Jesse Lento

T569SN

TRANSLATING OPEN SOURCE INTO MONETARY BUSINESS VALUE

Information Technology

November, 2013

MIKKELIN AMMATTIKORKEAKOULU

Mikkeli University of Applied Sciences

MIKKELIN AMMATTIKORKEAKOULU Mikkeli University of Applied Sciences	**Date of the bachelor's thesis** November 29, 2013
Author(s) Jesse Lento	**Degree programme and option** T569SN – Information Technology
Name of the bachelor's thesis Translating Open Source into Monetary Business Value	

Abstract

Open source is a philosophy that supports an idea in many ways. Learning, freedom, and community support are several aspects which relate to this ideology. The goal of this study was to introduce the open source way of thinking by defining it, comparing the benefits and drawbacks of using it, and analyzing implemented business models utilizing it as well. Also, a few companies that are largely related to open source were analyzed to see how open source has affected them. The second half of this study will demonstrate and explain how a business was created based on several open source ideas.

Subject headings, (keywords) Open source		
Pages 30	**Language** English	**URN** N/A
Remarks, notes on appendices N/A		
Tutor Matti Koivisto	**Employer of the bachelor's thesis** N/A	

CONTENTS

1 INTRODUCTION

Open source is a philosophy that is practiced in many fields. In relations with the IT field, many consider this ‘free’ technology with available designs. This applies to software, hardware, or designs/blueprints. There are many types of business models that evolve from the advantages and disadvantages of open source.

The aim of this study is to show how open source can be used in business strategies to monetarily profit from its use. First an overall understanding of open source will be achieved through information about the open source philosophy. This theory will cover applications of open source, different benefits and drawbacks of open source, legalities, and overall definitions of open source. The second part of the documentation will analyze several open source business models and companies utilizing open source, based on the knowledge provided in the first chapter. The final part will be formulated business idea models based on all the previous information in this study.

To fully understand the logic behind utilizing open source as a business strategy, it is important to comprehend the full meaning of open source. Open source is a philosophy, which applies to many different fields of study (not just IT; which will be the main focus of this study). Quoting the definition straight from one open source forum (Wikipedia):

“Open source as a philosophy promotes a) universal access via free license to a product's design or blueprint, and b) universal redistribution of that design or blueprint, including subsequent improvements to it by anyone” [1].

This, in laymen terms, dictates that anyone has free access to the design/blueprint of the product/service to modify or use; also this means that when people design something and label it as open source, it is available to the public to improve, customize, or market freely. Free is the key term, which is the most important thing to understand.

Once something is authorized and labeled as open source, it opens up an environment for development. This of course is the main principle behind the open source philosophy since people have rights to the code or designs, which means they can modify and adjust it to accordance.

Take for example a software developer who has created a new web browser. He knows that his software platform works, however knows that there are improvements to make. He has limited resources, so he decides to enlist it as open source. This enables anyone to work on it, sell it (depending on the legalities), or customize it in their own work. This of course brings up many benefits and drawbacks of 'open sourcing' (which will be covered later in this study).

2 OPEN SOURCE PHILOSIPHY

This chapter will explain the basic theories of open source. First an understanding on what open source is and what classifies something as open source will be achieved, then legalities surrounding the freedom will be introduced, and finally getting familiar with the benefits and drawbacks of open source.

2.1 Open source VS. Freeware and Shareware

Since open source is free to the public to do as they wish, it is often misconstrued with freeware or shareware. There are many aspects that are similar between these three philosophies, mainly the aspect of them being free.

The difference between freeware is the fact that in freeware, you do not have access to the source code [2]. This means that you have no chance on developing or improving the software. The purpose of freeware is to enable free access to free software, so that anyone that wants to can use it. This means there is no community or persons that are regularly developing, or improving the software – only the authors have this privilege.

