developers to communicate and share their knowledge, ask questions, and everything related to Open-Source Software. These platforms are communication channels and can be classified according to their structure (see Figure 1): support for synchronous or asynchronous communication, level of organization required, type of communication in such channel (one to one or one to many), and lastly if the platform is mobile or fixed. (Longmate 2003, 5)



Figure 1. Classification of communication platforms used for OCOSS according to their structure. (Longmate 2003, 5)

A suitable definition for online communities is the one provided by Iskoujina et al. (2017, 397): they are “communication networks between individuals and/or businesses that identify themselves with a community formed around a common interest and interact to exchange information or knowledge through a range of the internet-based technologies”. And they identified the key elements of online communities as shown in Figure 2:

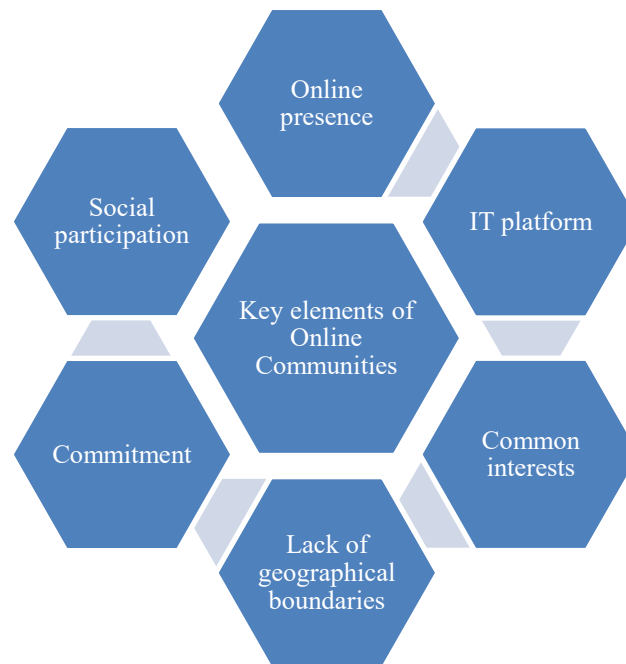


Figure 2. Key elements of online communities (Iskoujina et al. 2017, 397)

As shown in Figure 2, several elements make up an online community. Primarily, the community must have an online presence, available through an IT platform that allows communication between members. Being that communication that takes place online, the lack of geographical boundaries becomes an inner element of these. The other elements needed for a community to form are having common interests or an aligned purpose amongst members, and the commitment to participate in this community. In the context of OCOSS, all these elements are found. The common interest evolves around the learning, usage, and development of the open-source software, and these communications emerge through several platforms like forums and chats, described further in this chapter.

In their extensive study, Iskoujina et al. (2017) identified the three dimensions of online communities (Table 1), and went further to add classifications in each dimension,

using the dichotomous approach in which two opposing types are presented, and classification by purpose of said communities that covers the reason of their creation and their utility.

Dimensions	Classifications	Examples of OCs
Participants	Independent individuals Organizations and/ or their members	Member-mediated Person-oriented Professional Organization sponsored Closed/research and open/general
Platform	Totally virtual world	Virtual network based
	Partly virtual entity as an additional tool to the real world	Social relations Psychological support Entertainment Real group based Mobile communities
Purpose / profit	R&D	Open-source software
	Common interests	Online community of interest Communities of interest Communities of fantasy Communities of relationship Media-oriented communities
	Exchange	Exchange information or knowledge Communities of transaction
	Sales and marketing	Marketing and brand communities
	Proximity	Physically based Real group based

Table 1. Dimensions and classifications of online communities. (Iskoujina et al. 2017, 399)

Online communities of open-source software (OCOSS) can take a plethora of forms, they sometimes occur accidentally in chats, forums, repositories, and some others have a more structured and organized ways of working, guided by companies who are sponsoring the project (open core companies) or headered by the community itself, usually lead by *community champions*, community members who dedicate their time and effort to foster online communities. Here are some of the most common platforms where these take place:

Version Control Hosting Software are platforms that host code repositories in the cloud. They share characteristics like the ability to download code, review existing code, make pull requests (suggest modifications to the code), report bugs (unexpected behaviors in the code or plain errors), make improvement requests, etc. Some of the most known examples are GitHub, GitLab, BitBucket, Buddy, Microsoft Team Foundation Server, Assembla, etc. (G2, 2021)

The most known platform for questions and answers (Q&A) in the programming world is undoubtedly Stack Overflow. They not only provide a place to ask questions, but also immerge developers into an ecosystem by having the ability to add tags of different technologies used in the programming. These are characterized for being open to everyone, having a voting mechanism both for good and bad questions and answers, and having a self-moderation amongst members, where those with the highest reputation have more control over the platform. Other examples are Bloomfire, AnswerHub, Obie, Starmind, and Tribe Community Platform (G2, 2021).

While Forums are also platforms for Q&A, they differ from the former type in that they are usually specialized for a specific technology, programming language, or framework, and are hosted in a specific website for such technologies. They are moderated by the website owners and lack the openness and visibility of the platforms mentioned above.

Commercial platforms are software platforms offered as a turn-key solution. Their main characteristics usually include gamification features to increase participation and building loyalty amongst community members, as well as customization according to customers' needs, seamless opportunities for companies to interact with members for customer service, and analytics capabilities to track members' participation and reaction to current communications. Some of the most known solutions are Discourse, Vanilla Online Community, Tribe Community Platform, inSided, etc. (G2, 2021)

When it comes to Chat platforms, the present tools available are vast. Some of the most known examples are Slack, Discord, Gitter, Chanty and Flock. However, chat between developers can evolve in any software that offers one to one or one to many instant communications. These platforms provide the possibility of one-to-one or one-to-many conversations, usually in an asynchronous way, meaning participants do not need to be present throughout the whole conversation, and can leave and come back to it at any time. They have the disadvantage that the information shared in them might not be easy to search, and the communication may be slow-paced. (Whoson, 2021)

After going through the main platforms for OCOSS, it is easy to get the impression they all are channels to ask questions and give answers. However, Longmate (2003, 78) identified the most common activities found in online communities: sharing or exchanging information, discussing ideas, socializing, making friends, keeping in touch with people, and providing support. Understanding the role of platforms or locations is important when researching online communities because all the forums are potential places for development and growth. In fact, virtual places can play a significant role in building the community discourse and act as a physical metaphor. (Longmate 2003, 18–19)

2.2 Relevance of OCOSS to open core companies

Open core companies are those that use the open core business model to generate revenue, they utilize the practices of open-source software by having a free/open core product and find ways to offer additional value with commercial (closed) products, and/or services around their sponsored OSS (Widenius & Nyman 2014, 7 – 8). Online communities define the success or failure of open-source software projects, they are the main driver of knowledge creation and progress of such projects, and they represent the foundation for both tangible and intangible assets generation in an open core business model. For this reason, “an engaged community is at the core of any working open-source software project” (Riehle 2012, 6). Riehle (2012, 6) also listed the main benefits that come out of highly engaged communities in relation to business functions:

- a) Sales: increased sales and easier for the sales representatives at the company, thanks to the champions or evangelists in the community who promote and praise the OSS.
- b) Marketing: increased credibility seeing community members positively reviewing the project and less need of company paid marketing to promote the OSS.

- c) Product management: an engaged community will report bugs, request new features, contribute with code, which results in a better product.
- d) Engineering: Constant feedback from the community also supports creating a superior product.
- e) Support: more access to free support for the community members, who receive help from other members, and lower support costs for the company.

2.2.1 The open core business model

As defined by Prof. Dr. Dirk Riehle (2012), the open core business model, which he specifies as single-vendor commercial open-source software, is “open-source software projects that are owned by a single firm that derives a direct and significant revenue stream from the software”. Also commonly known as vendor-backed (open source) software, it essentially means there is a company behind the development and maintenance of the OSS that aims to profit from the project. In contrast, the other type of open-source project is the “Community Open Source”, that is managed by a community of stakeholders (Riehle 2012, 4).

The open core business model can also be compared to the more commonly known ‘freemium’ model, as they both share the same principles of giving something away to attract users, and then provide extra features with a price tag. The main difference is perhaps that in the open core model, users can also affect or be part of the development of the product (the software) itself, while the freemium model is unidirectional; the users have only the right to get more features, get access to otherwise locked content, remove ads, or simply get improved visuals of their experience with the platform or game, by becoming paying customers. Additionally, the open core model is not limited to offering products, and instead usually offers an array of services.

As sharply pointed out in the book “Getting freemium business model right” (2017, 17-18), the freemium model must focus on providing value for both free and ‘premium’ or commercial users by constantly improving their propositions or features in each tier. This implicitly states the existence of an interdependency between both tiers (and their users), and hints that to succeed with this model, both value propositions are equally important. The same can be applied to the open core model, where the sales cycle relies heavily on keeping the free users happy to convert them into paying customers.

In his paper, Riehle (2012) highlights four main revenue sources from open core companies identified by Bearden (2008). The first one is the core product, which is the open-source software, and Riehle (2012) explains that some customers pay for the whole product, which is usually free, mainly because of legal reasons. The second revenue source is the whole product, as the core product will most likely be a limited version of the product, and users must purchase access to additional features. In third place we find the operational comfort, which refers to when customers pay to have some sort of technical support, and it may include a way to get replies to questions, fixing bugs, or access to additional services. Lastly, revenue can come from the consulting services, and as the name implies these are services typically related to the execution of software development, review and consulting of current software code, training, migration assistance, etc. (Riehle 2012)

2.2.2 Tangible and intangible assets produced by OCOSS

As Iskoujina et al. (2017, 405-406) clearly highlighted in their study, the value of online communities is not only financial and tangible, but a broad variety of intangible benefits to take into consideration. Simply put, the tangible value that is provided by the online communities to businesses, is predominantly related to sales of services and products. It is also possible to gain tangible value by providing data, virtual-world experiences, or information in general. However, it is clear that the financial side only makes up for the small portion of all the possible benefits. Examples of these non-financial values are trust building, increased brand awareness, increased website traffic and better product support. The long-term effects of these intangible values are very hard to predict, but they can also contribute to the financial returns and act as a basis for the relationship between the businesses and online communities.

Boon, Pitt & Salehi-Sangari (2015, 347–351) also researched the intangible assets in their study which focused on information sharing in online communities and how the companies should manage it. According to them, communities that have trusting members within them and that are sharing knowledge with each other, are more likely to grow. From the company perspective, it also means that the members are likely to improve the content, share valuable knowledge, innovate, and maybe even become early-adopter customers. They realize that for companies, there is strong evidence that it is beneficial to engage with an online community because it can greatly affect how the consumers are

perceiving the brand. If the company is engaging with the community, they also have a chance to spread around the word about their product and foster collaboration. In business relationships, it is also important to recognize reciprocity as an important driver for information sharing. Online communities have social norms that make sure there is a generalized feeling of reciprocity in the community.

It is safe to say that if the company overlooks the intangible assets and only focuses strictly on sales, they will not be able to reach their full potential. Boon et al. (2015, 351–352) gathered a guideline for the communities, how they should stimulate the exchange of information between the community members because it is relevant to understand how to do it right to get the full benefits out of it. To develop trust, the company should enforce rules that help tackle the malpractices and foster personal communication between like-minded members. By establishing a reward system for helpful individuals, companies can also support the culture of reciprocity. The final argument from the guideline is to show the right example to the community members by also sharing knowledge openly and thus, making the information owned by the collective community.

2.2.3 Building brand online communities

In this subchapter, I will further analyze how brands and communities are tied together in a context of Online Communities, what is the role of identifying with a certain Brand Online Community and how this further benefits companies using the open core business model.

When interactive digital media was introduced, the consumption communities emerged. The internet is a great platform for rapidly developing both B2C and C2C interaction in different consumption communities, in which customer's social identities are based, especially on their role of consumption. In a wider sense, customers' identities are therefore related to the brands they use or consume. This also means that the providers can be positioned based on both their brand identity and the appeal of their brand communities. With the advancement of technology, the brand communities have also become more and more global in their nature both with the brand's involvement and without it. (Hammedi et al. 2015, 1.) Muniz & O'Guinn's (2011, 414—415) research supports the idea that brand communities are not tied by geography and they are explicitly commercial. They also see that brand communities have a strong interpretive role when negotiating

the brand meaning, making it a social construct rather than a delivered message from business to consumer.

In its essence, a Brand Online Community (BOC) is a defined group of consumers with a highly developed social identity and a shared enthusiasm towards the brand. The members of these communities are engaging in different actions inside the group, expressing their mutual values and achieving collective goals. Of course, there are as well other factors beyond the brand itself such as interest in the product, or other members of the community that might motivate them to become members of the community. However, it can be concluded that enthusiasm towards the brand is a necessary factor when the communities are being created but it is not sufficient by itself to drive the community forward and encourage continued connections. (Hammedi et al 2015, 2.)

