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Open Source Software Licenses Impact on Businesses

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The authors declare that they are the sole authors of this thesis and that they have not used any sources other than those listed in the bibliography and identified as references. They further declare that they have not submitted this thesis at any other institution to obtain a degree.

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Abstract

Open source licensing has a significant impact on the choice of business model for companies in the software industry. Permissive open source licenses provide greater flexibility in commercial use and distribution, while restrictive licenses limit revenue generation potential. Understanding the nuances of different open source licenses and complying with licensing requirements is crucial for companies seeking to navigate the complex world of open source licensing and maximize the benefits of open source software. Companies that can successfully navigate the complex world of open source licensing and business model choice can achieve competitive advantage and long-term success in the software industry.

The objective of this thesis is to examine the impact of open source licenses on businesses and delve into how they can shape the choice of utilizing open source software, as well as their implications for business operations. We conduct a literature study and complement it with an empirical study to provide a more complete understanding of the subject. The empirical study enables us to fill in the gaps in our research and compare and validate our findings.

Our findings demonstrates the significant impact that licenses can have on a business, highlighting the importance of understanding them for those utilizing open source software. While our results show that the use of open source software does not necessarily limit monetization, there can be restrictions on how products can be monetized. We discovered that the multi-licensing model, which combines an open source license with a proprietary license, can be a viable option for navigating these restrictions.

Keywords: Open Source, Licenses, Business Model, Businesses

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Contents

Chapter 1

Introduction

1.1 Open source software

Open source software refers to computer software whose source code is available to the public for anyone to view, use, modify and distribute [30]. What this implies is that the software is not owned by any individual or organization and that anyone could freely access it. This concept of open source software is a movement which emerged in the 1980s [24] and the philosophy behind the movement is the belief that software should be freely available and that users should have the rights to modify and distribute it without any restrictions.

Open source software is usually developed by a community of developers who collaborate and share their code. This development approach can make the quality, stability and efficiency better than proprietary software development [31]. This type of development can be used in a wide range of applications, from operating systems such as Linux, databases as MySQL or web developments.

One key benefit of using open source software is the flexibility of it. Users are able to modify the code to meet their own specific needs or add features that the original software did not have. This can be very useful for businesses that require customized software solutions. Another benefit is that open source software is based around being free of use so the cost is often cheaper to use than proprietary software and can benefit businesses that are either small or have a limited budget [25].

While open source software offers numerous advantages, it is not without its drawbacks. Companies that adopt open source software may encounter challenges such as limited support and potential security risks [13]. Since the source code is accessible to anyone, it can be scrutinized for vulnerabilities that could be exploited by malicious actors.

1.2 Open source software licensing

Open source software licensing is a critical component of the open source software movement, as it defines how the software can be used, modified and shared [30]. Different licenses have different requirements and restrictions which can have a significant impact on a company's revenue generation potential.

Some licenses permit commercial use and distribution, which means that companies can use the software in their products and services and sell them for a profit. Other licenses may however impose limitations on how the software can be used or

require that any modifications to the software is to be released under the same license [17]. This could impact companies ability to monetize their software, as they may not be able to sell it under a proprietary license or charge for certain features.

Understanding open source licensing is crucial for the software industry as more and more are turning their attention to open source software to power their own products and services. Because of this it is important to carefully review the license terms of any open source software they use or contribute to, to ensure that they follow the licensing terms and do not infringe on any intellectual property rights or any copyrights [21].

1.3 Business models in open source software

For every business they need a way to generate revenue. How this is done with open source software is something the developers need to consider. As discussed in [31] the industry has found ways to go around these decisions. The developers would need to consider if they want their revenue through selling support for the software [23,30,31] which would be a more of a service business model. Among the companies that follow this approach are Red Hat and Ubuntu, which offer paid support services to businesses and organizations [33]. Companies could sell a product based solely open source software's which would be a product that is tailored for the customers needs. Another popular approach is to provide their product with a multi-licensing model. Under this model the product is both released as an open source software license but also under a commercial license so the user could pick the license they want to use [30]. As the commercial license version is a pay to use product they often have features that are not available in the open source version, making it an attractive option for businesses that require additional functionality [28, 32]. Examples of companies that adopt this approach include MySQL and Sleepycat, which offer various licenses depending on usage [33].

One approach is for developers to generate revenue by selling support services for their open source software, which revolves around providing assistance to users of the software [19, 23, 26, 30, 31, 33]. This business model can be advantageous as it allows developers to build strong relationships with customers by providing high-quality support services.

Another approach is to sell a product that is based solely on open source software. This approach involves tailoring the product to the specific needs of customers, ensuring that it meets their requirements. By focusing solely on open source software, developers can provide a product that is free from licensing issues and is fully customizable [31].

While the approaches discussed so far are often referred to as for-profit models, there are also non-profit models that businesses can consider [31]. At first glance, it may not seem like a desirable option, but non-profit models are not designed to generate revenue from the software itself. Instead, they can be used when a company wants to ensure that the open source software they rely on is not monopolized by other businesses. Alternatively, the software may be necessary for the company to run its own services.

One non-profit model is the community-driven model, where the software is de-

veloped and maintained by a community of volunteers who contribute their time and skills [27, 31]. While this model does not generate revenue, it can be beneficial for businesses that require open source software as it ensures that the software remains available and up-to-date.

Another non-profit model is the foundation model, where a foundation is established to support the development and maintenance of the software. The foundation can be funded through donations, grants, or other means, but the software remains free and open source. This model can be attractive for businesses that rely on the software but want to ensure that it remains accessible to everyone [31].

1.4 Value

As described in [26, 30], it is important to understand the appropriate open source software license to utilize when starting up a project with the goal of achieving business success. The choice of license could limit the options of business models and being unaware of them could hurt the developers with legal actions or the business success. This could also hurt the future possibility with relationships for a community which is a great way to create software of better value [26, 28]. The purpose of this research is to understand how the choices of licensing and business models can impact the developers when they use open source software in their projects. The goal is to find out how the licensing can affect the choice of business models to use and provide insights of factors to consider when making the choices.

We believe with the help of our research questions and study that the insight of this will be greatly improved for anyone considering using open source software in their businesses, and also help them pick a business model fit for their needs. This is because our study specifically investigates the impact of licenses and their usage in businesses, providing valuable insights into the relationship between open source licensing and business model choices.

Chapter 2

Related Work

Prior to our research we have found that there are similar work that has been done. While they have not connected the topics we research together that we provide in our study they do have information that have contributed a lot in our research in different aspects. The articles that have been of most value are the following articles.

2.1 Matching Open Source Software Licenses with Corresponding Business Models [26]

This article explores how the choice of open source license can impact the business model of software companies and the broader dynamics of software ecosystems. As the use of open source software has become increasingly widespread in recent years, there is growing interest in understanding how open source licenses affect the choice of business model. The article analyses different factors that influences and affects the license decision. These factors are Externalities, Motivation creation, Leadership and Company size.

This article provides valuable insights on the importance of open source licensing and its impact on business models. Although the article's focus is on the decision-making process leading up to the selection of an open source license, it contains relevant information that is applicable to our work, which centers on the implications of open source licensing choices.