When talking about shareware, it usually means a free trial of the software is given, but eventually it must be paid for [2]. This means that the developer has full control, and is only testing the software/design or gathering feedback, with intents of marketing the final product at a later time. Usually there is a limited window of time to use the shareware, and after that time has expired it must be purchased to continue using it, or unlock the full features.

The main difference between these philosophies is the fact that open source is truly free. There are no restrictions, and the source code is provided. This means that the work someone else has done is fully available in all aspects, not just as a trial period, or as free software where the code is not publicly available.

This means that when people design something and label it as open source, it is available to the public to improve, customize, or market freely. When people decide to create something as open source, that means that they are open to ideas, changes, and people replicating their ideas.

2.2 Applications of open source

Today, there are many examples of how open source has expanded into a global initiative. There are many examples which relate to the IT field, and many that are outside of the IT realm. The only thing that is required for something to be labeled as open source is the fact that the source code must be available to the public and that it is free.

In the IT field, the most common form of open source is software. Someone can develop software, yet in many cases the realization by the developer(s) that outside help could in fact help improve the software. There are many open source software's that are available. These range from applications, operating systems, programming languages, API's, and server software platforms. Some of the most famous IT open source projects are shown below in Figure 1.

FIGURE 1. Open source applications

There are many more, but these are some of the most famous ones. Each of these examples are free, and have available source code. But this leads to the question of how they are able to profit if they are free? One common misconception is since they are giving their product or service out for free, that means they are unable to profit from it. There are many ways that they are able to maintain their status as globally recognized top brands, and at the same time profit from their open sourced ideas.

There are many other fields outside software that open source is practiced in as well. Electronics, medicine, science, robotics, digital content, teaching, and even food/beverages [1] are all examples of open source.

2.3 Legalities surrounding open source

When talking about the legal aspects behind open source, there are many things to consider. Firstly it depends on what type of model is at hand. Open source projects availability, creation, and development all have different laws protecting its open source origin.

2.3.1 Open source guarantees

Certain guarantees are provided with open source ideas. These are the aspects which define what is open source is, compared to proprietary ideas. These guarantees are as follow [3]:

- Freedom to redistribute
- Access to the source code
- Derived works allowed
- Integrity of author’s code
- No discrimination against persons or groups
- No discrimination against fields of endeavor
- Distribution of license
- License must not be specific to a product
- License must not restrict other ideas
- License must be technology-neutral

2.3.2 Commercialization of open source

All open source ideas can be used for commercial purposes, and this is guaranteed by the definition of open source. If you receive software under an Open Source license, you can always use that software for commercial purposes, but that does not always mean you can place further restrictions on people who receive the software from you [4]. There is no way to restrict freedom of how open source is to be used. This is another freedom protected by using open source. This of course opens the realm for ideas to be used for unethical purposes, yet it is still protected by open source as well.

2.3.3 Copyleft and permissive licenses

Copyleft licenses refer to open source ideas that are created and intended to stay open source. If something is created under GNU General Public License (which is a widely-used copyleft license), and then someone modifies it and distributes their own modified version, the modified version being sold must be licensed under the GNU GPL as well – including any new modifications included into the development of the modified version. [4]. There is other various copyleft licenses as well, yet the GNU GPL is the most common.

Understanding the licenses that accompany open source ideology is important to understand in order to avoid copyright infringements and court cases. There have been many cases surrounding legal copyright infringements and misuse of open source ideas.

Permissive license's is the complete opposite of copyleft licenses. This type of license protects the developer to redistribute the open source idea with a new set of restrictions different from the original idea. The MIT license and BSD license is the most famous permissive licenses [5].

2.3.4 Open source approval process

In order to turn an idea into open source, there is an approval process in place to review and prepare the idea. The first step is submitting an idea and describing and documenting it. A license review community will review this idea, and discussion will be

required with the community about questions regarding the idea. Next, the OSI board (an eleven-person Board of directors who oversees the Open Source Initiative) will be informed of the idea by the license review community, and will make the final decision, which may include addition information. Eventually the license review chair will receive the decision from the OSI board, and inform the decision. If approved, the OSI website will be updated appropriately [6].