Sharing brand stories is one of the driving factors of reinforcing the feeling of belonging between brand members and contributing to the imagined community. By sharing these stories, the newer members learn what are the shared values of a certain brand community, what happens if you leave the safety of the joint space and how the shared experiences of the brand link the members together.

Furthermore, by sharing the comments from community members, members tend to feel more secure in their understanding of like-minded others in the community. This also supports in ensuring the legacy and thus survival of brand cultures and their communities. (Muniz e O'Guinn, 2001, 423.)

Muniz & O'Guinn (2001, 418—419) argue that members of a brand community feel a so-called “we-ness” or togetherness. They do feel an important connection to the brand, but what is more relevant to note, is the even stronger connection towards the other members. This concept can be illustrated by a triangular social constellation brand-customer-customer which is a very central aspect of understanding brand communities and the way they work. Regardless of the ownership, usually anyone who is devoted enough to a certain brand, can become a part of it since they are generally open social organizations.

Lastly, Pierce et al. (2001, 304) introduce the concept of organizational ownership which is a relevant concept to understand in addition to the previously mentioned togetherness. They argue that members of an organization or a community might feel the sense of ownership towards an organization through their operative motives and participation. Through devotion and increased control, an individual becomes psychologically tied to the organization and this becomes an extended part of them.

2.3 Relevance of OCOSS to community members

After having cleared the nature online communities of OSS and their relevance to open core companies, the next step is to further understand what motivates developers to form part of these communities. I will continue to explore the topics of commitment derived from intrinsic and extrinsic motivation, and the common roles of members in online communities in the context of OSS projects.

2.3.1 Motivations to participate

According to Roberts, Hann & Slaughter (2006, 984) it is evident that open-source software communities cannot exist or thrive without the support and contribution of motivated groups of developers who are eager to commit their effort and time to the community. However, the setting is far from traditional since these developers are frequently self-employed freelancers and not contracted employees. This means that the companies must then solve the question of how to not only motivate but also how to direct, sustain and influence the behavior of these needed individuals in their community when there is no employment relationship to manage them.

For companies or leaders of OSS projects that are trying to attract committed developers to participate, it is vital to understand what motivates them to take part in the community, what kind of motivation generates participation the most and ultimately how the level of participation is sustained. (Robert, Hann & Slaughter 2006, 985.) Currently there is no clear answer to what way of motivating is the most dominant in OSS communities. However, motivation has been classified generally as intrinsic or extrinsic. Intrinsic motivation is related to the basic human needs for control and competence, which means that the activities are likely to be performed because it is interesting enough on its own. Naturally, extrinsic motivation is something coming from outside such as rewards or enhancing the status or career opportunities. The bases for autonomous and motivated behavior comes from both intrinsic motivation and well-internalized extrinsic motivation. (Deci & Ryan 2000, 234, 237.)

In the context of OSS communities, several different intrinsic and extrinsic motivations for contributing to open-source projects have been identified. Often motivations are related to developers' personal interests, enjoyment, being part of a team and even respect towards a certain software functionality. Status often comes to play as well and that means

the more a participant is valued, the more they give to the community. Companies might also encourage participation by adding a more traditional motivative force to the table, pay. However, this is a demanding topic for commercial companies to solve, since while pay might be a motivation to some, the ones who are left out might feel less motivated to contribute. (Robert, Hann & Slaughter 2006, 984.)

The one highly important aspect that was revealed in Lakhani & Wolf's (2005, 10—12, 16) study, was creativity as a motivating force in open-source projects. Personal sense of creativity was also identified as having the largest positive impact on the hours worked per week. When programmers in the study were engaged in writing code, they reported losing track of time and described it as stimulating and as one of the most creative things they have done. Creativity is tightly linked to the top-reason for contributing, which is simply the intrinsic enjoyment. Close, in the second place in the study was improving programming skills, an extrinsic motivation. Third most important reason in participating in an open-source software project was feeling obliged to give back to the community that they self-identified to and for the tools it provides to the developers. Based on these observations, it is safe to conclude that there is a strong interplay between extrinsic and intrinsic motivation, and they can exist at the same time without one dominating the other. In fact, it seems that it is not exceptional at all to find out that an individual's motivation might contain a hybrid of both extrinsic and intrinsic factors.

2.3.2 Roles of members in OCOS

Related to the motivations of the participants, the community members also have different roles and ways of taking part in the community. In a corpus study conducted by Barcellini, Détenne & Burkhardt (2014, 215—216) they analyzed what kind of roles and profiles the participants have and in what kind of spaces these roles exist in open-source software communities. It is important to note that the roles should not be mixed with status that refers to the social rankings within communities or other social spaces. In their study, the definition of roles is linked to the activities that the participants perform and to the spaces that these behaviors occur.

Barcellini et al. (2014, 210, 222) mapped the roles in four different types. In their opinion, the roles are situated which means that they are dependent on time, semantics, and context. In their study, the participants are acting in two spaces that are either for

implementation or discussion as illustrated below (Figure 3). As the names suggest, discussion spaces like forums and chats are dedicated for discussions between participants and implementation spaces are for the actual production and documentation of code.

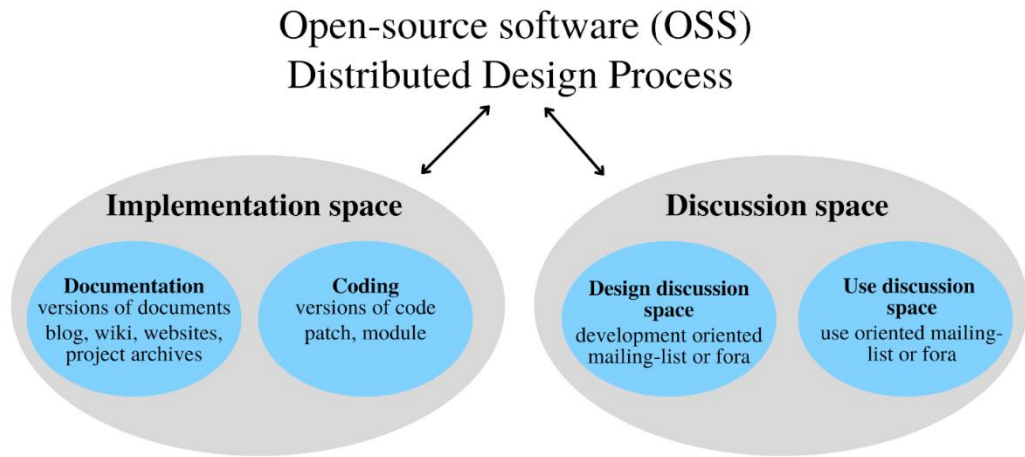


Figure 3. Distribution of open-source software (OSS) design process in discussion and implementation spaces. (Barcellini et al. 2014, 210).

The first role that they list is *the implementation role*, which means that the participant simply contributes to the design process in the implementation space. These contributions can be anything from code revisions to specifications. Other three roles are all *discussion roles* since they occur in the discussion space and are related to collaborative design processes. *Interactive role* is focused on the networking and communication aspect in the community. *Design-oriented role* means that the participant is focused on the design solutions and has an evaluating and clarifying approach. The last role they consider is the *group-oriented role* which is linked to coordination or management or the community or acknowledgement of other members. These roles can naturally be combined in one participant of the community, which is very relevant to note when analyzing the profiles of the key members of the community like leaders or super-experts. (Barcellini et al. 2014, 210)

2.4 Measuring the current performance of Online Communities of OSS

The aim of my study is to understand the sustainable growth of OSS communities but to get there, it is first crucial to understand what kind of methods the present theory uses to measure the participation of these communities, which evidently leads to the increase in value to community members (Spaeth, Haefliger, & Krogh 2008), and consequently the

success and growth of the open-source software project. Now, there are three main relevant views on the measurement that I am going to present in this chapter: the Onion core-periphery view, the new proposed model by Barcellini et al. (2011) and the BULB-Onion view.

Barcellini et al. (2011, 211–212) explain in their study that one of the most often used models of participation is the core-periphery hierarchy which is represented as a so-called onion-ring (Figure 4) or as a pyramid (Figure 5). According to them, all hierarchies are usually based on a distinction between contributors and users. Generally, the first layer is the passive users who do not participate in the discussion or implementation spaces of the OSS project, but they might observe and possibly even read the documentation and other online resources. What roles come after that layer in the hierarchy, are usually named after the development tasks that the participants contribute to. Jensen and Scacchi (2007, 1–2) illustrated both the onion-ring and the pyramid representations in their study. In the core of the onion-ring or on top of the pyramid, there are the core developers, program or module and quality assurance leads. The further down or away from the core you go, the less power the participants have to make decisions and more they lack the technical skills and power to contribute to the code.

Jensen and Scacchi (2007, 2) also focused their study on the fact that the roles of participation in OSS communities are not in like usual organizations where individuals move up the ladder towards a stronger authority. Participants in the OSS projects move closer to the core of the onion-ring, with higher decision-making power, and back to outer rings of the onion, or high up the pyramid and then back down more fluidly, which means that the organizational structure is far from traditional. In addition, it is not uncommon to see the participants move laterally to different tracks in the community involvement. As we know, OSS projects are usually volunteer-driven and how you advance in the project is usually a meritocratic process which means that the individuals need to prove their technical skills in accordance with their responsibilities. Another way to advance is of course to facilitate the work of others and this way, commit to the project also socially.

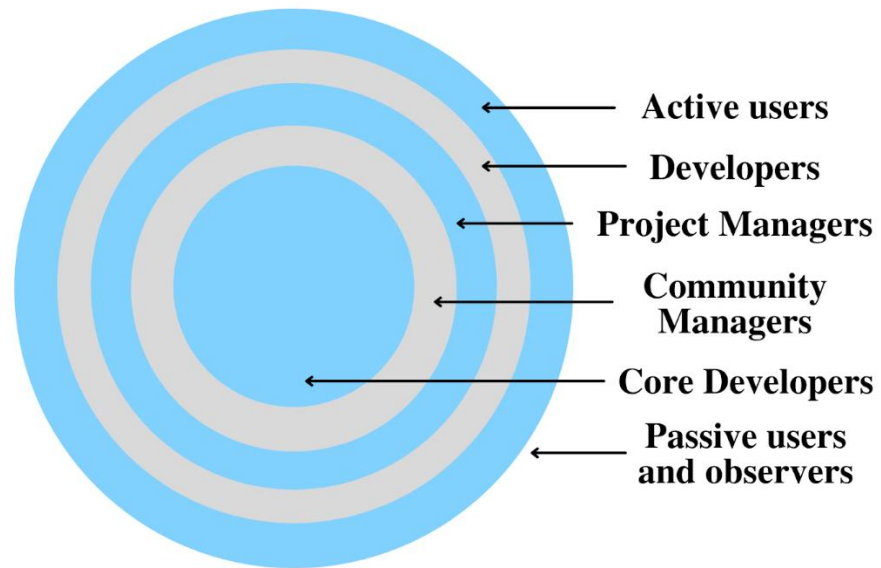


Figure 4. An 'onion' ring representing OSSD project organizational hierarchy. (Jensen and Scacchi 2007, 2).

Figure 4 represents the hierarchy of roles in an OCOSS with the traditional onion method. It portrays members with the highest ranking at the center of the onion, the core developers of the OSS project, who have the decision-making rights. On the outer ring or layer of the onion can be found those who are active in the community but lack the power to make decisions on the project and may not be contributing to the project with code.

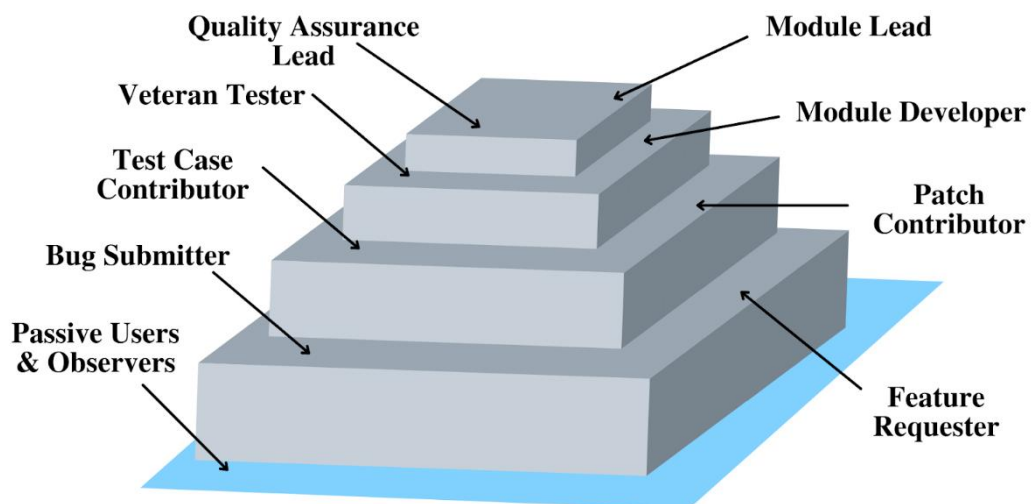


Figure 5. An 'onion' pyramid representing a generic OSSD project organizational hierarchy with multiple roles and progression tracks. (Jensen and Scacchi 2007, 2).