2.2 Open source software publishers' business models: the strategic role of licenses [28]

This article discusses the strategic role of software licenses in shaping business models. It goes into detail dividing licenses into categories and how they are related to revenue capture and value creation. The article describes and analyzes how popular business models adheres to these categories.

This is related as it provides valuable information about how open source licenses are used to generate revenue or create value of the product and shows how it could impact the decisions of using certain licenses in their products.

2.3 Single-Vendor Open Source Firms [32]

This article delves into the topic of business models and how they can be utilized by companies to achieve their goals. It examines various strategies, including marketing, sales, and product management, and how they can be leveraged to generate revenue. The article also explores different income-generating models, including non-paying models where companies rely on software and community support rather than generating revenue directly from the software. This piece of literature is relevant to our research as it sheds light on how various methods and models can be employed to generate revenue and how this may affect the use of licenses.

2.4 The Innovations of Open Source [31]

This article explores open source licenses and license compliance, including the copyleft practice and the permissive Apache Way license. It also discusses the impact of these licenses on the economic aspects of companies that use them, such as costs and revenues. The article also touches on various business models that utilize these open source licenses. As this topic is highly relevant to our research, this article provides valuable insights into how these licenses are used and their potential impact on businesses.

2.5 Toward a Framework for Implementing Open Source Software in Public Administrations: Legal, Economic and Societal Aspects [30]

This article introduces various types of licenses and discusses their use in businesses. It covers Copyleft, Permissive, and Multi-licenses, providing examples of programs that use them. The article also mentions the most popular licenses in each category, according to research by Black Duck Software in 2012 [14]. Additionally, the article explores some of the costs of open source software and its economic aspects. This topic is relevant to our study, as it can help us answer our research questions and understand the potential impacts of open source licenses.

Chapter 3

Method

This section introduces our research questions and outlines our research methodology, including our literature review and empirical study. We also identify potential risks to the validity and reliability of our research.

3.1 Defining research questions

After considering how we could find value of our thesis study we have constructed three research questions we believe would be of great value to understand the relationship between open source licensing and business model choice. Our aim is to provide answers to these questions by conducting data collection through our literature study, followed by our empirical study. By exploring how licenses influence the decision to adopt open source software and the long-term success of businesses we can gain insights into the factor that businesses should consider when making these choices. This can help inform decision making processes and potentially lead to a more effective use of open source software in businesses. These are the research questions we have constructed:

- **RQ1:** How do open source licenses influence the business model choice of software companies?

The purpose of this question is to investigate whether open source licenses have any impact on the choice of business models. While we believe that they do have an effect in some cases, we aim to research the extent of this impact or whether our assumptions are incorrect.

- **RQ2:** How do open source licenses influence the decision of software companies to adopt open source software?

This question is intended to gather information on whether and how different types of licenses impact a company's decision to use open source software. Our current knowledge on this topic is limited, so we are looking to explore the potential effects of licenses on adoption of open source software.

- **RQ3:** How does the open source licenses affect the long-term success in businesses?

This research question was formulated to explore how open source licenses affect the long-term success of businesses. Given our expectation that licenses may have some influence on businesses, we aim to investigate how these licenses can impact the long-term success of businesses.

3.2 Literature study

For our literature study we decided to do our primary search on IEEE Xplorer using IEEEs database for our articles of study. While we used that as our primary source we have also be doing some searching on other search engines such as Scopus, Google Schoolar and Google to get more basic knowledge about the topics we were interested in during our research. For the former we were using a search string containing our main focus which is "open source software", "license" and "business model". With this we were able to get a limited amount of results who all contain the focus for our research in some way. The main string we used in our literature study on IEEE Xplorer was: "open source software" AND "business model" AND "license*"

This string provided us with 42 results with conference papers, magazine articles and a few journal papers. We decided to use all of these in our selection of materials as we find that conference papers and journal papers are done by experts in their fields and are either peer-reviewed or done with the purpose of presenting at a conference. Magazine articles will be included as we had identified that some of the articles in our results are published by IEEE and should therefore have a foundation of legitimacy for our research.

To help us with if the articles are relevant for our research we laid out some pre-requirements to find if an article would be relevant or not for us. Those requirements were:

- It should be found from our string
- The abstract should be talking about open source and business models
- The abstract should be talking about open source licenses
- The abstract should contain any information that could relate to those.

While these requirements were not specific enough we thought it would provide us with a similar result in the end and make sure we do not miss anything that could help us with our research. The ones that matched our requirements and we thought were relevant from the abstract would be included while the ones we could not really tell would be reviewed further by looking through the text in the introduction and more if necessary. After both of us had listed the articles we found relevant we then compared our results with each other to determine our agreement level. The result provided us with 19 articles in total that we both found relevant for our topic or that could provide us with some information for our research. Where we also had 10 other articles that one of us had found some relevancy and after both had reexamined them we decided to keep 6 of them so our end result was 25 articles in total. The final result can be found in the appendix list A.2.

As we began our initial literary study by reviewing 25 different articles that we found through our search. Both of us then read these articles, and we created a set of questions to use as guidelines for our data extraction to ensure that we collected the necessary information in a consistent manner. These were straightforward questions designed to guide us in understanding our requirements, rather than imposing any restrictions on our extraction process. Here are some examples:

- What licenses are commonly used in open source software and why?
- Are there any connections between the choice of open source license and the business models?
- For what type of software is open source software used?

In addition to these questions, we included other information that we thought would be useful in answering our research questions. As we progressed with our research, we identified specific subjects where we required more information, such as specific licenses. To obtain this information, we searched the internet for legitimate sources of the subjects.

3.3 Empirical study

We recognized that a literature study alone may not provide us with a comprehensive answer to all of our research questions. Therefore, we opted for an empirical study to supplement our research and gain more hands-on experience on the subject matter, allowing us to fill in gaps or validate our findings.

3.3.1 Interview structure

Our study included interviews with three knowledgeable individuals from different regions of Sweden. Although the small number of participants is a limitation in terms of our validation, we believe that their backgrounds and expertise in the industry provide valuable insights that are relevant to our research questions. It should be noted that the questions were sent to the participants prior to the interview to ensure that they were able to answer the questions from their company's perspective. The participants were selected by reaching out to two software companies that we had previous contact with if they had someone that would be willing to be interviewed regarding our topic. The companies then chose individuals who possessed expertise in our topic to serve as our interview subjects.

The interviews were structured to serve two main purposes. Firstly, to confirm the participants' expertise and knowledge in the topic area, we asked questions such as:

- What is your background regarding open source software and their licenses, as well as businesses within this area?
- Are you aware of the licensing for the open source software when you use it?

Secondly, we aimed to gather firsthand experiences and insights related to open source licenses. The following questions were designed for this purpose:

- Do you use open source software's in your products, and if so, why?
- Are there certain types of businesses that tend to prefer one open source license over another? Why?

- Have you ever had to change your business model in order to accommodate an open source license? If so, can you describe that process?
- What open source licenses have you used in your business, and why?
- Have you seen any cases where the choice of open source license had a significant impact on the success or failure of a business?