2.3.5 License categories

There are many different licenses with separate rules and restrictions. These rules must be followed, in order to protect integrity of the open source community. When trying to create, use, or redistribute open source it is important to fully understand the laws, as well as respect them. For business purposes, there are markets for consulting on the legalities and proper implementations. These types of business models will be discussed later on.

2.4 Benefits of open source

There are many benefits that arise from using and publishing open source materials. Many reasons for both users and developers to enter the realm of open source exist, other than the fact that it is obviously free.

2.4.1 Developing as a community

Due to the fact that the code/design is publicly available, and free to modify or change, this gives a great opportunity for improvements and customization. When something is created and made open source, there is probably the chance that it is not perfect on its initial release. Open source can be considered a platform, where people come together to fix bugs, make improvements, learn, and improve the original work. Communities and networks are built as well where people come together to share knowledge and ideas, which in turn leads to possibilities of new ideas emerging.

There are many great examples of ideas being born from open source communities. Linux is software that is all open source, and based around a huge community. It was

developed by Linus Torvalds in 1991 [7] and has since undergone many changes and been forked into different distributions, based on work within all of the communities.

2.4.2 Security

One reason open source projects can be considered more secure in comparison with proprietary projects, can be summed up by “Linus’ Law”: “given enough eyeballs, all bugs are shallow” [13]. This can be interpreted as meaning that the more people who can see and test a set of code, the more likely any flaws will be caught and fixed quickly [14]. An example is the discovery of a number of defects in the Android kernel by Coverity [14]. This was all made possible by the fact that the Android kernel is open sourced.

This does not mean, however, that open source is more secure that proprietary projects. It only means that the bugs of open source ideas can be viewed or found by the public, whereas in proprietary ideas the bugs can be only known by people inside of the proprietary project. This leads to the time of bugs being fixed or patched taking longer in proprietary projects, whereas in open source projects the communities will help fix them almost immediately.

2.4.3 Costs

Cost is the most favorable benefit of using open source, since everything is free without restrictions or license fees. Scalability is priceless, and start-up costs are reduced as well. There are many cost saving strategies that are implementing open source technologies to replace expensive proprietary solutions.

Initial cost savings of open source systems are dramatically less expensive than proprietary systems [15]. An example could be a company needing to install operating systems on all 100 of its computers. Instead of using a 100 licenses of Windows, an alternative option would be to use Ubuntu. This would significantly save costs and allow those savings to be used for other aspects within the company.

2.4.4 Freedom and control of designs

Since open source designs are available publicly, there is possibility of development, improvements, and customizations. In open source, the code is open and it is a simply a matter of modifying it or tweaking it to achieve functionality suited to your own needs [14]. When something is proprietary and not publicized, it is almost impossible to redesign or edit the original designs. Development and improvements can better the services and results of the company, which are facilitated by open source.

Freedom is granted to the user, which is one thing that enables the open source philosophy. By being able to modify and edit, it is possible to come up with new ideas and improve the original design. This supports competition, and security (since flaws are found and corrected fast). Also vendor lock-ins are avoided by choosing open source, whereas in proprietary systems the customer is at the mercy of the vendor's vision, requirements, dictates, prices, priorities and timetable, which limits what the customer can do with the product they are paying for [14].

2.5 Drawbacks

Free is something that comes with drawbacks as well. Open source does have its benefits in any consumer, developer, or company aspect. These are also disadvantages that must be considered before implementing open source designs into a strategy, be it personal or business. Many business models capitalize on the disadvantages of open source in order to be able to provide their services, which will be discussed later.

2.5.1 Difficulty

Ease of use with open source technology is not as straight forward as proprietary designs in most cases. That is one thing that holds back many from using open source. Since it is free, it is an 'as-is' model that you are receiving, meaning there can be little support included unless you do the research yourself. This is why communities and forums are available, to assist in any features or issues that are hard to comprehend.