Figure 5 substitutes the traditional onion method with a pyramid, with the purpose to show how members' roles in a community can move vertically and horizontally, according to their participation throughout the project. Barcellini et al. (2014, 245—246) introduced an alternative view to the core-periphery model. They state that the original model offers a static view to the participation and is mostly concentrating on the implementation side (coding, fixing bugs) and not emphasizing on the different forms of participation in the discussion space. Their research suggests a few additions to the model to enrich it. The first point in the alternative model is to consider both implementation and discussion spaces when measuring participation. They also see that the participation is to be seen as both situated and as grounded in collaborative design activities. This signifies that the participation is related to a certain design problem and collaborative activities occur regardless of a participant's status in the community. They applied this enhanced model to their research on a Python (programming language) community, which led to a wider understanding of participation in both implementation and discussion spaces, and on the boundaries of them. According to the research group, participation purely focused on coding does not exist at all, but the participation is indeed a hybrid in both spaces and in between them. What is happening in the coding, documentation, and reporting side, is only a small piece of what is considered as OSS community participation.

Back in 2010, Kilamo, Aaltonen & Heinimäki came up with what they called the BULB method, which is built on the Onion-based model, originally described by Nakakoji, Yamamoto, Nishinaka, Kishida, and Ye (2002). The BULB method aims to measure a community by using an onion-shaped figure that encompasses different layers, with representations to measure two things: the size of the community and the activity level of members, both portrayed in the same *onion*.

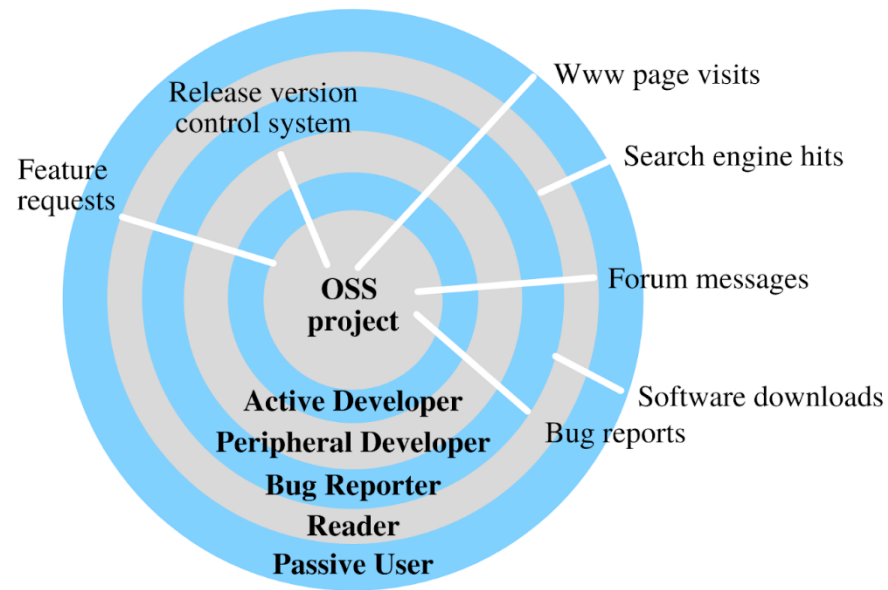


Figure 6. The data sources of the onion. (Kilamo et al. 2010, 3).

In Figure 6, the concepts in bold describe the different roles of members in a community, and the rest are the activities these members carry out in the community. According to Kilamo et al. (2010, 4) the traditional onion model cannot on its own describe how activity levels vary in different layers of the onion, which is precisely the reason why they decided to introduce the BULB method (see Figure 6 above). They argue that the size of the community may remain the same while the activity on different levels changes so a model should be able to illustrate this aspect accurately.

3 SUSTAINABLE GROWTH IN ONLINE COMMUNITIES OF OSS

3.1 What is sustainable growth in Online Communities?

According to Chang (2012) sustainable growth in business is defined as “the highest speed at which a business can grow without consuming its own financial resources”. While an online community does not carry its own financial resources, it does have to consider the resources members can contribute over a timeframe, possible limitations with the platform(s) in use, and in the case of a *sponsored community* (a community created and backed by an open core company), there are financial and human resources involved as well. Sustainability in the context of online communities with a social construct can be defined as the ability to “continue providing benefits for members over the long term” (Butler 2001).

Although there is a fair amount of research on success factors in online communities, including those in the OSS context, there is little over the implications of building a successful online community in the long term, or how to attain sustainable growth. One of the few studies, that specifically covers the elements of sustainability in OSS communities, dates to 2007 and it was conducted by Vainio, Oksanen, Vaden & Seppänen. They state (2007, 4 – 6) that when it comes to communities, sustainability can usually refer to the vitality of them and to their capability to adapt to the changes the environment poses to them. Vitality is also related to the fact on how well the community can fulfill its purpose or the reason of existing. Based on this definition they grouped community sustainability to four different aspects: social, cultural, legal, and economical. The social sustainability is related to the member profiles, division of its labor and the size and form of it. When there exist a variety of individual characteristics of community members in play, those can turn out to be either a risk or a benefit and it is hard to predict. According to the researchers, it seems like the open-source software communities follow the rough 20/80 rule from sociological research that 20% of the community members do all the work. If the community does not have a system for decision-making and solving conflicts, it is a clear risk from the social sustainability point of view because as the community grows over time, there are more technical decisions to be made and potential issues between members to be solved. (Vainio, Oksanen, Vaden & Seppänen 2007, 4 – 6)

Vainio et al. (2007, 6– 7) move from social to cultural sustainability, which are evidently tightly linked to each other. When members of the community first join and start the process of making their first contribution, they are faced with certain values, beliefs

and ethics that are connected to that community. The traditional hacker culture could culminate to the idea of free information, hands-on attitude and doing things for fun. As this culture now faces communities that have paid contributors, there is a certain clash that affects the sustainability of communities. While stability and credibility might increase, it also adds an unknown effect to the open collaboration if a company takes part in contributing, such as it is the case in the open core business model. There are also cases where most of the responsibility lies on the company and in that way, the risk to sustainability is significantly reduced. Some communities might somehow document the cultural traits and ideals of the project which support the cultural sustainability of the OSS community.

Surprisingly, legal sustainability should also be considered (Vainio et al. (2007, 7–9), and that is because over the years software has gained more and more economic significance and thus, increased legal and governmental interest. This environment forces open-source communities to also think about the legal perspective and strategy to tackle possible challenges to be sustainable. Some ways to solve these possible legal challenges are adding disclaimers, taking insurances, seeking legal counsel, patenting, licensing or even lobbying for a better environment for open-source software. The last part in the sustainability framework is economic sustainability. Something to note is that back in 2007, there was no clear conclusion and many of the companies were still experimenting with how the collaboration could work with the community, while still making a profit. It is still safe to conclude that the economical side does play a significant role in sustainability of the community when a company is investing or starting an open-source software project and paying members to contribute to the community work.

3.2 Success factors that influence Community Growth in OSS

There are many different factors that need to be taken into consideration when analyzing how the successful open-source software communities grow, and moreover, how they keep growing sustainably. Butler (2001) suggested the sustainability of online communities depends on two main factors: available resources for community members, and how those can be turned into both tangible and intangible assets for them. In a study conducted by López, Farzan, and Yu-Ru (2017, 7), they used past research on the topic to identify the aspects of community sustainability. According to them, sustainability can be characterized by three different categories: attraction, retention, and performance. By attraction they mean the ability to attract new members, retention signifies keeping the existing ones

and performance shows the capability to gather content and then consequently generate an impact in the community. (See Figure 7)

Engagement and participation have been boasted as the main drivers of successful online communities. In a study conducted by Leyton Escobar, Kommers, and Beldad (2014), they found that using genuine narratives, or storytelling, boosts participation of members in online communities. They also argue that narratives support building cohesive communities and can also be used to make a change in attitude between members. While the study was conducted using the Nerdfighter community, a community unrelated to OSS, storytelling has been documented as a powerful tool in diverse areas from education (Robin, 2008) to getting a competitive edge in business (Lazauskas, Snow 2018).

In a study conducted by Moran & Gossieaux (2010, 234–244) many critical elements for community success were listed. According to them, two of the most important elements that contribute to the community's effectiveness are the ability to connect with like-minded people and the ability to help others. Next in importance in the research results were the topic of the community and the facilitation of discussion and moderation of the community space. Related to the good facilitation, the community manager or team also needs to be skilled and qualified to do their job. When it comes to individuals, it is also important that the community members have fitting profiles and they have an ability to develop their skills by being part of the community. One of the findings Moran & Gossieaux made was that even after these success elements were identified by companies, there was still a disconnect between business goals for the communities and what the community teams were measuring.

Moran & Gossieaux (2010, 237–238) also introduced the concept of hyper-sociality which can help companies to better leverage their online communities and make them successful. It is no surprise that when the members of the community are united in the same platform with the same interest, they are going to interact and share stories with each other, which also requires an unusual level of sociality and new skills from the company and its marketers. Based on their research, they were able to identify four pillars of hyper-sociality that are being used by thriving community sponsors. They stated that instead of marketers focusing on individual traits of people, they should see them as a tribe that has certain behavioral traits. They also highlight that successful communities always put the members first, not the company. The core actions by the company should be to consistently help the members of the community and not the other way around. The third pillar is about finding the correct channel to engage with the members of the community

because in the networked world it is crucial that the message does not get lost in the networks. The fourth and final pillar is highlighting the importance of having a process for effectively engaging with the community. If the interaction is not planned and there is no process or policy for it, it becomes too messy. (Moran & Gossieaux 2010, 237–238)

López et al. (2017, 6—7) conclude in their study on identifying sustainability factors of hyper-local information systems that both offline context and the system design, that is the online context, are having a part in the role of sustainability. Of course, in the context of this study, the offline side is not relevant since the open-source software community members might not have an offline interaction with each other at all. In addition to the offline and system design perspectives, the researchers classified the factors of participation as collective or individual, which can also be connected to the open-source software context. To both levels, they included four comparable categories. Starting with the collective level, they divided the factors as community aspects (population size), online activity (tenure heterogeneity), social network (size and connectedness) and content (content distribution and online responsiveness). When it comes to the individual level, they included individual aspects (roles), network position (centrality), online activity (tenure) and content (type of content and level of online responsiveness).