Additionally, we sought their personal opinions on the matter, with questions such as:

- What open source licenses do you typically look for when evaluating software for your business?
- Do you have your own open source software products, and if so, how did you decide which open source license to use when releasing the product?
- Do you think certain types of open source licenses are more sustainable in the long term than others? Why or why not?
- Looking back in time, is there something that you would change or evaluate more, in regards to the business with open source software?

Through these structured interviews, we aimed to gather comprehensive insights into participants' expertise, experiences, and opinions related to open source licenses and their impact on business models. All the interview questions can be found in the appendix A.1.

The interview was conducted using a qualitative approach to establish a more personal connection with the participants. We conducted three interviews, one of the interviews was conducted in person and the other two over Zoom calls. The interviews lasted between 20 and 30 minutes each and the answers was written down by us and was also confirmed after the interviews that it was a correct interpretation. This approach also facilitated follow-up questions when needed. We analyzed the results by documenting the interviews and answers obtained from the participants.

3.3.2 Thematic Analysis

After conducting the interviews, we proceeded to analyze them using thematic mapping. In conducting our thematic analysis, we employed a systematic approach to examine and analyze our interview data. Our primary objective was to identify meaningful similarities and patterns in the participants' responses that would contribute to our research analysis.

To achieve this, we initially engaged in the process of coding. We carefully reviewed the interview data and assigned codes to segments of text that shared similar ideas, concepts, or experiences. These codes served as building blocks for our thematic map, enabling us to organize and structure the data in a meaningful way.

Building upon the codes, we then derived overarching themes that encompassed and described the identified patterns in the data. The themes we identified include experiences with open source licenses, business model and licensing choice, use of

open source software, long-term success and intellectual property, success and failure, and licensing impact on business models.

We deliberately selected these themes as they were central to our research objectives and addressed specific gaps in the existing literature of our research. Each theme offers unique insights into the participants' perspectives, experiences, and challenges related to open source licenses and their impact on business models.

By adopting this systematic approach, we aimed to gain a comprehensive understanding of the interview data. Our thematic analysis also allows us to address our research questions effectively while filling the gaps in the literature study.

3.4 Validity and reliability

One potential risk on the validity of our empirical study is that we sent the questions to the participants prior to the interview. This could lead to more polished and rehearsed answers, compared to if they were interviewed without prior knowledge of the questions. However, we have confidence in the credibility of the answers given by our participants, as we believe they are trustworthy and capable of providing honest responses.

As described in our method we believe that having both a literature study and empirical study gives us a much better validity for our research. By conduction a literature we were able to gather existing knowledge and research on our topic, which helped us provide context and support for our research. The criteria we set out for our selection of articles ensure that the literature we gathered were relevant for our research questions. Additionally our empirical study which included multiple interviews with knowledgeable personnel provided us a more personalized and firsthand perspective of the relationship between open source licensing and business model choices. While a wider perspective with a survey for a more responses could have been used, we believe that interviews with experienced personnel within the topic are a better match for our research.

Furthermore we see our research questions as well-defined and focused which have allowed us for a clearer understanding of our objectives of the research. The research questions have allowed us to explore the different licenses and how they impact of businesses. It allowed us to also explore what licenses exists and how they are adapted in the development of open source software environment to have a long-term success for a business.

Chapter 4

Results and Analysis

In this section, we will examine the outcomes of our literature review and data extraction, which provide valuable insights for addressing our research inquiries. The findings of our empirical study are presented as a thematic analysis. With these findings we then analyse it and try to answer our research questions.

4.1 Literature study results

In this study, we examined the different categories of software licenses and their restrictions. We found that software licenses can be divided into three main categories: free open source licenses, proprietary licenses, and hybrid licensing [28]. The most common licenses that we have found can be located in 4.1.

4.1.1 Free open source license

For a license to be classified as free according to the GNU Operating System [18], there are four essential freedoms. These freedoms say that for a software to be free they need to be free for the user to run as they want, the code should be open for study and modification as the user wants, the freedom to redistribute copies to help others and the freedom to distribute copies that are modified versions of the original. However, these licenses may have requirements that any derivative works created from the original software must be released under the same or a compatible open source license. Examples of free open source licenses include the General Public License (GPL), Apache License, and MIT License.

4.1.2 Proprietary license

Proprietary licenses, on the other hand, are more restrictive and usually require licensing fees to use the software. These licenses typically give the owner of the source code exclusive rights to distribute and modify the software, while end-users are usually restricted from redistributing or modifying the software without approval from the owner [16]. Examples of proprietary licenses include Microsoft Windows and Adobe Creative Suite.

License Group	License	Description
Free and Open Source	MIT License	A permissive license that allows the use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the software [10].
	GNU General Public License (GPL)	A copyleft license that requires derivative works to be licensed under the same terms as the original work [7].
	Apache License	A permissive license that allows the use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the software, as well as providing an express patent license [4].
	BSD 3-Clause License	A permissive license that allows the use, copy, modify, and redistribute of the software, with some additional conditions [1].
	Mozilla Public License 2.0	A copyleft license that requires derivative works to be licensed under the same terms as the original work, with some additional conditions [11].
Proprietary	Microsoft Office License	A license that allows the use of Microsoft Office software for a fee, and may have restrictions on copying and distribution [9].
	Adobe Creative Photoshop License	A license that allows the use of Adobe Creative Photoshop software for a fee, and may have restrictions on copying and distribution [2].
Hybrid	PostgreSQL License	A permissive license that allows the use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the software, with some additional attribution requirements [8].
	Common Development and Distribution License (CDDL)	A license that allows the use, copy, modify, and distribute the software, with some additional restrictions on patent and trademark rights [5].
	Eclipse Public License (EPL)	A permissive license that allows the use, copy, modify, and distribute the software, with some additional requirements for contributions and modifications [6].

Table 1. Groups of licenses based on their restrictions

4.1.3 Hybrid license

In certain situations, a standard open source license may not suffice. Some products require a license that allows certain open source aspects to thrive while restricting users' rights in other areas. These licenses are known as hybrid licenses and are considered non-free open source licenses by L. Muselli [28]. They can not be classified as free open source licenses because the limitations placed on user rights are too restrictive, but could still be compatible with the free open source requirements that they are free to use for anyone.

4.2 Multi-licensing

As described by Irena Petrijevacanin Buksanovic and Bojan Sudarevic [30], multi-licensing is a type of software licensing model that combines elements of both free and proprietary licensing. This approach allows software developers to offer two or more versions of their software under different licensing terms. For instance, some

aspects of the software can be open source and available for use, modification, and redistribution without restriction, while other aspects can be proprietary and subject to restrictions. The Mozilla Public License (MPL) is an example of a license that allows developers to use the open source code from one product and combine it with proprietary code without much complexity as long as the original open source remains under the same license [11].