One example that portrays the difficulties in using open source projects, is the fact that a user may not know which version does what or whether it is compatible with other software on your proprietary platforms [16]. This can cause a lot of problems in many

situations, yet can be remedied by hiring an IT expert, or outsourcing to find support elsewhere.

2.5.2 Limited feature environment

When comparing Windows and Linux, for example, the amount of programs and features for each is marginally huge. The difference does in some ways reflect on the fact that one of the two is open source, and the other is not. However, even though there are many more programs available only in Windows (where there are only a few that are available in Linux only), this is due to the fact that there is research backing up amount of users that use Windows over Linux. This makes it favorable for proprietary projects to be introduced in Windows for example.

This example proves though that it is not only due to the fact that more potential customers are using Windows, but that since Windows already has a payable customer base, the likelihood of them paying for other proprietary software is more common. Even though in Linux is still possible to use these types of programs (Wine), most of them are designed only for Windows since there is a guaranteed market for the product.

2.5.3 Community connection

According to Jono Bacon from Canonical, there are 2 areas of open source: collaboration behind building the platform, service, or product, and delivering it to regular users and people. Integrating an open source platform into a product is straightforward, but the connection with a community is the hard part. There are many hurdles and obstacles for example when a developer is trying to contribute a patch, such as legal review and admin testing [17].

Even though there are many leading open source communities, which provide developments and improvements regularly, there are also some open source projects that receive small amounts of outsourced development. Not every project will succeed, but if there are people interested in the project it will mean that some forms of development will occur. This means that the idea that is being publicized as open source must

be substantially good, otherwise it will receive little attention and will undergo very little development (if not fail altogether).

2.5.4 Money incentive

Stormy Peters from Mozilla makes a point about one drawback of open source (and provides a solution on how to fix it), which is the incentive for developers to create. If everything is open source and free, how do the developers and creators earn money? This can be done: instead of bringing an idea completely openly and free to the world, bring it completely openly and free but charge for a part of that service. She goes on to say how the Firefox Marketplace is available to the world so developers can host their apps and get paid, but the marketplace environment is completely open source so others can host their own marketplaces [17].

2.6 Benefits and drawback analysis

Even though there are many weaknesses of open source, these are in some cases corrected with willful individuals who choose to support and develop the ideas. The weaknesses have correlations with various business models, which in turn replace these weaknesses with business ideas to gain revenue. By understanding the benefits and weaknesses of open source, it is possible to determine possible plans of implementation, as well as strategies to profit from open source philosophy and ideology.

3 OPEN SOURCE BUSINESS MODELS AND STRATEGIES

There are many open source business models, in which the main goal is to somehow make money from the product or service. Many approaches to profit from open source are viable, however there are some approaches which are widely used in the global market to make profits. Just because the ideas are free, and openly available designs are public, it does not mean that there is no way to implement the ideas into a market strategy with the hopes of gaining revenue. There are many good examples of open source companies making huge amounts of money, even though their work is free and available to change. Figure 2 below depicts the main models and strategies that will be covered in this chapter.