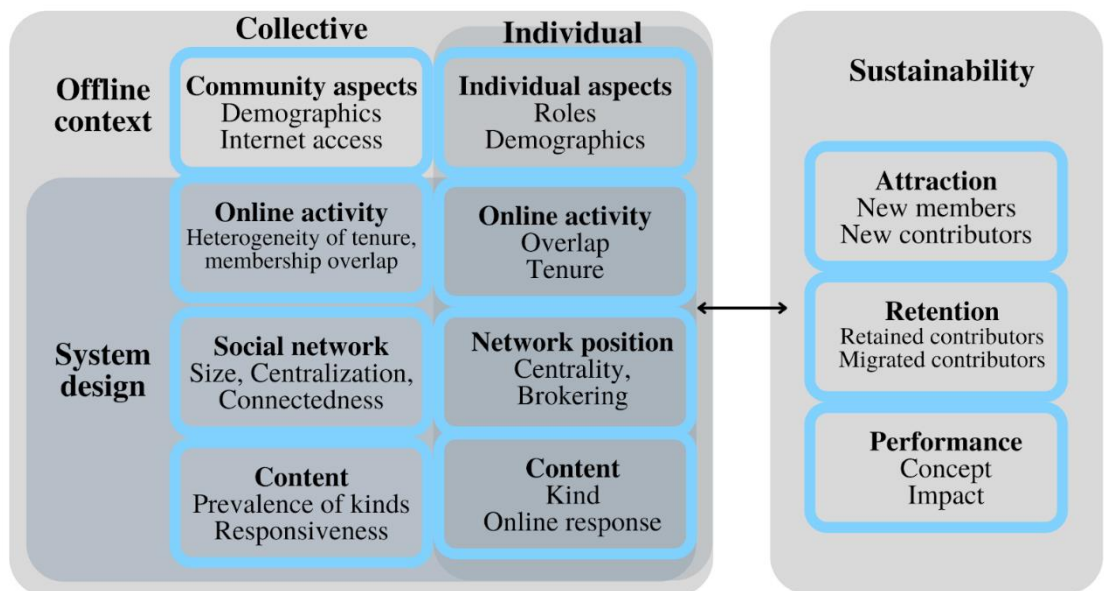


Figure 7. Measures to analyze sustainability of information systems for members participation. (López et al. 2017, 7)

After López et al. (2017, 8—9) had agreed on the structure of the analysis framework and the categories highlighted in the previous chapter, they needed to be able to measure the sustainability of the hyper-local communities, which is why they operationalized them into variables. They mapped out dependent variables related to attraction, retention, and performance. Attraction is measured by number of new members, number of new contributors and the proportion of them, retention is number of retained members, proportion of retained and migrated contributors and finally, performance can be measured by posts, productivity and change in productivity. Independent variables were then grouped into community aspects (size, diversity, instability, full access to Internet), online activity (membership overlap, heterogeneity of tenure) and social networks (size, connectedness, centralization). All these categorizations serve as a good base to understand the sustainability of open-source software communities even though they are not hyper-local. Regardless of the purpose and platform, similar ways can be used for example on how to measure the number of retained contributors or how the productivity changes. (López et al. 2017, 8—9)

In the article ‘A design theory for digital platforms supporting online communities’, the authors focused on the characteristics that make a platform of online communities ripe for sustainable growth, arguing the platform itself plays a big role in the sustainability of online communities. They identified what they called the three types of “social interaction structures”: information sharing, collaboration, and collective action. For information sharing, members create and share content in a spontaneous way, where participation is considered free and without formal rules and these contributions become resources for the whole community. Whereas in collaboration, rules and coordination are required among members, in the pursuit of a common objective. Finally, in collective action, the authors describe a yet closer collaboration between members, where the group behaves like one by reaching an agreement on how to proceed to reach a common goal, and group interests are put above individual ones. (Spagnoletti, Resca, & Lee 2015)

In a study by Fang & Neufeld (2009, 47) their goal was to find out what mechanisms are involved in sustaining the long-term voluntary participation in open-source software communities. According to them, OSS communities are distinctly oriented to contribution, which makes them special in the field of communities of practice. Their main finding was that OSS administrators can promote sustained participation by continuously rewarding and encouraging developers to contribute both conceptually and practically. As

a theoretical background Fang & Neufeld (2009, 13) used the Legitimate Peripheral Participation theory (LPP) which describes how situated learning, identity construction and participation are evolving simultaneously when a person is entering and engaging in a community of practice or in this case more specifically, community of open-source software. When digging deeper into their results, it is relevant to go through the figure below that visualizes the conceptual process model of sustained participation:

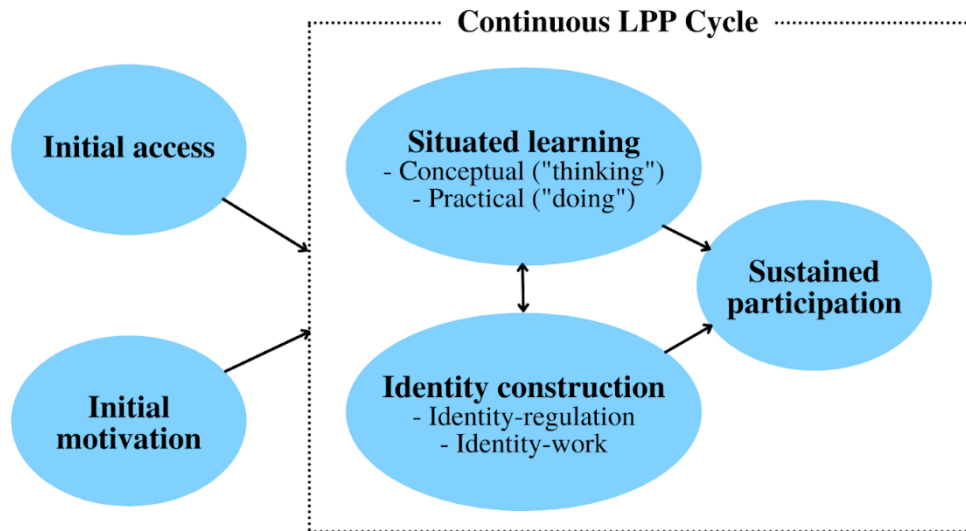


Figure 8. A conceptual process model of sustained participation in the OSS community - Legitimate Peripheral Participation theory. (Fang & Neufeld 2009, 26, 44.)

As demonstrated in Figure 8 above, initial motivations and access are necessary to first join the OSS community but are not enough to sustain the participation if the iterative LPP process does not follow. Regardless of the length of presence in the OSS community, the research found that one of the main initial motivations to join was the use value. In the context of the OSS community, situated learning is both conceptual like advising others and practical like coding. Developers' identities are then constructed through community recognition and self-perception. As this process of situated learning and identity construction is repeated and reinforced, participation and growth of the community can be sustainable. Additionally, it is relevant to note that to remain a long-term participant, the developers must arrive with the correct competences and be prepared to contribute consistently. Therefore, situated learning in an OSS community is not about learning programming skills but rather engaging with a community in a knowledgeable way and then, in the process, constructing their unique social identity. (Fang & Neufeld 2009, 26, 44.)

Bagozzi & Dholakia (2006, 1100) also discuss advocacy as a concept, because OSS projects rely on it. Developers not only contribute to code, but they also assist and help new users to become members of the community via user groups for example. Advocacy must arguably be one of the most important functions that support the continuous learning and the sustainability of OSS projects and communities.

A sense of community is one of the key concepts when talking about sustainably growing communities. McMillan and Chavis (1986, 9—11) listed down four elements that take part in building the sense of community: membership, influence, integration and fulfillment of needs, and a shared emotional connection. Membership is a sense of belonging, influence is about making a difference, integration is a feeling of having their expectations met and a shared emotional connection relates to the belief that the community members have and will share a history together. If the members have a strong sense of community and they are actively contributing and enforcing the collective culture, it means that they are at the same time influencing the group but also being influenced by the shared narrative of it. When the community members share common values and they identify with the shared history, the sense of the community will work as a cohesive force and boost participation.

A dissertation by Nissilä (2016, 2, 93) discusses open-source software's role in promoting scalability and sustainability. According to the study, OSS may lay a basis for a business ecosystem that supports the mentioned factors, because OSS products tend to have certain qualities like being able to be used without restrictions and the modifiable code. A study by Del Rocio Martinez-Torres (2014, 114) supports this idea, and according to her, it is a clear advantage that the source code is open, and everybody can access and review each other's work and learn from each other. Scalability and speed of development are clear attributes to the success of OSS projects.

To conclude, there are many different perspectives to success factors that influence the community growth such as sense of community, learning, advocacy, identity construction, correct platforms, scalability, nature of open-source software and networks. Success factors for community sustainability can also be analyzed at a collective or individual level or as part of attraction, retention or performance categories as highlighted in this subchapter.

3.3 Barriers for Sustainable Growth in OCOSS

It is evident open-source online communities cannot flourish and succeed in the long-term if there are no newcomers frequently joining the community and then staying and contributing to the projects. In this subchapter, I am going to highlight what barriers the current research identifies as the main reasons the communities are not growing sustainably.

In an extensive two-phased study conducted by Steinmacher, Gerosa, Conte & Redmiles (2018, 247), they aimed to understand the social barriers that the newcomers are faced with when they join a community and are planning to make their first contribution. In the first phase of their study, they made a literature review of existing research and collected data from practitioners. Based on their findings they were able to identify and create a model of 4 categories for social barriers. In the second phase of the study, they also created a portal that supported the newcomers in their onboarding to the community to test how the social barriers could be avoided.

All four of the social barrier categories (Table 2) they were able to identify were: reception issues, newcomers' communication behavior, newcomers' orientation, and cultural differences.

Barrier category	Barrier
Reception issues	Not receiving an answer
	Delayed answers
	Impolite answers
	Receiving answers with too advanced or complex contents
Newcomers' communication behavior	Not sending a meaningful or correct message
	English level
	Shyness
	Making useless comments in the mailing list or forum

	Low responsiveness
	Not acknowledging or thanking answers received
Newcomers' orientation	Difficulty finding a mentor
Cultural differences	Some newcomers need to contact a real person
	Message is considered rude

Table 2. Social barriers according to first timers and experienced newcomers. (Steinmacher, Gerosa, Conte & Redmiles 2018, 267)

When it comes to the second phase of the study, Steinmacher, Gerosa, Conte & Redmiles (2018, 257, 278) created a portal for the newcomer onboarding called *FLOSScoach* to evaluate its effect on the social barriers that were identified in the first phase of the study (see Table 2 above). Their conclusion was that the portal reduced the barriers related to communication by guiding the newcomers to the right means of communicating in the community and thus, reducing the uncertainties in interaction. However, communication issues that were related to limited skills in English were not solved by *FLOSScoach*. Based on these results, they even set out some guidelines on how to tackle these social barriers. According to Steinmacher et al. (2018: 278—279) it is important to answer quickly, make newcomers feel like they are part of a team, identify mentors or experts and create a newcomer-specific page.

A survey study conducted by Lee & Carver (2017) analyzed the barriers that one time code contributors face in Free/Libre Open-Source Software projects. This study is especially relevant to consider in the context of this study, because by understanding why one time code contributors (OTC) do not continue to participate in the community, we might find the core reasons that prevent sustainable growth in the OSS communities. According to Lee & Carver (2017, 194—195) the identified barriers that prevent the OTCs becoming long term contributors are time, process, entry difficulties and lack of knowledge. Lack of time can have an impact in many ways since it can be related to contributors' own resources, employers' demands or lengthy review processes. The process to submit code can also be too complex to learn which makes it a very clear barrier to even make the first contribution to a project. Entry difficulty barriers concern mostly the understanding of the open-source software project because sometimes the code is

poorly documented, project management is not clear, or the support pages are not helpful. Lack of knowledge is mainly related to the unfamiliarity with certain programming languages or bugs that are above the skill-level of a contributor.

One important attribute that emerges from the study by Fang & Neufeld (2009, 16) is the developer's status or identity in the community. In their study, they focused on understanding the sustained participation instead of one-time contributors or newcomers like the previously highlighted studies did in this chapter. According to them, if a developer does not receive recognition in the community, he/she will have fewer and fewer chances to engage in the community and thus, fail to build self-esteem and status. In other words, one barrier to sustained growth of an OSS community, is a lack of continuous recognition from peers.

4 STUDY DESIGN

4.1 Methodology and data collection

This thesis is an intensive qualitative case study aiming to provide a holistic and contextualized description and understanding of the chosen case from the inside out. The main purpose of a case study is for the researcher to first construct the case and then analyze and interpret it by focusing on the different viewpoints and experiences that are provided by the people, in this case the interviewees, involved in the study. With the results of a business-related case study, a researcher might be able to give directions on how to perform in a preferred way or how to avoid certain problems, at least in a particular business context or in an organization in question. (Eriksson & Kovalainen 2008, 116–117)

To further extend the current knowledge of sustainable growth in online communities of OSS, I decided to conduct several interviews with people working closely on building and growing OCOSS. The goal is to understand their stance on those characteristics upon which an open core company must consider ensuring a prosperous community in the long term, what are the challenges that impede sustainable growth, and what kind of actions they take daily and strategically to track progress, identify growth barriers, adapt to a constantly evolving community, and promote engagement.

The selected company as the case study is an open core company, which provides an open-source software platform to build web applications and offers several tiers of commercial products and services subscriptions to enhance their tooling. Over the years, their focus evolved from services only to a focus on subscription-based products, offered on top of their free core version of the platform. The company counts with a dedicated team to look after its Community, and they use communication platforms for their community that cover the most typical examples described in this study, which makes them a perfect case example of an open core company for the research.

The interviews chosen are the following:

- Subject 1 (S1): He currently holds the position of Community Manager and was chosen because he oversees the strategic decisions on how to improve the experience for community members, tracks the evolution of the community, and leads the Community team in the company.
- Subject 2 (S2): Part of the Community team, he holds the position of Developer Relations Manager (commonly known as DevRel). He has been directly involved

in working with the community for over six years, with activities such as presenting at live and online events, creating written and multimedia tutorials, advocating for the company platform, and has written books about the technology. He was chosen since he works closely with the community and used to be part of the community before joining the company.