4.3 Thematic Analysis

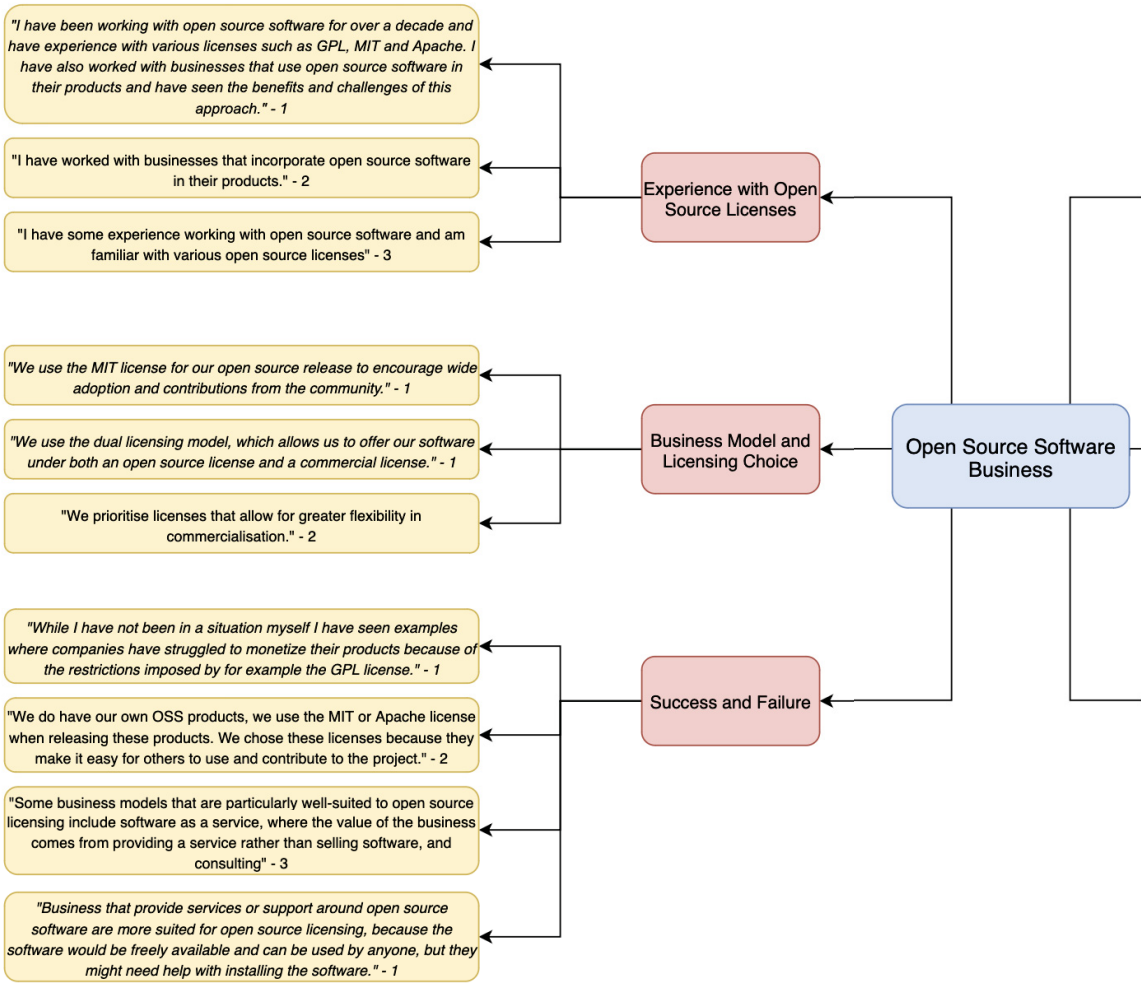

Figure 1. Thematic map of conducted interviews, view 1.

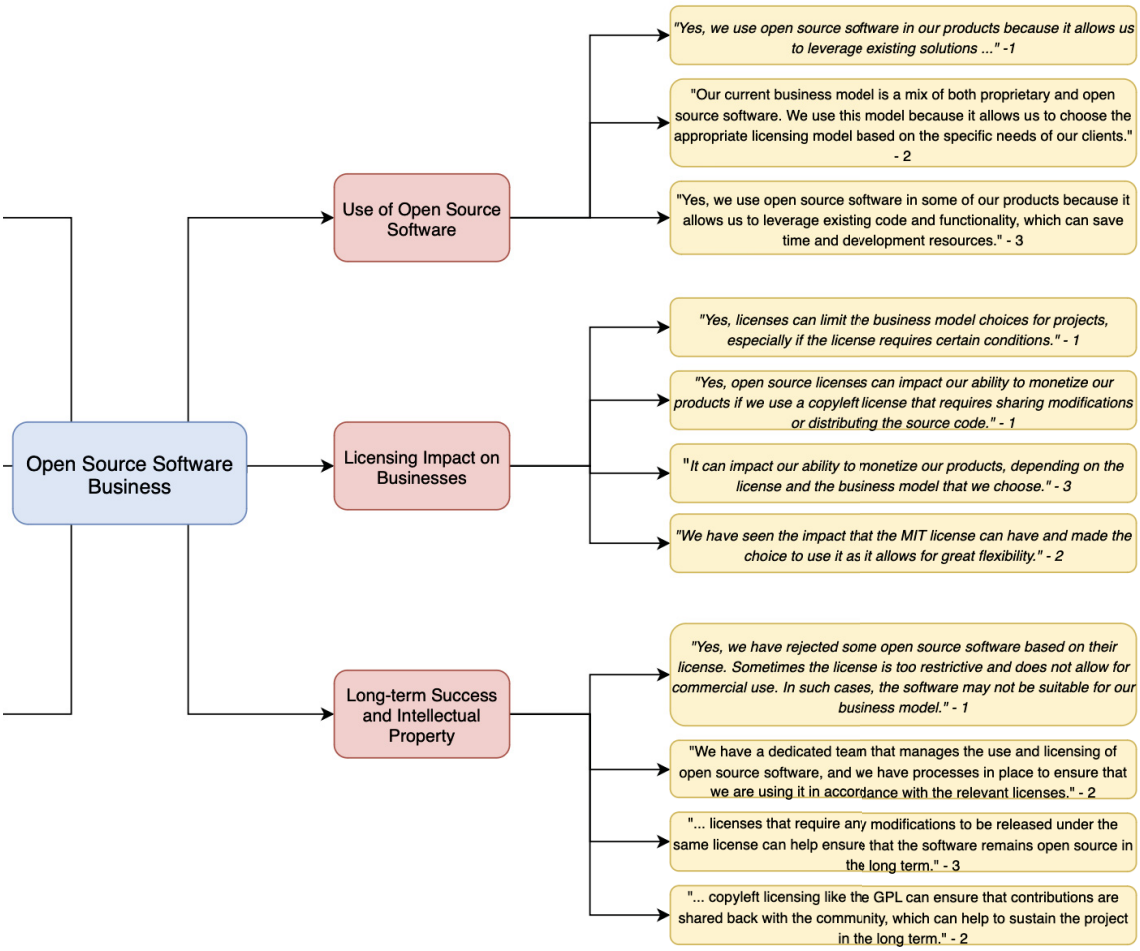

Figure 2. Thematic map of conducted interviews, view 2.

Figure 1 and 2 presents the results of our thematic analysis, showcasing the findings obtained through our analytical process.

4.3.1 Experience with open source licenses

This theme was selected to gain insights into participants' familiarity and firsthand experience with open source licenses. This theme is of particular interest as it allows us to validate and confirm their experience in our research domain.