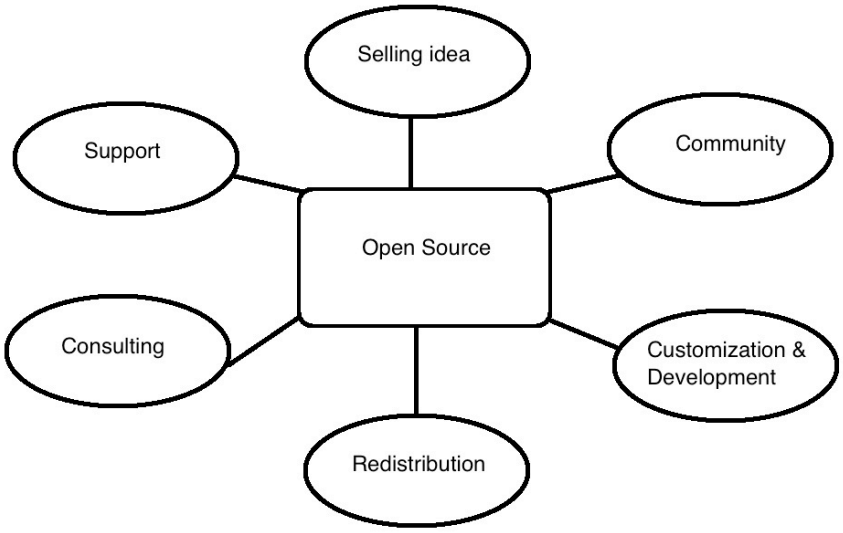


FIGURE 2. Models and Strategies

3.1 Selling out

The most profitable, and dreams of most open source projects, is that the idea will be bought out by a huge company or investor for millions/billions of Euros. This means that the idea is solid, and there are investors or proprietary companies willing to pay for the idea to brand it under their own name. Of course, this does not happen every day. It is quite rare for an open source project to be bought out (when thinking of how many there are out there), and when it does happen it is usually a groundbreaking idea or technology.

One example of this type of acquisition is the purchase of MySQL by the company Oracle. MySQL was developed in early 1994 as open source, and was purchased by Sun Microsystems in 2008 for $1 billion [8]. Later in 2009 Oracle had stepped in and acquired Sun Microsystems for $5.6 Billion, after IBM and Hewlett Packard deals fell short with Sun Microsystems [9].

This is a huge deal, however one of the creators of MySQL (Michael ‘Monty’ Widenius) had started a petition to “save MySQL” from Oracle. The main goal was to protect the open source aspects, which had been changed with the acquisition of Sun Microsystems by Oracle, which in turn also resulted in the acquisition of MySQL.

This eventually failed [9], however several forks of MySQL were created, as well as a commercial and GPL license for MySQL is provided by Oracle today.

Huge amounts of money were involved in the ideas behind the open source MySQL. It passed through two very big companies in the IT field, as well as had deals that fell through between two other big companies as well. This is a good example of an open source idea selling out, and making lots of money. Of course when developing an open source idea, it is important to stay in reality and realize that this is not always the case. This is not a problem though since there are many other viable methods of getting profits from open source.

3.2 Providing support

One model that is used by many companies and individuals use is by selling support, training, or documentation services for open source software or idea. Even though something is open source, it does not mean that idea or software is easy to use or implement. There can be many variables that affect performance, maintenance, usage, or installation. That is why there are several models built for support that can in turn create revenue for a specialist.

Selling support with a contract is one method of profiting from open source. This does require knowledge of the open source idea, but by having an understanding it is possible to translate this knowledge into revenue. It does have a limited market, however with adequate knowledge about various difficult open source technologies and a professionally marketed service it is possible to be successful. This includes instant phone or email support, live tech support, or remote support. OpenLogic is one company that provides commercial-grade support for open source software as well as support for CentOS Linux based on several packages that vary in prices [19].

Work is dependent on the level of support needed, as well as the amount of work needed to maintain the open source technology to the customers' satisfaction. Support can be difficult to sell due to the profits needed to support the company. There are many large companies that partake in selling this type of support, but they also make money apart separately with other services. Another aspect to keep in mind is competition, since there are also many other support services available which require cheap-

er prices. This type of support can be considered sustainable, yet in most cases it requires hard work and a lot of time to complete.

Another variation of the support service model is selling documentation or training. Creating user manuals for open sourced ideas, and selling them, is one method of gaining income. This requires an extensive amount of knowledge, as well as formulated ideas that the customer can easily use. One method is providing this documentation for already published open source ideas at a cost, meaning that you publish information on setup, maintenance, features, and future developments. Training can be considered another method, which is more hands on. Instead of documentation, there is a physical contact lesson to teach the user on how to use the open source technology.