- Subject 3 (S3): He is also part of the Community team, he has held the position of Content Marketer, with the main task of creating content to help the community thrive. He was chosen because he oversees finding and filling the gaps in guiding users to content, keeping them up to date, and making sure there is visibility of the company's new products.
- Subject 4 (S4): This person holds the position of Marketing Manager and oversees activities like tracking the product usage, conversion rates of free to paying users, following the trials of commercial products, the visibility of the company website by the number of visits and time spent. He was chosen because he leads the strategy for identifying community members who are interested in the commercial offerings, and he will provide an overall view from the Marketing perspective of growing a community.
- Subject 5 (S5): This person has not only been at the company for many years but has held the role of DX (developer experience) lead for the most part, whose job is to ensure the newcomers (as well as long-time users) have a seamless experience with the product. He also advocates for the company's community members by testing the products, following the onboarding paths, and making sure the developers have a good adoption experience. He was chosen because he will provide an overall view from the developer experience point of view, and the current (and past) struggles of newcomers.
- Subject 6 (S6): One of the Product Owners of the company, he has actively been part of the community by keeping in touch directly with its members through different channels, such as Twitter, Discord, and online events. He was chosen as he can provide a product development point of view on the importance of building a highly engaged community.

The interviews are going to follow the standardized open-ended interview approach which means that the wording of the 15 questions is the same for each six interviewees, but the participants can respond to them in an open-ended way. This approach allows the interviewees to go into details as much as they see fit and fully express their experiences

and the researcher is also able to ask questions to follow-up if needed. (Turner 2010, 756.) I chose this style of interviewing to have the flexibility to add follow up questions that will further uncover the objectives of this study. They will be conducted using Google Meet, and one and a half hours will be reserved for this. To provide the interviewees the opportunity to prepare for the interview, a list of topics will be shared with them in advance. The software Otter AI will be used to automatically transcribe the recorded interviews and will be then reviewed to correct any mistakes before the analysis. The account is protected by password and complies with the current regulations on data protection.

The questions will evolve around the two main research questions, with a focus on different themes or topics on each category. First, I will ask some foundation questions on their definition and understanding of what sustainable growth means in the context of online communities, and why they deem it important for (the company)'s community. After these, a series of questions will follow regarding the three main attributes for sustained engagement: members, communication platforms, and company's involvement. Finally, the last set of questions will try to uncover the main barriers according to the literature review: resources, communication, social, awareness, brand perception, and product development. The goal of the interviews is to find out what are the characteristics they deem more relevant for (the company)'s community, how they identify them, and how they act on them to aim for a sustainable growth in the community in the long-term.

4.2 Data analysis

My approach to the thematic analysis is loosely based on a six phased analytic process introduced by Terry, Hayfield, Clarke, and Braun (2017, 23). This approach gives space to different processes because it is not strictly linear but rather iterative. The first phase of thematic analysis is to familiarize oneself with the data, which already begins during the data collection, in this case the interviews. The second phase is about creating the building blocks for the analysis, which I started creating when making the sets of questions for the interviews. After going through the entire dataset with the building blocks in mind, the third phase consists in doing the preliminary construction of the themes. The next phases are then reviewing, defining, and naming the themes based on the preliminary idea. The final phase is to then produce the report that accurately communicates the most important findings of the data. I see that the groundwork for the themes and building blocks was already started for this study when I was planning the structure and questions

for the interview and going through the existing research during the literature review of this study, in the form of the operationalization table (see Appendix 2). But as stated earlier, thematic analysis can be iterative, and the main goal is to be able to answer accurately to the research questions.

4.3 Trustworthiness of the study

In all research, it is important to evaluate the trustworthiness of it throughout the study. According to Eriksson & Kovalainen (2008, 291, 295) it is a common challenge to the qualitative researchers to prove to their researcher readers that their study has a good quality and is trustworthy and scientific in its nature. They also introduced a concept of trustworthiness that can be separated into four different aspects: credibility, transferability, dependability, and confirmability. In this thesis, the dependability aspect has been covered by providing sufficient information about the way the study has been conducted. The standardized open-ended interview approach, all the interviewees and the data analysis method are all thoroughly described in the previous chapters to prove the logic behind the choices. By doing that, it also means that a similar study could be conducted, and the results would be somewhat comparable. Naturally, this is a case study of one company, and the chosen interview approach allows the six interviewees to express their personal experiences and thoughts. If the questions were asked from a different set of people in another company, the success factors, and barriers they have faced might also be different. The extensive literature review also makes sure that the results of this thesis add up to the current knowledge of the open-source software's online communities and their sustainable growth.

The credibility of the thesis consists of many aspects. The literature review goes through the characteristics of the online communities from different perspectives, their relevance, business model and the sustainable growth to be able to identify the relevant themes, compare my results to the previous knowledge and overall, justify the purpose of this study. The iterative six-phased analysis method that was chosen for the thesis to make sure that a report of the main findings would be as accurate as possible. In the conclusions, the main findings are being linked to the current knowledge by highlighting the aspects that are relevant to compare the results to. This work is part of the final aspect, confirmability. By putting the pieces together, the reader of the research should be able to easily

understand the results of the study and how it is linked to previous studies in the field.
(Eriksson & Kovalainen 2008, 295.)

5 MAIN FINDINGS

5.1 Relevance of OCOSS to open core companies and its community members

S1 introduced two key benefits of sustainable growth in OCOSS; scalability, which refers to the ability to leverage efforts with the help of the community, and credibility amongst other projects in the OSS ecosystem. Unequivocally, S2 added that a bigger community represents more business opportunities for open core companies, stating:

The equation is simple: the more people are talking about your technology and hence using it the more business opportunities you will get in the future.

(S2)

From the growth perspective, S1, S4 and S6 argue that the sustainability factor relies on support that the members receive from other members. S1 defines helping others as the core value that members provide to the community. As a secondary benefit S1 and S5 mention members also help the company to find and fix bugs for example, which improves the product. S2 agreed on this and goes further to define contributions as the centerpiece of not only product improvement, but also in the role of building a sense of community.

Both S1 and S6 mentioned that it is difficult to separate free and paying members in the community and argued they can be identified just as members of the community. S1 expressed trying to differentiate them makes for a ‘false dichotomy’. At the same time, both acknowledged that more paying members bring economic benefits to the company, while non-paying ones can provide value as well, making it easier to attract new members and paying customers.

There is a really big value in just having a large kind of active, vibrant community, because that, that makes it a lot easier for new people to kind of look at what is happening and a lot of people helping each other. (S1)

S2 and S4 focused on the OSS vs commercial offerings the company provides in the project. However, they reached different conclusions; S2 believes developers should have the possibility to do everything with the platform on their own, while having the possibility to enhance their experience with paid features. S4, on the other hand, believes in splitting members by their profile and went ahead to consider the managers or bosses of the developers who use the platform, as they often are the decision-makers on technology

adoption. This situation leads to believe developers who use the platform will always be ‘free members’ while their managers are paying for solutions on top of that OSS.

As highlighted by S1, S3, S4 and S5, the (the company) community is comprised mostly by members that work for enterprises and thus, are considered professional developers. S1 mentioned age related to the use of Java as a programming language and added the community may be getting an influx of younger developers with the introduction of the new software framework, which uses Typescript, a programming language considered to be more modern.

S2 focuses on the level of experience of community members to differentiate them, as well as their programming language preferences when it comes to using the framework 1 or 2. On the other hand, S3 separates members into those with an enterprise mindset focused on the numbers, and those who seek a bigger connection with the OSS tools they use. Similarly, S4 mentions members from a commercial point of view, divided by the profile of the company they work for.

S5 and S6 categorize community members in terms of their activity level in the community; and both define highly active members as “hobbyists” that either love the people in the community or feel deeply attracted to the technology from a technical point of view.

Interestingly, S1 mentioned hobbyists as members from a purpose point of view, referring to them as those who are not using the platform for a professional goal. While S5 and S6 make use of ‘hobbyists’ referring to those who are highly committed to the OSS projects, yet may also be participating in professional activities.

Ways to classify community members’ profiles	Proposed by:
Purpose: professional vs non-professional.	S1, S3, S4, S5
Activity: highly active (hobbyists) vs passive (consumers).	S5, S6
Experience: advanced vs beginners.	S2
Mindset: OSS vs commercial	S3
Company profile: small vs big company.	S4

Table 3. Ways to classify community members’ profiles, according to interviewees.

Table 3 shows the main ways to classify community members, as proposed by interviewees, using a dichotomous approach. Mainly, it was suggested to see members in

terms of their interests, who are either utilizing the OSS for professional purposes or just personal projects, and to see them by their current activity levels in the online community.

5.2 Factors that promote sustainable growth in OCOSS

The study has identified a list of themes that were frequently mentioned throughout the interviews as the main factors that promote sustainable growth in online communities of open-source software.

Unsurprisingly, *support* [SU] was identified as the most important factor by interviewees, as getting support translates to an increased perceived value of the community by its members. As S4 put it, for OCOSS the support that members receive for the product plays directly into the long-term success. It was mentioned throughout the interviews that OCOSS are highly technical communities, so getting enough support is crucial for all stages of members, from adoption to advocacy. Furthermore, support can be identified as the main value members perceive from a community and may lead the way to an uncomplicated path to advocacy.

“The sustainability of the product is related to how much support it gets from the community”. (S4)

Support, according to participants in the study, must emerge in many ways, such as having good documentation for different levels of expertise from getting started to advanced topics, having code examples, and getting replies in one of the communication platforms where the community is present. S1 went further to add a view on how the company should leverage its resources to provide support (see Figure 9) and explained the dedicated Community team inside the company should be the at the core, and work to activate the rest of the company members to participate in the community, and at last the external community, or non-employees, will in turn help other community members.



Figure 9. Representation of community support layers. (S1)

Lastly, all interviewees agreed that there should be a special process in place to help newcomers, although their emphasis on what is the most important had slight variations. S1 and S4 argued on the importance to guide new users by providing useful resources by email, and then help them through the chat platform. This guided interaction through the first steps of newcomers was defined as ‘hand-holding’ by S4. However, S2, S3, S5 and S6 brought forth a stronger attention on providing good self-service content such as getting-started instructions, and constant updates on new discussions where newcomers can ‘jump in’ regardless of when they join the community. Additionally, S6 mentioned the importance of providing a quick response to feedback or help requests from new community members, stating they should hear the company listens to their concerns and it is there to help.

Following the factor of support, and highly related to this, the informants reported that *engagement* [EN] and participation are the pillars of a community, because without them the community would not exist. Engagement involves an active community who reacts to the company’s activities and products, participates giving feedback, helps other members, contributes to the project, or simply interacts with other members. Something worth noting was the mention that participation relates to activities in the community from both members/users, and from the company employees who interact with members or each other in public communication channels.

It is just important that the existing community is active there, and responses come fast enough. (S6)

Feeling valued [FV] or recognized was identified from interviewees as one of the crucial factors not only to motivate members to participate and contribute but also to sustain this engagement in the long term. S2 made some strong remarks on how important it is to make community members feel loved in the sense of appreciated, while S6 agreed on the same idea by stating members need to feel valuable in the community in order to fully commit to it and went further to provide a personal example on his experience with another community to reflect that when someone does not feel he is needed, leaving the community becomes an easy step.

Having a good product was repeatedly mentioned by interviewees, with a strong emphasis on how it must solve a problem, however small, to differentiate in the ecosystem and gain track among other OSS projects. Therefore, *product improvement* [PI] was identified as crucial for sustainable growth in a constantly changing ecosystem as it is open-source software, as a product that is not evolving to cover the ever-changing demands of the ecosystem and its users is deemed to become obsolete and fail.

S5 provided a traditional point of view, in which the product plays the most important role to attract new people. He mentioned having a relevant solution for current problems is crucial for the adoption of the platform.

We must be relevant today; we have to be modern enough today. We have to be useful in some way for people to actually look and jump into the OSS project. (S6)

A *sense of community* [SC], also known as togetherness, a sense of comradery, fellowship, or we-ness, was mentioned as the amiability of community members towards other members, and the connection members make with one another. In other words, building relationships and feeling welcomed and accepted. According to participants' answers, building a strong sense of community develops other factors such as feeling valued and into the identification with the company brand, which leads people to engage more in the community.

Surprisingly, a *sense of ownership* [SO] was brought up many times by interviewees as an essential promoter of sustainable growth, explaining members become 'defenders' of the project and are more likely to continue participating and contributing once they contribute with code or in other relevant ways to the community. Although the sense of ownership factor is highly linked to 'advocacy', another success factor, it is mentioned on its own because both can be achieved independently from each other.

One tactic at least is to encourage them to be leaders, lead their own initiatives. In general, contributing, so they feel “I am part of this, this is mine.”