> *"I have been working with open source software for over a decade and have experience with various licenses such as GPL, MIT and Apache. I have also worked with businesses that use open source software in their products and have seen the benefits and challenges of this approach." - Participant 1*

> *"I have worked with businesses that incorporate open source software in their products." - Participant 2*

> *"I have some experience working with open source software and am familiar with various open source licenses" - Participant 3*

In these quotes, participants expressed their direct involvement and exposure to open source software and licenses. Their experiences spanned working with different licenses and businesses, highlighting the benefits and challenges associated with incorporating open source software into products.

4.3.2 Business model and licensing choice

We constructed this theme based on the answers we found regarding the types of licenses used by open source software companies and the reasons behind their choices. Exploring the business model and licensing choices in the open source community is essential to understanding the factors that drive decision-making in this domain.

One participant highlighted their use of the MIT license, stating:

> *"We use the MIT license for our open source release to encourage wide adoption and contributions from the community" - Participant 1*

By adopting the MIT license, they aim to promote widespread adoption and encourage active community participation.

Furthermore, one participant emphasized the importance of flexibility in commercialization, stating:

> *"We prioritize licenses that allow for greater flexibility in commercialization" Participant - 2.*

This suggests that certain licenses are preferred because they provide more opportunities for businesses to capitalize on their software.

By considering these quotes and explanations, we gain insights into the motivations behind the business model and licensing choices made by open source software companies. This knowledge helps broaden our understanding of how licenses can impact business strategies and foster the successful adoption of open source software.

4.3.3 Success and failure

The theme of success and failure emerged from the interviews, where participants shared examples and insights regarding the implications of using open source software. Through these discussions, we gained valuable perspectives on the outcomes and consequences associated with utilizing open source software solutions.

> *"While I have not been in a situation myself, I have seen examples where companies have struggled to monetize their products because of the restrictions imposed by, for example, the GPL license." - Participant 1*

This quote demonstrates how certain licenses, like the GPL license, can impact the ability of companies to generate revenue from their products.

Another participant emphasized the use of permissive licenses such as MIT or Apache, explaining their choice and benefits:

> *"We do have our own OSS products, we use the MIT or Apache license when releasing these products. We chose these licenses because they make it easy for others to use and contribute to the project." - Participant 2*

This quote highlights the motivation behind selecting permissive licenses, which facilitate widespread adoption and community contributions.

By exploring these examples and narratives, we develop a deeper understanding of the diverse aspects of success and failure in utilizing open source software. This knowledge expands our awareness of the factors influencing successful implementations, as well as the precautions and considerations needed to address potential risks and challenges.

4.3.4 Use of Open source software

This theme emerged from the interviews as it became evident that all participants utilized open source software in their products. The interviews provided insights into the reasons behind their adoption of open source software, including factors such as the use of already existing solutions.

One participant highlighted the benefits of using open source software, stating:

> *"Yes, we use open source software in our products because it allows us to leverage existing solutions..." - Participant 1*

This quote emphasizes the advantage of leveraging existing solutions through the utilization of open source software.

Another participant shared their business model that incorporates both proprietary and open source software, explaining:

> *"Our current business model is a mix of both proprietary and open source software. We use this model because it allows us to choose the appropriate licensing model based on the specific needs of our clients." - Participant 2*

This quote highlights the flexibility of their business model, enabling them to select the most suitable licensing approach for their clients.

Additionally, another participant highlighted the time and resource-saving aspect of using open source software, stating:

> *"Yes, we use open source software in some of our products because it allows us to leverage existing code and functionality, which can save time and development resources." - Participant 3*

This quote emphasizes the efficiency gained through the utilization of open source software, resulting in time and resource optimization.

By incorporating these quotes, we gain insights into the reasons for the widespread use of open source software by participants. These reasons include leveraging existing solutions, flexibility in choosing licensing models, and the efficiency gained in development processes. This knowledge enhances our understanding of the role and impact of open source software in various industries and domains.

4.3.5 Licensing Impact on Businesses

This theme holds great importance as it sheds light on the significant role licenses play in shaping business strategies and operations within the open source software industry.

By examining the interviews, we discovered valuable insights into the implications of licenses for projects and businesses. The participants' discussions reveal the potential limitations that licenses can impose on the choices available for business models. As one participant aptly stated:

> *"Yes, licenses can limit the business model choices for projects, especially if the license requires certain conditions." - Participant 1*

This quote emphasizes the crucial role licenses play in determining the scope of business model options and highlights the need for careful consideration in license selection.

The interviews also highlight how open source licenses can impact the monetization of products. Participants emphasize the challenges that can arise when using copyleft licenses, which demand the sharing of modifications and distribution of source code. As Participant 1 pointed out:

> *"Yes, open source licenses can impact our ability to monetize our products if we use a copyleft license that requires sharing modifications or distributing the source code." - Participant 1*

This quote underscores the potential limitations imposed by certain licenses and the subsequent impact on revenue generation and monetization strategies.

Furthermore, the selection of an appropriate license that aligns with the chosen business model emerges as a crucial factor. As Participant 2 highlighted:

> *"We have seen the impact that the MIT license can have and made the choice to use it as it allows for great flexibility." - Participant 2*

By analyzing these quotes and theme, we can utilize this knowledge to make informed decisions regarding licensing choices and business strategies. This enhanced understanding enables us to navigate the complications of licenses and their impact on businesses.

4.3.6 Long-term Success and Intellectual Property

This theme explores the impact of licenses on the long-term success of projects and their implications for intellectual property. The interviews provided valuable insights into how licenses influence decision-making processes and the considerations for ensuring the longevity of a project.

Participants discussed the importance of license selection in relation to the long-term success of projects. They highlighted situations where licenses that are too restrictive and limit commercial use can lead to the rejection of open source software. This highlights the need for licenses that align with the business model.

> *"Yes, we have rejected some open source software based on their license. Sometimes the license is too restrictive and does not allow for commercial use. In such cases, the software may not be suitable for our business model." - Participant 1*

The interviews also emphasized the significance of managing and ensuring compliance with relevant licenses. Participants mentioned dedicated teams and processes in place to effectively handle the use and licensing of open source software. This demonstrates the importance of proper licensing management in the long-term success of projects.

> *"We have a dedicated team that manages the use and licensing of open source software, and we have processes in place to ensure that we are using it in accordance with the relevant licenses." - Participant 2*

Furthermore, the discussions touched upon licenses that require modifications to be released under the same license, ensuring the preservation of the software's open source nature over time. Additionally, the benefits of copyleft licenses, such as the GPL, were highlighted, as they encourage the sharing of contributions with the community, contributing to the long-term success of the project.

> *"... copyleft licensing like the GPL can ensure that contributions are shared back with the community, which can help to sustain the project in the long term." - Participant 2*

By analyzing these insights, we gain a deeper understanding of how licenses impact projects and can make informed decisions to ensure long-term success while protecting intellectual property rights.

4.4 Answering the Research Questions

Within this section, we thoroughly analyze the outcomes of our literature study and empirical research, aiming to address our research questions.