Documentation and training does require a lack of internal knowledge of the customer group, as well as a high marketing strategy to get people interested. Also this means that the customer can learn all the information at once, meaning that the service will no longer be needed, which in turn results in a non-reusable services.

3.3 Consulting services

Consulting is on aspect that relates to support, yet differs in many ways. Consulting is always a profession that is viable in any field of work. Expertise is required, as well as a well-organized network of organizations. This can be done on many levels. Instead of providing support, as mentioned above, it is possible to contact companies and sell them on the idea of cutting costs, new open source technologies, or improvements utilizing open source to help them profit.

Take for example an area such as operating system and database environments of a company. Today every company needs a network for employees, owners, customers, and investors to communicate. There are many proprietary companies that sell software’s or services that suit the needs of the company. This type of situation is ideal since it means they are not invested into saving company costs. Even switching operating systems from Windows to Linux saves money. Changing to similar software’s that are open source which the company is already using, or implementing other new open source ideas to replace proprietary technology saves money as well.

Customizing a company to your expertise is a way of consulting with open source ideology. Even if its not your open source idea, it is still possible to sell it to someone if you have the ideas of implementation that make the customer happy. The main idea here is to save money on expensive proprietary ideas, and replace them with free open source ideas. Also possible is bundling support and training to implement these ideas as value added service.

3.4 Customized ideas

For developers, it is possible to harvest ideas from open source and its communities to create new ideas and improvements. Linux for example has many branches of the OS that are all in theory based off the same system. This can be translated to other fields as well. Many 3D printers have also been created from the ideas of the RepRap project. This is how communities work, and if enough information is gathered and utilized it is possible to create a whole new product or service based off the original open source idea.

By using open source, the idea does not have to be your own. If you have your own groundbreaking ideas on how to use the technology, or customization ideas to sell it as your own product, then it is all in the realm of possibilities to manufacture or produce this idea. This saves time in R&D since the ideas are publicly available, which also reduces costs as well to produce this idea.

Add-ons to existing open source ideas are another personally customized service that is possible. There are many open source ideas that have add-ons, plugins, or customized versions that use the open source idea to make it a better environment. One example of this is for CMS web design platforms. Joomla, Wordpress, and Drupal all have different communities where people come together to improve the web design environment. Themes and plugins are created by users within, and sold on a regular basis.

In this business model, development is the main aspect that must be mastered in order to be able to translate the new and improved idea into monetary value. Marketing is

another aspect that must be accomplished in order to get people interested and willing to pay for the idea.

3.5 Downplaying the idea

Another model for selling and marketing an idea is by only open sourcing the bare-bone of your idea. This is done by not publicizing all the features, and keep some private in order to be able to sell them as a bundle or separately later. This relates to the freeware and trial software's provided by many companies.

By removing certain features, it is possible to have a usable open source idea which people are interested in. Once the interest has matured and people are using this idea, it is possible to later market the hidden features as a bundle or as a proprietary package. This of course is one strategy that many companies are using, but it requires a fundamental idea that works on its own without the need of the features to make it great. The features are just a bonus, and that is where the money will be made from.

3.6 Providing a community

Communities are where open source ideas are developed, improved, and supported. One business model is hosting a community for open source ideas to take shape and grow to the next level. For example hosting an online forum (which is the most common form of community since everything is communicated online), or hosting a convention where people come to gather in person. Through this business strategy, there are many ways to make money. While hosting a forum or convention, advertising is one of the main possibility for gaining profits.

When people are able to communicate through forums or conventions, their ideas and knowledge are improved. These types of communities of ideas are perfect breeding grounds for new co-operations, improved ideas, and marketing strategies which are the main reason ideas turn open source in the first place.

By hosting these types of forums, it is possible to beneficially and co-operably gain profits through marketing. Within the realm of these communities, there are many different types of people who gather information, develop information, or create new

ideas who are susceptible to marketing. With advertising, both the advertiser and the hoster are able to make profits from others.