(S2)

Sustainable growth in OCOSS requires the ability to sustain this growth consistently over the long term, and *scalability* [SA] was identified as a foundation because it encompasses the ability to leverage existing resources and tools to continue serving the increasing community without decreasing the perceived value by its members (S1). This success factor was mentioned in several ways throughout the study, although participants shared a different focus towards achieving it. For some, scalability meant having the right processes in place to prepare for community growth, while others mentioned scalability as a tool to leverage existing community members to attract new members and support the existing ones. Lastly, one of the participants mentioned scalability merely as a result of community growth, explaining that the bigger the number of members in a community, the higher the chances are that other members will provide support. Overall, scalability was highly linked with the increasing need of resources to support new community members, be it that they are provided by the company or other community members.

A crucial step for any growth always involves *attracting new members* [AM]. In this study, newcomers were represented not only as future potential customers for the company, but also potential contributors to the project, supporters of the community who will help others, contribute to code, and even become advocates. A rapport found from their replies was the need to have collaborations with other communities, and how this leads to increased awareness and attracting new members.

Interestingly, interviewees had varied ideas on what the most efficient methods to attract new members are. S1 provided a foundation to attract newcomers: create educational content, create collaborations with other communities, and increase the visibility of the platform in external websites, such as Stack Overflow and external blogs.

S2 mentioned the most important to attract new members is to appeal to the emotional side of people, by having a ‘contagious enthusiasm for the technology’ when demonstrating its capabilities to potential users. Similarly, S3 believes that being an OSS project, the most important thing to attract new users relates to giving away free things, such as new content and ‘swag’, branded products with company logos such as t-shirts, stickers, etc.

What you try to do is to become contagious about your enthusiasm for the technology. (S2)

A more holistic approach was provided by S4, who mentioned several stages needed to attract new members, such as providing good documentation for those evaluating adopting the platform, creating special events to increase visibility, and then have a strategy in place to ‘remarket’ the existing solutions provided by the company, making use of ads to reinforce and promote company material. S5 on the other hand provided a traditional point of view, in which the product plays the most important role to attract new people. He mentioned having a relevant solution for current problems is crucial for the adoption of the platform.

This study identified that *advocacy* [AD] provides credibility to the community of an OSS and increases the awareness of it in the larger ecosystem. S6 introduced the concept of advocates, which are community members who become promoters of the technology and go beyond the average members activities to positively talk about the project and mentioned the key to attract new members is to keep the existing ones ‘super happy’ so they can convert into advocates. Advocacy also plays a bigger role in the factor of support, as advocates were mentioned to help other less experienced community members. Interviewees identified advocacy as the end goal for a community member, where their loyalty and identification with the brand is high, and they turn into evangelists themselves.

Visibility & awareness [VA] were common themes identified from the research interviews, usually in the context of an evident interdependency between technologies with other technologies in the ecosystem. A common view amongst interviewees was that the main promoter of awareness creation in the OSS ecosystem was creating collaborations with other communities. S4 mentioned as an example a successful joint webinar, while S5 shared examples on product integration with other communities helps to attract people to use the company platform, and lastly S6 used another experience in a tight collaboration with another community, in which both sides agreed to add documentation on the other platform, write join blog articles, etc.

“It is a matter of ecosystem. It is not only what you do, but it is what others do, and how you connect to that bigger picture.” (S4)

S1, on the other hand, provided an example that he called ‘as simple as being very reactive’ with members. Meaning giving them a quick reply on concerns, acknowledging their feedback, and fixing the most relevant issues for the community.

A general view on awareness was that collaborations with different technologies or companies have a big impact on positioning the company brand, attracting new members,

and increasing the visibility of the platform in the ecosystem. Secondly, a quick reaction to members' inquiries was mentioned as impactful.

The majority of participants agreed that *brand building* [BB] was a key for building sustainably growing online communities, as it relates to several other factors that promote growth, such as creating awareness in the OSS ecosystem, attracting new members, generating engagement, developing advocacy amongst members, and even creating a sense of community (S1). However, when asked about the relevant things to consider around brand building and the current state of community members' perceptions towards the company brand, answers from participants showed mixed results. There was overall a consensus that the messaging around the product and company were important for brand building, while some interviewees argued the company's current brand status was very positive, others reported a more negative view. Another thing that was mentioned in regard to brand building during the interviews was having a good product, and secondarily the idea that having good visuals (such as logos and slogans) helped to stand out in the ecosystem.

Clarifying the company on a brand level, the why of (the company) so that we have a very clear core message or a cause that were that are trying to achieve with (the OSS platform) and that is usually something that makes it a lot easier for people to associate with and start building a sense of unity.

(S1)

The findings of this study show how connected these success factors and challenges are with each other and indicate an interdependency that cannot be ignored when planning for sustainable growth in online communities. Moreover, the research shed light on the main activities that work towards underpinning these factors for sustainable growth in OCOSS. They are classified into four categories: members' activities, communication platforms, company involvement, and product & marketing.

5.2.1 Member's activities

Opinions differed as to how to identify ideal community members, and if it should be done in the first place. S1 explained this is currently done in an 'ad-hoc' way, where they see people who is active and try to foster them on a per-need basis. However, he expressed the need to build a 'community champion program' where they can have a process in line

for recognizing and supporting those highly active members that are most valuable to the community.

The more conventional marketing tools as product analytics were mentioned by S4, yet the biggest challenge he identified was the limitation on how these tools can be implemented for OSS products, and how open core companies may struggle to gather useful information from its users in comparison to the more traditional commercial (closed) software companies. S3, on the other hand, believes identification is not useful in the open core business model, and that the company should instead focus on sharing the right message on the right communication platforms.

Actions	Success factors it supports
Helping others.	SU, SA
Feedback from community members.	PI, EN
Contributions.	SC, SA, SO
Highly skilled members.	BB, PI, SU
Highly active and committed members.	EN, SA

Table 4. Identified actions from members' activities.

As summarized in Table 4, S1, S2 and S6 shared the most valuable members for the community are those who commit their time into the community, and S1 added these are usually developers who are passionate about software development. S5 partially shared this view on highly active members being the most important for the community's prosperity, yet he went ahead and added all members are needed for the community and none specifically can be identified as 'ideal'. S3, on the other hand, identifies the most valuable members as those who are highly skilled, as they increase the community's credibility and high-quality feedback in the form of bug reports.

5.2.2 Communication platforms

When asked about the characteristics in communication platforms that promote community engagement, S2 and S5 mentioned the need for several platforms to communicate, serving for slightly different purposes yet with the same goal: an excellent developer experience. The mentioned platforms are good documentation, an instant messaging platform, an indexable Q&A platform in which answers can be found from search engines, a

platform to provide feedback and report errors, and one to share code examples for specific uses.

They need great developer experience. That means not only having a great product, but something that is forgotten often; having a good documentation is key. (S2)

S3 took a different approach, stating it is important to have a platform where community members can communicate informally and with low barriers, and for them to ‘hang out’ so that communication happens naturally. This point of view brings into the picture the notion of having a sense of community, and it implies that conversations in these types of communities should also go beyond the OSS topics.

The replies from S4 and S6, however, present opposing views in relation to the importance of technical features provided by the platforms. S4 argued these platforms should provide easy ways to differentiate questions and answers between specific versions and to determine the quality of those answers. Contrarily, S6 reflects that these features do not play an important role for participation, and instead claimed a highly active community is the determining factor for other members to participate.

The interviewees were asked which communication platforms had been most successful for the company to promote engagement within community members. Most of them (S1, S3, S4, S5, and S6) seemed to agree that the technical forum had been one of the most successful platforms. One of the reasons they mentioned was the ability of this platform to index its content to search engines, which made it very easy for people to find answers to previously asked questions. Another reason that came up, was the control the company could have over this platform (see Table 5). However, they also mentioned a recent decision from the company to move from the self-hosted forum to Stack Overflow, a public Q&A platform. Interestingly, the two main reasons explained for this is that situation in the OSS community changes, and that (the company) was part of an ecosystem and they could not remain ‘isolated’ anymore.

In second place after the forum, an instant messaging platform such as a chat was mentioned to be important. S1 described it as an ‘inviting place... to join the discussion’, while S3 refers to it as a ‘hangout area’ and goes further to say the chat has been the most successful platform for the company. S5 also added other platforms where code sharing is more prominent, such as the directory and cookbook, as well as the documentation.

S1 was the only one to mention social media platforms as the most successful for the company and important for sustainable growth in OCOSS, and emphasized on the different purposes each of these has to reach different profiles, such as average developers, thought leaders, and decision makers.

Features	Success factors it supports
Adequate features in communication platforms.	SU, SC, PI
Indexable Q&A forum.	SU, SA
Instant communication platform.	SC, SU, EN
Moderation in communication platforms.	SU, SA

Table 5. Identified features in communication platforms.

While the original question to interviewees was around the evolution on the platforms when the community grows, changes in these communication platforms seem to be less relevant when it comes to scalability. S1 mentioned the importance of having more moderators, either internal or ‘community moderators’ to look after the discussions. S3 focused on the planification for growth, aiming to have all community members getting a reply to their questions. S4’s statement goes in line with the importance of people getting replies and mentions a special program to reward and motivate community members to help others might support growth. S6, on the other hand, considered growth as a solution itself to scalability, assuming community members will help each other, which results in less resources and involvement needed from the company.

If the community grows a lot, this kind of seeding that we have been doing in the past is not needed that much anymore. So, I think the community can then help itself at some point. (S6)

For communication platforms, one of the main takeaways from the study is the identified need to have different channels for communication that support the needs of the community, and a strong emphasis on having an indexed Q&A forum that facilitates finding replies to common queries.

5.2.3 Company involvement

A common view amongst interviewees was that ideally as many as the people working at the company should be interacting with the community. Two main groups stood apart in their responses; the Community team, which is a dedicated team of people at the company in charge of procuring community growth, and the Engineering or R&D team, who are in charge of product development and should interact with the community to improve the product using the direct feedback from the community, as expressed by S1 and S4.

Actions	Success factors it supports
Reward programs for highly active users.	FV, AD, SA, EN
Quick replies & acknowledgment.	FV, SU, AD, VA, EN
Collaborate with other communities.	AM, SA, VA
Contagious enthusiasm.	AM, SC
Giving away free things; swag, content, etc.	AM, SC, FV, EN
Hosting events for members.	AM, SC, PI, EN
Keeping existing members happy.	AD, AM, SC
Constant updates.	AM, SC
Praising contributions.	FV, EN
Engaged core development team.	PI, EN
Having a Rockstar developer.	VA, PI
Acting on feedback.	FV, PI, SO

Table 6. Identified actions related to company involvement.

Several different activities were provided in the context of company involvement in the community (see Table 6), with a strong focus on the need to have a proactive open core company for the community to thrive. Around those activities can be recognizing community members with reward programs or acknowledgements, having free branded products like t-shirts and stickers, and hosting live events for community members to gather, even if they are only virtual. On the reactive side, it was strongly emphasized by several interviewees that being quick to reply to comments and questions was vital, as well as acting on feedback by fixing things or acknowledging and implementing suggestions from members.

5.2.4 Product & marketing

A common understanding among participants was that the product, in this case the OSS platform, had a huge impact in the sustainability of community growth. Things like the quality of the product, the differentiation from other available products, and in particular the documentation, which was seen as crucial to promote everything from attracting new members to generating engagement in the community, were considered of high relevance (see Table 7). At the same time, the topic of having a clear message around the product and company was brought up frequently during the interviews, with a special consideration pertaining the high competitiveness of the ecosystem with many different options available to solve the same issues and the importance of positioning the product as open source, even though the company also offers commercial products and services.

Actions	Success factors it supports
Having a unique product	BB, VA, AM, AD
Effective promotion and marketing	VA, BB
Having good documentation	AM, SA
Special support for newcomers	AM, SU
Having low (or none) barriers to contribute	EN, PI
Being genuine	EN, BB
Having resources for students and low skilled members	SA, SU, AM
Having a clear company message	BB, AM
Having a common enemy	SC, EN

Table 7. Identified actions in the product & marketing area.

Interestingly, an action that was exhortated up by S3, was the use of storytelling to build a sense of community within members by creating a narrative of having a common enemy. In other words, making use of communication and marketing to position the company values including those things the company stands against.

5.3 Main challenges that hinder sustainable growth in OCOSS

The main challenges identified by interviewees can be grouped into five categories. Communication barriers were widely mentioned (see Table 8). A lack of resources in time, documentation, and skills (see Table 9) was also commonly referred to. In third place are the brand misconceptions, which seem to impact mostly those outside of the community and therefore impede attracting new members (see Table 10). Several issues were identified by interviewees regarding the brand image in the OSS ecosystem, and the challenges to properly position the company and technology. Thus, engagement of members in the community is hurt by these challenges, and the findings of this research imply issues in the brand building also affect the sense of community, and the awareness of the company in the broader OSS ecosystem.