4.4.1 How do open source licenses influence the business model choice of software companies?

When it comes to open source software, licensing is an important consideration for businesses looking to use and distribute open source software in their products. The type of license a software project uses can impact the business model of companies that use that software, as certain licenses may impose restrictions on how the software can be used or distributed [20].

For example, the GNU General Public License (GPL) requires that any software product that includes GPL-licensed code must also be distributed under the GPL or a compatible open source license [20]. This means that businesses that want to sell their product under a commercial license may need to avoid using GPL-licensed software or find alternative licensing options.

However, for businesses that want to sell support for open source software rather than the software itself, the options for using open source software are more flexible. These businesses can distribute the software for free and generate revenue by offering support services for the software [26].

This is talked about from one of the interviews where it is mentioned that businesses that provide services and support are well-matched for open source software.

> *"Some business models that are particularly well-suited to open source licensing include software as a service, where the value of the business comes from providing a service rather than selling software, and consulting" - Participant 3*

To avoid the complexities of open source licensing restrictions, some businesses use the multi-licensing model. With this model, the software is released under two separate licenses - an open source license and a commercial license.[21] The open source version of the software can be freely distributed under the open source license, while the commercial version can be sold under the commercial license. This allows businesses to use open source software in their products while still maintaining control over the distribution of their commercial software [34].

Participant 1 mentioned that they use the dual licensing model, which is another name for the multi-licensing model, strengthening the suggestion that it is used by businesses for a purpose of having two is to have one open source licensed version and one commercial licensed version.

> *"We use the dual licensing model, which allows us to offer our software under both an open source license and a commercial license." - Participant 1*

During our interviews with our participants, we found that the choice of business models can be hindered by the use of certain licenses for open source software.

> *"Yes, licenses can limit the business model choices for projects, especially if the license requires certain conditions." - Participant 1.*

> *"We have seen the impact that the MIT license can have and made the choice to use it as it allows for great flexibility." - Participant 2.*

The first participant's comment suggests that certain license conditions can restrict the choice of business models if a software is under a license that does not allow for certain usage as redistributing it under a commercial license. In contrast, the second participant highlights the importance of selecting a license that allows for greater flexibility with how the software under it can be used by the user's with no restrictions.

> *"It can impact our ability to monetize our products, depending on the license and the business model that we choose." - Participant 3*

When we asked the third participant if licensing could affect their ability to monetize their products, they acknowledged that licensing could indeed have an impact on their business model of choice and ability to monetize their products as mentioned earlier about GPL.

4.4.2 How do open source licenses influence the decision of software companies to adopt open source software?

Open source licenses play a crucial role in determining how businesses can use, modify, and distribute open source software. Different types of open source licenses have varying levels of restrictions and obligations, which can influence the decision of businesses to adopt open source software.

Businesses may prefer open source software that does not have overly restrictive licenses, as such licenses can add complexity to product distribution. To bypass this issue, some businesses use a multi-licensing approach, where they can still use open source software but not license that part of the product under an open source license [34]. Instead, they use a proprietary license for that part.

The type of open source license used can also influence community involvement and contribution in the software's development. For example, permissive licenses, such as Apache, MIT, and BSD licenses, may attract more individual contributors interested in contributing to the project without significant restrictions. In contrast, copyleft licenses like GPL may attract more corporate contributors who have a vested interest in the project's success and are willing to comply with the licensing requirements in order to use the software [26].

Some businesses prioritize their ability to make modifications and improvements to the open source software they use, which is more easily achieved with permissive licenses that allow greater freedom in modifying and redistributing the software.

Businesses may be more inclined to adopt open source software with permissive licenses as they offer greater flexibility in how the software can be used and distributed. Copyleft licenses like GPL, however, may act as a deterrent for businesses looking to keep their code proprietary or use open source software in closed-source products [31]. The decision to use a particular open source license ultimately depends on the specific needs and goals of the business.

> *"Our current business model is a mix of both proprietary and open source software. We use this model because it allows us to choose the appropriate licensing model based on the specific needs of our clients." - 2*

As noted by participant 2, some businesses use a mix of both proprietary and open source software in their business model. This approach allows them to select the appropriate licensing model based on their clients' specific needs.

Despite the difficulty in obtaining direct answers about the impact of licenses on the adoption of open source software, the interviews did reveal some important insights about why participants chose to use open source software.

> *" Yes, we use open source software in our products because it allows us to leverage existing solutions ..." - Participant 1*

> *"Yes, we use open source software in some of our products because it allows us to leverage existing code and functionality, which can save time and development resources." - Participant 3*

Participant 1, as shown in the first quote, mentioned that they use open source software because it allows them to leverage existing solutions. This highlights the convenience and practicality of using open source software when appropriate solutions are already available.

Similarly, the second quote from Participant 3 emphasizes the importance of using open source software when it saves time and resources. These reasons indicate that the adoption of open source software is not solely driven by the licenses they use but is often a practical and cost-effective choice.

> *" Yes, we have rejected some open source software based on their license. Sometimes the license is too restrictive and does not allow for commercial use. In such cases, the software may not be suitable for our business model." - Participant 1*

Participant 1 did also share an experience where license restrictions influenced their decision to reject an open source software. The participant explains that certain licenses may be too restrictive and not allow for commercial use or require any changes to be released under a different license. This indicates that the choice of license can still play a role in the adoption of open source software when it conflicts with the business model or use case of the organization.

4.4.3 How does the open source licenses affect the long-term success in businesses?

During our research, we found that licensing can significantly impact the long-term success of businesses in the realm of open source software. One notable example is the copyleft licensing, which is designed to prevent further distribution of the software under a different license. By choosing a copyleft license, companies can release their product for free in the open source community while ensuring that any modifications or improvements made to the software are still available to the community under the same license [30].

One way that companies can leverage licensing for long-term success is by building a community of common interest. If the product is something that many people

find useful, they may be more likely to participate and contribute to the community. This approach can potentially help companies save on development costs, improve the quality of the product, and reach a wider market while promoting their company [27].

However, it is important for companies to choose a license that fits their needs and the product's purpose. If a company uses a license that does not align with their goals or the intended use of the software, it could potentially harm the company in the long run. For example, if a product is poorly managed due to issues stemming from bad licensing or community involvement, the primary responsibility falls on the company as they are responsible for developing and maintaining the software.

Another business model that we encountered in our research is the multi-licensing model, which allows companies to release their products under both open source and commercial licenses [34]. This approach can be beneficial for developers who want to offer a free version of their product to the community while also providing a commercial version with additional features. By doing so, the product can reach a wider audience, as many users may prefer to try a free version first before investing in a commercial one. If they find the product useful and need the premium features, they can then choose to purchase the commercial version.

When incorporating open source software into one's products, it is crucial to carefully examine the licensing terms to avoid any potential conflicts or limitations. If the software is licensed under a copyleft license, any modifications or derivative works of that software must also be released under the same license. This could restrict the company's ability to sell their product under a proprietary license or monetize it in other ways [28]. Additionally, some licenses may require that any modifications made to the software be released back to the open source community [29], which could lead to a loss of competitive advantage or intellectual property rights. Therefore, it is important to thoroughly evaluate the licensing terms of any open source software being used and consider the potential impact on the product's distribution and revenue streams.