3.7 Common ideology of business models

The above mentioned business strategies all have one thing in common, which is their relation to open source ideas. There are many ways to profit from these ideas (be it as a creator, developer, or middle-man). One thing that important to note is that there is no single best way to build a successful business strategy surrounding open source ideas. In some strategies, there are certain aspects that are suitable, whereas another model might have a complete separate approach. The key to finding a suitable business model is realization about what is being delivered to the customers.

In order to market open source related ideas, it is important to realize that the goal is to sell meaningful solution bundles. This means that understanding the customer or persons concerns is the main priority. In order to meet their satisfactions, gathering information about the customers' project needs, timelines, and a budget is important to be able to provide them services to satisfy their needs. The most important factor is being able to provide services that the customer will be satisfied with, such as a solution to a problem or a replacement to a previous plan.

Value is another aspect that must be fully considered while marketing open source ideas. This relates to ongoing business relationships with the customer. It is important to have a services or product that the customer is willing to pay for continuously. They must be able to evaluate the service or product, and gain a sense of genuine necessity to keep the relationship ongoing (which is the goal). Freedom is one last aspect that customers choosing to purchase open ideas require. When a customer is paying for an ideology that is free and open source, it means they are wanting to cut product or service costs, or development fees.

4 COMPANY ANALYSIS

The following chapter will analyze several top companies in the open source market. Several similarities can be identified within the different technologies, yet there are many differences in implementation strategies and technology used. Software, as an

operating system, will be analyzed through Linux. 3D printing company Makerbot will be analyzed as an integrated solution of hardware and software into a product. The final one will be of the Ubuntu Edge mobile platform campaign.

4.1 Linux Operating system

One of the greatest examples today of open source is Linux. This has been around from the beginning of IT open source philosophy, and has remained around up until today. It is an operating system that can be utilized on many different levels. Desktops, servers, integrated devices, and even mobile technology are utilizing the Linux operating system. Today, many different distributions (or versions) are available that are all Linux based. There are many reasons why Linux is successful, and a viable choice for any business strategy. Figure 3 below shows a chart of many successful Linux distributions.