5.3.1 Communication barriers

Over half of those interviewed reported that communication barriers were the most challenging in terms of sustainable growth for OCOSS, and something that stood out from their replies was the vast array of places where communication issues can occur. Being an online community used globally, language barriers were naturally mentioned, as well as having a slow-paced communication due to big time differences between members. In addition, finding the right communication channels and opportunities to reach big audiences alongside having the right messaging that resonates with members were seen as challenging (see Table 8).

Identified issues, challenges, or barriers	Success factors they affect
Inconsistent messaging	AM, BB
Not advertising ways to participate	EN, SO
Slow-paced communication	SU, EN, SC
Language barriers	SU, AM, SC
Finding big audiences to spread the word	VA, AM
Balance between free vs commercial messaging	EN, AM, BB

Table 8. Identified Communication barriers

One concern regarding the communication from the company with the community was finding the right balance between free and commercial approach. Being an open core company, this balance was presented as something hard to achieve and delicate at times yet crucial for sustainable growth of both the community and the business.

5.3.2 Inadequate resources

Amongst the challenges of inadequate resources, informants reported that the main concerns evolved around a lack of time to support the community by answering their questions and paying the sufficient attention to the contributions (see Table 9 below), and a lacking documentation in areas such as guidelines to contribute. Secondly, it was recognized the difficulty to identify the satisfaction of members with the product due to limited product usage analytics being their main product an OSS platform, and how that further limits their understanding of market trends and needs, and the overall product improvement as well.

Identified issues, challenges, or barriers	Success factors they affect
Lack of time	SU, EN, AD
Lack of attention and low prioritization of contributions	FV, EN
Hard to find a place or platform to contribute	PI, EN, SO
Lack of guidelines to contribute	PI, EN, SO
Low quality contributions	PI, SO
Limited product usage analytics	PI

Table 9. Identified challenges in Resources.

Although it was not included in the table above, one participant also added that a lack of enough human resources could be a contributing factor to hinder sustainable growth, with a focus on the complex skillset needed from these people to provide value to a highly technical community such as those of OSS.

5.3.3 Brand misconceptions

Several issues were identified by interviewees when asked about the way people outside of the community perceives the company. For S1, the company has not communicated clearly the ‘why’ or the reasons behind the company’s actions, which makes it more difficult for people to associate themselves with the company as a brand, and therefore fixing this would facilitate newcomers to join the community. This view was echoed by another interviewee, S2, although with a different notion of the missing message to communicate. For S2, the company has some place for improvements when it comes to making it clear to understand what they offer, or the ‘what’ of their platform. There was also a negative comment by S3 concerning the aggressive approach in marketing and messaging the company uses, which harms the notion of OSS and scares potential community members away.

S3 went further to provide a way to tackle the challenges on different messaging provided by a number of people and departments in the company and explained the need to have a funnel where all people end up seeing the same ‘core’ message, which according to him it should answer to a specific problem all of them can identify with, and only then try to direct them to a different kind of message according to their profile.

S4 and S6 presented a different view, in which the technology/platform can be seen as outdated by outsiders. S6 explained this is in great part due to some past mistakes from the company that involved heavily promoting the use of another technology in their platform, which is now deprecated (out of use) in the OSS ecosystem, and some people continue to associate the company platform with this, even though that technology is no longer used by the company.

Lastly, S5 identified some perception issues in the platform brand by stating the highly specialized developers, which he defines as the ‘DIY guys’, often find the platform to be ‘too opinionated’. In other words, the platform can be seen as inflexible and making too many decisions for its users, thus it becomes a challenge to get them to adopt this technology.

Identified issues, challenges, or barriers	Success factors they affect
Negative comments in public communication channels	BB, AM, EN
Misconceptions of the brand	BB, AM

Unclear company values and value proposition	BB, AM, EN
Perception of technology being too specialized	AM, BB

Table 10. Identified issues in Brand Misconceptions.

5.3.4 Social challenges

Some challenges that were mentioned by interviewees in fewer occasions were those in Social issues (see Table 11), such as conflicts between community members. However, two of the interviewees weighted on the difficulty to motivate company employees to be active members in the community and mentioned this had a high impact in the community support. S6 emphasized this as the main challenge for community growth, which indicates the community relies not only on motivating the users of the platform, what are commonly referred to as community members, but also the internal community members; employees who work directly or indirectly with the product and/or services.

Identified issues, challenges, or barriers	Success factors they affect
Low motivation in company employees to participate in the community	SU, EN
Frustration between highly experienced members towards less experienced	SC, EN, AM, SU
Conflicts between members	SC, AM

Table 11. Identified Social challenges.

While the overall perspective was that social challenges such as conflicts among members were limited and not the most impactful, one of the interviewees added that these differences in opinions and preferences were needed for the community to grow, as having ‘too much homogeneity can kill growth’ (S5). It was also noted by S1 that most of these conflicts were a result from members coming from other communities, which were not friendly with each other, independently to the company’s community.

5.3.5 Challenges in product development

Lastly, product development issues were part of the discussion (see Table 12), where the main pain points relate to the involvement of the community into the decision-making process, and the consequences of an inefficient process, which impacted negatively all the stages of the members' journey in the community. From the company side, it was mentioned that having an inflexible roadmap (see Table 12 below) was a major hurdle for the community, as it often meant the company cannot follow the requests from the community, or that it was not capable of changing direction quick enough when needed. On the same note, a lack of openness from the company regarding the product development plans was also identified as a risk for community growth, due to surprising changes not being welcomed or accepted by community members, especially those that require a big effort to adopt.

Identified issues, challenges, or barriers	Success factors they affect
Inflexible roadmap	EN, PI
Difficult to identify valuable opinions	PI, FV, EN
Lack of openness from the company	EN, BB

Table 12. Identified challenges in Product Development.

Whilst participants mentioned the importance of getting feedback from community members to identify market needs and improve the product, it was also identified as a challenge to establish which of those opinions or suggestions were more relevant to maximize members' satisfaction, mainly because the different use cases of the OSS platform among members vary greatly and the options in the OSS ecosystem for using different technologies when programming are vast, making these suggestions often very diverse and sometimes contradictory.

6 CONCLUSIONS

6.1 Theoretical contributions

The aim of this research was to unify the previous studies on the success factors of OSS projects, growth of online communities, and sustainable growth, to provide a foundation of the current understanding on sustainable growth in OCOSS. At the same time, a special emphasis was given to uncover the present theory around the relevance these online communities provide to both community members and the open core companies.

This research confirmed the statements by Riehle (2012) on how online communities help in several areas of the company, such as sales, marketing, product management, engineering, and support, as these were repeatedly brought up during the interviews in different ways. It validated as well how important these communities are for the business success of open core companies, proving this business model heavily depends on building an online community around the OSS product.

The most obvious finding to surface from this study is that support in online communities of OSS leads to an increase of perception of value from community members and leads to the sustainable growth of said community. The observation related to the value the communities provide for members is aligned with previous studies and for example Moran & Gossieaux (2010, 234) highlighted the ability to help others as one of the most important elements of successful communities. Closely related, engagement was identified by the literature as one of the main determinants of communities' success and value (Riehle 2012, 6) and the opinions of the interviewed experts were in line with this. On a third place, product improvement was an extremely important factor to drive growth. Riehle (2012) identified product improvement as a benefit from having an engaged community, in what he expressed as 'product management' derived from bug reports and code contribution, and 'engineering' that is benefited from a constant influx of feedback from the community. Nevertheless, interviewees identified that having a good product is a foremost factor of sustainable growth. This leads to infer product improvement is both a benefit and a promoter by itself, from and for online communities of OSS.

More surprisingly was the reliance community growth in the long term has to making its members feel valued and providing them with the possibility to feel an ownership of both the community and the product. It supports the current theory provided by Robert, Hann & Slaughter (2006, 984) that claims the more valued members in the community

feel, the more likely they are to participate. While the feeling of ownership was introduced by Pierce et al. (2001, 304) and how it plays into the psychology of community members for a stronger identification with the company. The findings of this study extend our previous understanding of the relevance of this concept by portraying how deep it runs into the inner motivation of community members to contribute and advocate for a community, especially in the long term.

The relevance of challenges such as communication barriers and inadequate resources also contribute to the theory, with some of the concrete actions surrounding communication being found to be in line with the study from Steinmacher et. al (2018, 267), and added the challenges that a global setting of the online community adds to the mix, such as time difference, slow-paced communication, among other concerns. Inadequate resources were previously explored by Lee & Carver (2017, 194—195), and the data from this research confirms the lack of time, skills and resources to contribute play a big role in dampening community growth.

While this study confirmed the importance of recognition and the feeling of being valued in an online community, previously suggested by Fang & Neufeld (2009, 16), despite its exploratory nature, it did not find the empirical evidence of how this lack of recognition impacts the engagement of community members and the subsequent hinder to sustainable growth in OCOSS.

6.2 Practical contributions

The list of uncovered factors that promote sustainable growth in online communities of open-source software can serve as a framework for companies to analyze how these come into play in their own community and according to their communication platforms, and to further create a strategy to take stock of their current processes for each of the factors and ways to measure progress in community growth. Complementary, the categories of both growth promoters and challenges along with the actions to consider may be used as a foundation of examples for their action plan.

Considering the level of complexity in open-source software projects can vary substantially, open core companies are advised to regard that while support is arguably the most valuable factor for members of OCOSS, the types of support that members regard as more valuable can also differ greatly from project to project. However, a good starting

point when creating a strategy for sustainable growth is to examine the state of the documentation and the possible shortcomings of the same. Secondly, open core companies must ensure the communication platforms they encourage or endorse do not limit the community's potential to contribute, and instead facilitate participation and engagement. Thirdly, it is suggested to look further into the notion of making community members truly feel valuable, as this not only creates loyalty and possibly stimulates advocacy, but it may also play a bigger role in creating value for community members as a whole, and therefore promoting sustainable growth of the online community.

6.3 Study limitations and recommendations

This is a relatively small case study that was conducted based on one company in the OSS ecosystem using the open core business model, and the collected data is limited by the views and experiences of the people interviewed. A larger study including a bigger sample of different companies in the ecosystem would further expand and test the current findings of this study, preferably interviewing the community managers on those organizations, to continue to deepen the understanding of sustainable growth in OCOS by leveraging their direct experience on working closely with the community.

An advantage this study provided to create a foundation of the key elements related to sustainable growth, was to interview people in different positions who interact directly or indirectly with the community, which ensures they had a considerate grasp on the topic, while also providing a different point of view according to their main activities and responsibilities in the company. They shared indispensable insights related to their interactions with the community and helped to create a broad understanding on the ways a community provides value to the company and to its members.

This study relied heavily under the premise that sustainable growth is significantly influenced by the engagement and participation of members in an online community, however, another research approach would be to consider engagement as merely a consequence of existing value in the community and focus instead on uncovering value creating factors that led to that result. Another possible approach would be to procure a holistic view on the customer journey of community members and examine what are the main activities that impact their decision-making process during each stage, such as adoption (or joining the community), staying in the community, becoming a community advocate, or when they decide to leave.

A very interesting finding is the roles that feeling valued/recognized and the sense of ownership play in the long term within community members. More scrutiny in the progression of those feelings during the different stages of community membership would further bring value to online brand communities, as well as facilitate the development of customizable reward programs according to the perceived values of their members.

A topic that came up during the study was the challenge of balancing between the free and commercial offering and messaging that comes from the open core business model. No strong evidence was found of this directly influencing the community growth, thereby it was left out of the study. Nevertheless, finding future implications of the right balance for revenue sources and other considerations for the open core business model would greatly benefit these types of organizations.

7 SUMMARY

Open core companies rely on building an online community, as the members of it represent potential contributions to the project, support for other members, and ultimately potential customers. The aim of this case study is to provide the company's point of view and add the long-term element to the growth of online communities, which relates also to their sustainability. The main objective of thesis is to better understand the nature and relevance of online communities, both for the open core companies and the community members, and to find the factors that promote sustainable growth, as well as the main challenges that hinder it. The literature review unifies the previous studies on the success factors of OSS projects, growth of online communities, and sustainable growth, to provide a foundation of the current understanding on sustainable growth in online communities of open-source software (OCOSS). At the same time, a special emphasis was given to uncover the present theory around the value these online communities provide to both community members and the open core companies.

The research questions are:

- a) What is the nature and relevance of online communities of OSS?
- b) What are the main factors that drive sustainable growth in online communities of OSS?
- c) What are the barriers for sustainable growth in online communities of OSS?