It is worth noting that there are alternative licensing models that companies can consider, such as permissive licenses or multi-licensing. Permissive licenses, such as the MIT or Apache licenses, allow for more flexibility in how the software is used and distributed, but may not offer as strong of protections for the original developer's intellectual property. Multi-licensing, as mentioned before, allows for a product to be released under both open source and proprietary licenses, which can provide additional revenue streams and offer more control over the distribution of the product.

While the interviewees were not able to provide a straightforward answer regarding how different types of licenses influence the long-term success of businesses, they did offer some valuable insights into their experiences with different licenses.

> *"... licenses that require any modifications to be released under the same license can help ensure that the software remains open source in the long term." - Participant 3*

Participant 3 explained that licenses that require any modifications to be released under the same license can help ensure that the software remains open source in the long term. This is because any modifications or improvements made to the original

software would also have to be released under the same open source license, thus ensuring that the code remains freely accessible to the community.

> *"... copyleft licenses like the GPL can ensure that contributions are shared back with the community, which can help to sustain the project in the long term." - Participant 2*

Participant 2 added that copyleft licenses like the GPL can also be an effective way to sustain a project in the long term. Copyleft licenses require that any modifications or derivatives of the original software be distributed under the same license, thereby preventing anyone from closing off the code and keeping it proprietary. This ensures that the code remains open source and freely accessible to the community, which can help to sustain the project over time.

> *"We do have our own open source products, we use the MIT or Apache license when releasing these products. We chose these licenses because they make it easy for others to use and contribute to the project." - 2*

Furthermore, Participant 2 revealed that in their own open source software products, they use the MIT or Apache license. They chose these licenses specifically because they make it easy for others to use and contribute to the project. The MIT and Apache licenses are more permissive than copyleft licenses like the GPL, which means that they allow for more flexibility in terms of how the code can be used and distributed. This can make it easier for others to contribute to the project and for the code to be integrated into other software systems, which can help the long-term success of the project.

Chapter 5

Discussion

5.1 Research question findings

The objective of our study was to investigate the implications of open source licensing on various business models. We specifically focused on understanding how these licenses could influence the decisions of developers and users of open source software when incorporating it into their products. Our research questions aimed to explore the impact of open source licensing on business model choices, software adoption decisions, and long-term success in businesses.

> *How do open source licenses influence the business model choice of software companies?*

The first research question asked how open source licenses influence the business model choices of companies using open source software. Our findings suggest that licenses do influence these choices, as each license has its own limitations that companies need to consider when selecting a business model. For example, some licenses may restrict a company's ability to monetize their product fully, while others may be more permissive.

> *How do open source licenses influence the decision of software companies to adopt open source software?*

The second research question investigated how open source licenses impact the decision of companies to adopt open source software in their products. Our findings indicate that licenses can have an impact, but they are unlikely to be a complete barrier to adoption. Instead, companies may choose to use a multi-licensing model to accommodate the restrictions of a particular license, which allows them to release their product under both open source and proprietary licenses.

> *How does the open source licenses affect the long-term success in businesses?*

The final research question examined how open source licenses affect the long-term success of businesses. Our research shows that licenses can have a significant impact on the long-term success. Companies need to carefully consider the license terms to avoid potential conflicts or limitations that may hinder their ability to monetize the product or restrict the use of the software by the community. Choosing the wrong license could lead to missed opportunities for growth or even failure in the long run.

5.2 Key Findings and Patterns

Our research has highlighted the significance of having a proper open source software license. Although this may seem like an obvious statement, the importance of licensing can be easily overlooked without a thorough understanding of the subject. This can result in significant losses for a company. To mitigate such risks, one of the interviewees we spoke to stated that their company has a dedicated team to manage the use and licensing of open source software.

> *"We have a dedicated team that manages the use and licensing of open source software, and we have processes in place to ensure that we are using it in accordance with the relevant licenses." - Participant 2*

The quoted statement from participant 2 indicates that some businesses have recognized the significance of maintaining proper licensing for open source software and have implemented dedicated teams to mitigate any legal risks associated with their usage. Although our study's small sample size does not permit us to confirm whether this practice is widespread among other companies, it demonstrates that this approach could be employed to effectively address and manage the legal aspects associated with open source software.

Our research has also revealed that businesses can find ways to use software even if the licensing restrictions may pose a challenge. One effective solution we found is the multi-licensing model, which offers great flexibility and allows a company to use most open source software in their product by having multiple versions under different licenses. However, whether this approach is appropriate depends on the specific product being developed. For example, if a free version of the software does not offer any value to the user but a proprietary licensed part does, it could potentially harm the product's growth as hesitant users may not be willing to invest in the proprietary version before trying out the software.

Another crucial aspect for a company developing open source software is the community that supports it. Without a community, the opportunities for wider expertise and product development may be limited. If the company relies on a community that wants to keep the software updated and use it to help with their production, but is unable to rely on the community, it may potentially hurt their production and require another model for the software. Therefore, it is important for the company to provide a solid platform for the community to grow and flourish.

5.3 Unexpected Findings

Prior to conducting this study, we had limited knowledge on the impact of software licenses, although we believed that they must serve a purpose. We had no clear expectations regarding the extent of their impact, making the discovery of the multi-licensing model surprising. This model is notable for its ability to accommodate both proprietary and open source licenses, a revelation that shed light on the fact that even companies that offer everyday products like Spotify utilize it and rely on community contributions to their software [12].

Another finding we were surprised of was to find that many of the research papers we encountered were relatively old and that there hasn't been more recent interest in the subject as we expected. Initially, we expected to find a mix of older research papers with valuable insights but outdated information, along with more up-to-date articles that would have a more current perspective on the subject. However, we discovered that most of the information remained the same and there wasn't as much updated information available as we anticipated.

In our view, many of the findings were not completely surprising. However, what did surprise us was the extent to which open source software is integrated into society and how much it is relied upon. The example of Spotify shows how even widely used everyday products depend, to a certain degree, on open source software. Android phones serve as another prime example of products that incorporate open source software [3]. This is evident through their utilization of a modified version of the Linux software [15].

5.4 Justification and conflicts

We decided to conduct both a literature study and an empirical research at the beginning of our project. This was done to ensure that the data we collected would align with the real-world situations that we were studying. After conducting the research and later interviewing participants, we can conclude that the research papers we studied hold some validity. The information obtained from the literature study was similar to that gained from the interviews with the companies. An illustrative instance of this is the participants acknowledging the utilization of open source software in their product to harness pre-existing solutions.

> *" Yes, we use open source software in our products because it allows us to leverage existing solutions ..." - Participant 1*

> *"Yes, we use open source software in some of our products because it allows us to leverage existing code and functionality, which can save time and development resources." - Participant 3*

This is evident in the Delta3D article, which showcases their software architecture and the incorporation of existing open source projects [22]. Furthermore, one of the articles discusses the cost shift associated with this approach, aiming to achieve cost savings [31]. The same article also touches upon the business model of selling pre-existing open source software as a product. These examples collectively emphasize the widespread adoption of such practices within companies.

Throughout the study, we found that there were different types of licenses for open source software, permissive, copyleft, and hybrid are three of them. While the interviewers never talked about any of the hybrid ones. The hybrid licenses are a licenses for a specific need so getting more knowledge about that through experience of a participant would require to interview someone that has a need for a tailored license for them.

Both the interviews and literature study provided information on how permissive licenses such as the MIT and Apache licenses are used to build communities and make

it easy for contributors to participate in projects. The copyleft and multi-licensing concepts also aligned with the research papers and participants' experiences.

Given the alignment between the various aspects mentioned above, it is reasonable to conclude that the findings from this study validate each other. However, it is crucial to acknowledge that the sample size of this study was limited, which is a limitation on this study. Due to the small sample size, the possibility of outliers may be more challenging to identify. Nevertheless, despite the small sample size, we believe that the experience of the interviewed participants in the industry is significant enough to support our results.

5.5 Limitations

As touched upon above the sample size of interview participants is a great limitation of our research. To obtain more diverse perspectives and enhance the validity of our findings, a larger sample size would be necessary. The participants would need to come from various sectors of the open source community. This would enable us to validate the data collected through the literature study and identify any conflicting information.

Another potential limitation of this research is that all the research articles being studied come from the IEEE Xplore originally from our search. While this may not significantly impact the validity of the research, there could be other articles with different data on the subject that are available elsewhere. However, considering the scope of this research, we had to set a limit on the number of articles we could gather and analyze at the outset. Nonetheless, we believe that the IEEE Xplore database was an appropriate choice as it is a well-respected database in the fields of engineering, computer science, and related areas.

Chapter 6

Conclusion and Future Work

After reading this article, the reader should now have a better understanding of how open source software licensing works and how businesses utilize them in various ways. The primary findings of the study include the various types of licenses, such as the free and open source categories with copyleft and permissive licensing, proprietary licenses, which are not open source licenses but may use open source software in their products, and hybrid licenses, which combine both open source and tailored restrictions.

By understanding these categories and the information gained from the participants, readers should see how these licenses can impact the choice of business models. It is important to choose the correct license for the software, as using the wrong one can severely impact revenue or even the survival of the software. However, while licenses can have an impact if a company uses the software, there are multiple ways to work around some of the licenses by using different methods for their business model. Knowing these decisions and how to work with them can give the company a competitive advantage and ensure long-term success in the software industry.

One potential direction for future research would be to expand the participant pool to include a broader range of individuals, either through conducting surveys across different companies or conducting more interviews. This study could be similar in topic to the current study in order to identify any conflicting data and assess the impact of licenses on business models, or it could aim to validate the current findings. Another potential avenue for research would be to delve deeper into how open source companies utilize licenses in their business models and examine the specific benefits of each type of license. Additionally, exploring other factors that influence decisions surrounding business models for open source software, beyond just licensing, could be a valuable area of investigation.

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Appendix A

Supplemental Information

Table A.1: Interview Questions

Question
What is your background regarding open source software and their licenses, as well as businesses within this area?
What is the current business model that you use and why do you use that particular one?
Do you use open source software's in your products, and if so, why?
Are you aware of the licensing for the OSS when you use it?
Do you have your own open source software products, and if so, how did you decide which open source license to use when releasing the product?
In your experience do the licenses limit the business model choices for projects?
Does open source licenses impact your ability to monetize your products?
What open source licenses have you used in your business, and why?
How have you seen different open source licenses affect the business models of other companies in the industry?
Are there specific open source licenses that tend to be more popular among companies with certain types of business models?
Have you ever had to change your business model in order to accommodate an open source license? If so, can you describe that process?
What open source licenses do you typically look for when evaluating software for your business?
Have you ever rejected a piece of open source software based on its license? If so, what was the reason for that decision?
Are there certain types of businesses that tend to prefer one open source license over another? Why?
Do you think the type of open source license affects the quality or reliability of the software itself?
Have you seen if the choice of open source license impacts the community around a software project?
Have you ever faced sustainability challenges related to open source licensing? If so, what were those challenges and how did you address them?
Do you think certain types of open source licenses are more sustainable in the long term than others? Why or why not?
How do you balance the benefits of open source software with the need to protect your intellectual property and maintain a competitive advantage in the market?
Are there any specific business models that you think are particularly well-suited to open source licensing? Why?
Have you seen any cases where the choice of open source license had a significant impact on the success or failure of a business?
Looking back in time, is there something that you would change or evaluate more, in regards to the business with open source software?

Table A.2: Literature Study Articles

No.	Title	Link
1	Matching Open Source Software Licenses with Corresponding Business Models	https://ieeexplore.ieee.org/document/5733336
2	Open source software publishers' business models: the strategic role of licenses	https://ieeexplore.ieee.org/document/46545354
3	Setting up shop: The business of open-source software	https://ieeexplore.ieee.org/document/744568
4	How to Succeed in the Software Business While Giving Away the Source Code: The AdaCore Experience	https://ieeexplore.ieee.org/document/8792964
5	Service oriented license providing	https://ieeexplore.ieee.org/document/5410462
6	Plenary talk: Adoption of open source software in corporate sector	https://ieeexplore.ieee.org/document/5972498
7	Choosing an Open Source Software License in Commercial Context: A Managerial Perspective	https://ieeexplore.ieee.org/document/5598103
8	An open source(d) controller	https://ieeexplore.ieee.org/document/4448885
9	A Model of Open Source Software Style R&D on Business	https://ieeexplore.ieee.org/document/4031831
10	Business Models Based on Open Innovation Strategy	https://ieeexplore.ieee.org/document/5997947
11	The Changing Software Business: Moving from Products to Services	https://ieeexplore.ieee.org/document/4445598
12	Overcoming technical constraints for obtaining sustainable development with open source appropriate technology	https://ieeexplore.ieee.org/document/5444388
13	CAG: Compliance Adherence and Governance in Software Delivery Using Blockchain	https://ieeexplore.ieee.org/document/8823885
14	Enterprise Service Bus and an Open Source Implementation	https://ieeexplore.ieee.org/document/4105027
15	Dual licensing policy — New way for software development	https://ieeexplore.ieee.org/document/5752997
16	FLOSS for the Canadian Public Sector: Open Democracy	https://ieeexplore.ieee.org/document/5432781
17	A structure of co-creation in an open source software ecosystem: A case study of the eclipse community	https://ieeexplore.ieee.org/document/6017787
18	Single-Vendor Open Source Firms	https://ieeexplore.ieee.org/document/9062364
19	The Innovations of Open Source	https://ieeexplore.ieee.org/document/8690207
20	Challenges and Governance Solutions for Data Science Services based on Open Data and APIs	https://ieeexplore.ieee.org/document/9474387
21	Toward a framework for implementing open source software in public administrations: Legal, economic and societal aspects	https://ieeexplore.ieee.org/document/6308021
22	Projects in VR: the Delta3D open source game engine	https://ieeexplore.ieee.org/document/1438251
23	A Study on the Derivation of Utilization Intention Factors of AI Vision Open API	https://ieeexplore.ieee.org/document/8935748
24	Ai fairness 360: An extensible toolkit for detecting and mitigating algorithmic bias	https://ieeexplore.ieee.org/document/8843908
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