This qualitative case study was conducted by collecting empirical experience from employees of an open core company who oversee the community growth, and it was performed using the standardized open-ended interview approach and a six-phased thematic analysis. The research verified the value OCOSS bring to open core companies, in the areas of sales, marketing, support, and product improvement. In terms of relevance of these communities to its members, the study confirmed that support plays a major role in the perception of value, whilst it extended the current understanding that factors like feeling valued, and a feeling of ownership, provide to the engagement of members in the community and the ensuing sustainable growth.

The findings of the study identify four categories that comprise the most relevant actions towards building sustainable growth in OCOSS: member's activities, communication platforms, company involvement, and product & marketing. Oppositely, the main

barriers that hinder sustainable growth were identified as communication barriers, inadequate resources, brand misconceptions, social issues, and challenges in product development.

The study limitations pertained to the research being conducted solely on employees from one open core company, and further recommendations were given to pursue in future research such as verifying how these found factors apply to different communities, looking into these factors from a holistic view around the community members' journey, and exploring the implications of the feelings of ownership and being valued, and how these affect the likeliness of members to participate and stay in the community.

REFERENCES

- Barcellini, Flore – Détienne, Françoise – Burkhardt, Jean-Marie (2014) A Situated Approach of Roles and Participation in Open Source Software Communities. *Human-Computer Interaction*, Vol. 29 (3), 205–255.
- Best Version Control Hosting Software (2021) G2. <<https://www.g2.com/categories/version-control-hosting>>, retrieved 3.2.2021.
- Boon, E. – Pitt, L. – Salehi-Sangari, E. (2015). Managing information sharing in online communities and marketplaces. *Business Horizons*, 58(3), 347-353.
- Brian S. Butler – Patrick J. Bateman – Peter H. Gray – E. Ilana Diamant (2014) An attraction-selection-attrition theory of online community size and resilience. *MIS Quarterly*. Vol. 38 (3), 699–728.
- CBInsights (2019) The Future Of Open-Source Software: How The \$33B Industry Is Changing The Way Software Is Developed. <<https://www.cbinsights.com/research/report/future-open-source/>>, retrieved 4.5.2021.
- Chang, Y. (2012) “Strategy formulation implications from using a sustainable growth model”. *Journal of Air Transport Management, Elsevier*. Vol. 20 (C), 1–3.
- Christian, J. (2020) SpaceX sent Nasa astronauts into orbit using Linux software – Another win for open source software. <<https://futurism.com/the-byte/spacex-nasa-astronauts-linux>>. retrieved 1.2.2021.
- Cohen-Almagor, R. (2013) Internet History. In: *Moral, Ethical, and Social Dilemmas in the Age of Technology: Theories and Practice*, ed. by R. Luppigini 19–39. Hershey, USA.
- Bagozzi & Dholakia (2006) Open-Source Software User Communities. *Management Science*. Vol. 52(7), 1099-1115.
- Discourse Alternatives & Competitors (2021) G2. <<https://www.g2.com/products/discourse/competitors/alternatives>>, retrieved 3.2.2021.
- Deci, E. L. – Ryan, R. M. (2000) The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psych. Inquiry*, Vol. 11 (4), 227–268.
- Del Rocío Martínez-Torres, M. (2014) Analysis of activity in open-source communities using social network analysis techniques. *Asian Journal of Technology Innovation*, Vol. 22 (1), 114-130.

- Eriksson, Päivi – Kovalainen, Anne (2008) *Qualitative methods in Business Research*. Sage Publications. London
- Fang, Yulin – Neufeld, Derrick (2009) Understanding Sustained Participation in Open Source Software Projects. *Journal of Management Information Systems*, Vol. 25 (4), 9–50.
- Getting “freemium” business model right: Key to remarkable success or a costly trap? (2017) *Strategic Direction* Vol. 33 (9), 16–18.
- Hammedi, W. – Kandampully, J. – Zhang, T. T. C. – Bouquiaux, L. (2015) Online customer engagement: Creating social environments through brand community constellations. *Journal of service management*, Vol. 26 (5), 777– 806.
- Iskoujina, Z. – Ciesielska, M. – Roberts, J. – Li, F. (2017) "Grasping the business value of online communities", *Journal of Organizational Change Management*, Vol. 30 (3), 396–416.
- Jensen, C. – Scacchi, W. (2007) Role migration and advancement processes in OSSD projects: A comparative case study. *Proceedings of the ICSE 2007 International Conference on Software Engineering*. IEEE Digital Library.
- Kilamo, Terhi – Aaltonen, Teemu – Heinimäki, J. (2010) BULB: Onion-Based Measuring of OSS Communities. In: *6th International IFIP WG 2.13 Conference on Open Source Systems, (OSS)*, May 2010, Notre Dame, United States. 342–347.
- Lakhani, K. – B. Wolf (2005) Why hackers do what they do: Understanding motivation and effort in free/open source software projects. In: *Perspectives on Free and Open Source Software*, ed. by J. Feller, B. Fitzgerald, S. Hissam, K. Lakhani 1–27. MIT Press, Boston, MA.
- Lazauskas, Joe – Shane Snow (2018) *The Storytelling Edge: How to Transform Your Business, Stop Screaming into the Void, and Make People Love You*. 1st edition. Hoboken, New Jersey, Wiley.
- Longmate, Elisabeth (2003) *Analyzing the development, management and growth of integrated digital communities*. Doctoral thesis. The University of Birmingham, Birmingham.
- López, Claudia – Farzan, Rosta – Lin, Yu-Ru (2017) Behind the Myths of Citizen Participation: Identifying Sustainability Factors of Hyper-Local Information Systems. *ACM Transactions on Internet Technology*. Vol. 18 (1), 1–28.
- Mcmillan, David & Chavis, David. (1986). Sense of Community: A Definition and Theory. *Journal of Community Psychology*. January 1986 (14), 6–23.

- Moran, E. & Gossieaux, F. (2010). Marketing in a Hyper-Social World: The Tribalization of Business Study and Characteristics of Successful Online Communities. *Journal of Advertising Research*. 50. 232–289.
- Muniz, A. M. – O'Guinn, T. C. (2001) Brand community. *The Journal of Consumer Research*, Vol. 27 (4), 412–432.
- Nakakoji K. – Yamamoto Y. – Nishinaka Y. – Kishida K. (2002) Evolution Pattern of Open-Source Software Systems and Communities. In: IWPSE'02 Proceedings of International Workshop on Principles of Software Evolution. ACM Press, 76–85.
- Nissilä, J. (2016) *Promoting Scalability and Sustainability of ICT4D Projects Using Open Source Software*. Turun yliopisto. Turun kauppakorkeakoulu.
- Ofek, Eli – Matthew Richardson (2003) DotCom Mania: The Rise and Fall of Internet Stock Prices. *Journal of Finance*, Vol. 58 (3), 1113–1137.
- Ortiz-Ospina, Esteban (2019) The rise of social media. <<https://ourworldindata.org/rise-of-social-media>>, retrieved 1.2.201.
- Pierce, J. L. et al. (2001) Toward a theory of psychological ownership in organizations. *The Academy of Management review*. [Online] Vol. 26 (2), 298–310.
- Posey C. – Lowry P. – Roberts T. L. – Ellis T. S. (2010) Proposing the online community self-disclosure model: The case of working professionals in France and the U.K. who use online communities. *European Journal of Information Systems*, Vol. 19 (2), 181–195.
- Raleigh, N.C. (2019) Red Hat Reports Fourth Quarter and Fiscal Year 2019 Results. Press releases. <<https://www.redhat.com/en/about/press-releases/red-hat-reports-fourth-quarter-and-fiscal-year-2019-results#:~:text=Full%20fiscal%20year%202019%20total,15%25%20measured%20in%20constant%20currency.>>, retrieved 1.2.2021.
- Riehle, Dirk (2012) The single-vendor commercial open course business model. *Information Systems and e-Business Management*, Vol. 10 (1), 5–17.
- Roberts, Jeffrey – Hann, Il-Horn – Slaughter, Sandra (2006) Understanding the Motivations, Participation, and Performance of Open Source Software Developers: A Longitudinal Study of the Apache Projects. *Management Science*, Vol. 52 (7), 984–999.
- Robin, R. Bernard (2008) Digital Storytelling: A Powerful Technology Tool for the 21st Century Classroom. *Theory into Practice*, Vol 47 (3), 220 – 228.

- Schwab, Leila – Gold, Stefan – Kunz, Nathan – Reiner, Gerald (2017) Sustainable business growth: exploring operations decision-making. *Journal of Global Responsibility*, Vol. 8 (1), 83–95.
- Spaeth S. – Haeffliger S. – Von Krogh G. (2008) Communal resources in open source software development. *Informationresearch*, Vol. 13 (1), 1–24.
- Spagnoletti, P. – Resca, A. – Lee, G. (2015) A Design Theory for Digital Platforms Supporting Online Communities: A Multiple Case Study. *Journal of Information Technology*, Vol. 30 (4), 364–380.
- Stack Overflow for Teams Alternatives & Competitors (2021) G2. <<https://www.g2.com/products/stack-overflow-for-teams/competitors/alternatives>>, retrieved 3.2.2021.
- Stanoevska-Slabeva, Katarina – Schmid, F. Beat (2001) Typology of Online Communities and Community Supporting Platforms. In: *Proceedings of the 34th Hawaii International Conference on System Sciences*.
- Steinmacher, I. – Gerosa, M., Conte, T. U. – Redmiles, D. F. (2019) Overcoming social barriers when contributing to open source software projects. *Computer Supported Cooperative Work (CSCW)*, Vol. 28 (1), 247–290.
- Terry, G. – Hayfield, N. – Clarke, V., & Braun, V. (2017). Thematic analysis. In W. Stainton Rogers, & C. Willig (Eds.), *The SAGE Handbook of Qualitative Research in Psychology*, (17–37). (2nd). London: SAGE Publications.
- Turner, D. W. (2010). Qualitative Interview Design: A Practical Guide for Novice Investigators. *The Qualitative Report*, 15(3), 754-760.
- Vainio, N. – Oksanen, V. – Vaden, T. – Seppänen, M. (2007). Elements of Open Source Community Sustainability. (*OSS2007*, Limerick, Ireland, June 2007).
- Widenius, Michael – Nyman, Linus. (2014) The Business of Open Source Software: A Primer. *Technology Innovation Management Review*, Vol. 4 (1), 4– 11.
- Whoson (2021) The difference between synchronous and asynchronous messaging. <<https://www.whoson.com/our-two-cents/the-difference-between-synchronous-and-asynchronous-messaging/>>, retrieved 4.5.2021.

APPENDICES

Appendix 1. List of interview questions for the research

Main questions	Follow-up questions
1a. How would you define sustainable growth in OSS communities?	1b. Why is it important for online communities like your company's?
2a. What are the most typical profiles of members in your Community?	2b. What kind of value do they provide to the company and the community?
3a. How would you describe ideal community members in terms of their engagement?	3b. How do you identify and foster those ideal members for community growth?
4a. As an open core company, what is the right balance between free and paid members to benefit both the community and the company?	
5a. What do you do to attract new members?	5b. How do you support newcomers in your community?
6a. What makes members contribute and stay in the community?	6b. How do you promote and sustain engagement in the community in the long term?
7a. What characteristics do you look for in communication platforms for your community?	7b. In your experience, which communication platforms have proven most useful to promote participation in the company's community? Why?
8a. If the community grows, how should these communication platforms evolve?	8b. Do you have some examples?
9a. How does the company interact with the community?	9b. Ideally, who in the company should interact with the community?
10a. What kind of resources do you have to work with the community? (i.e., time, skills, people, money, priority for the company)	10b. What other resources would be needed ideally?
11a. What challenges have you faced when interacting with the community?	11b. How do you identify and tackle these challenges?
12a. In your experience, how do you create a sense of fellowship or togetherness in the community?	12b. What kind of social/relationship issues have you identified in the community?
13a. What are the most important things when it comes to building awareness in the OSS ecosystem?	13b. Do you have some examples of actions you take to create awareness in the OSS ecosystem?
14a. How do you think the company is perceived as a brand inside and outside of the community?	14b. Have you identified issues with brand perception?
15a. How does the company involve community members in product development?	15b. What issues arise from this involvement (or lack of)?

Appendix 2. Operationalization table

Research questions	Themes	Interview questions
What is the nature and relevance of OCOSS?	Definition	1a
	Relevance	1b
What factors promote sustainable growth in OCOSS?	Members	2a, 2b, 3a, 3b, 4a, 6a
	Platforms	7a, 7b, 8a, 8b
	Company involvement	5a, 5b, 6b, 9a, 9b
	Resources	10a, 10b
	Communication	11a, 11b
What are the barriers that hinder sustainable growth in OCOSS?	Social	12a, 12b
	Awareness	13a, 13b
	Brand perception	14a, 14b
	Product development	15a, 15b