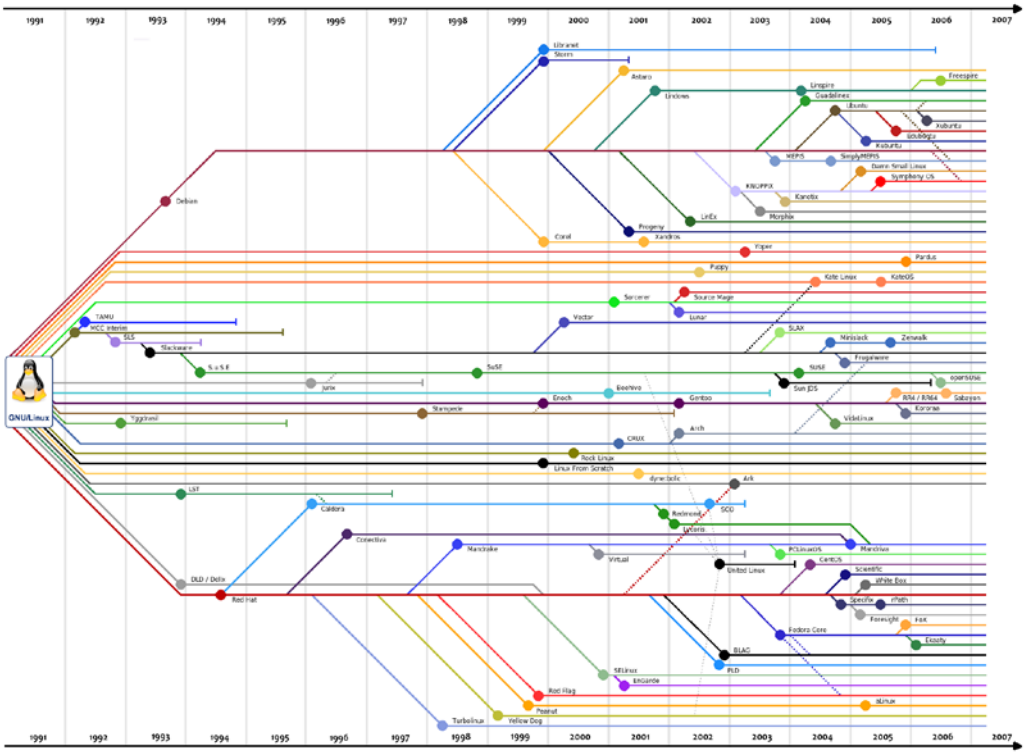


FIGURE 3. Linux distributions [18]

4.1.1 Ubuntu desktop

Ubuntu desktop is the most common, and easy to use Linux distro. This distribution of Linux focuses on the end user, and is meant to replace Windows or Mac. When Linux

was originated, and just up until recently, it has always been considered a hard operating system to use due to the fact that it is based off of command line interface. Windows has always been focused on ease of use to the user. In comparison, Windows is more user friendly, while Linux is more developer friendly.

Today, however, there have been many developments and features added into the Linux environment which are making it just as easy to use as Windows or Mac. Ubuntu 12 released a very updated version of the software center, which replaced the need to install and manage many programs from command line. This has resulted in an increase of Ubuntu desktop usage.

For developers, Linux has always been the most suitable option since everything is open source; thus allowing for tweaking and modification of system, and an ideal development environment. Many servers are based of Linux, yet Windows also has its own proprietary systems for servers as well. When it comes down to differentiating the difficulty between the two, it has now almost reached a point where Linux is easier than Windows. The only drawback with Linux is the fact that most software and applications are based off of Windows, since it is proprietary, but more and more developers are making applications Linux based as well. Wine is a program that is able to use as a go-around for solely Windows based programs, since it is able to virtualize them under Linux.

Ubuntu definitely does require more knowledge, yet Windows seems to be making things harder and harder to use as time progresses. With the release of the new Ubuntu software center, it has become viable option to replacing expensive Windows licenses, as well as a favorable operating system all around with the GUI as nice as it is.

4.1.2 Other Linux ideas

From the origins of Linux, there have been many systems that are based off the original system. Ubuntu is the most common version for desktops, however there are many other environments such as red hat, fedora, open BSD, Debian, SUSE, Backtrack, XBMC, Android, and many more. Each one has its own aspects, which are used for different purposes. Each one is of course open source, and developments and improvements are constantly made. Compared to Windows and Mac, the possibilities for

utilization are endless. Computers, tablets, servers, and even mobile device operating systems are all being run more and more with Linux environment.

4.1.3 Future of Linux

The future of Linux can be interpreted by the recent growth in popularity. As it becomes easier to use, and more feature rich, there will be more developments and ideas evolving from this platform. The concept of the Linux system is simple, and will always remain simple. This means that newer applications of this system will be implemented across many different environments. Mobile, media, and integrated systems are becoming dominated with Linux based systems, which reduce startup and maintenance costs, as well as free the user from proprietary systems and software's.

4.2 Makerbot – 3D printing

Makerbot is a consumer 3D printer retailer, which has open source roots, and has come to dominate the consumer 3D printer market. Originally, Makerbot was open source, and had developed a 3D printer based off of the RepRap designs. This first prototype was made open source, and has since then undergone much development and improvements through various communities and developers. The second version of the Makerbot 3D printer became a proprietary product under the name Makerbot, and no longer was available to the public. Also Makerbot owns Thingiverse, which is one of the biggest 3D model sharing platforms.

This company is a great example of how using open source provided an environment for creating a name brand product. By using open source communities, development and ideas were collaborated into a product, which now dominates the market. This was done through several modifications to the original prototype and other various 3D printer models. One aspect is the custom case with logo and LED lights, which has an overall appearance that separates it from the rest. Another is the dimensions and shape of the printer.

4.2.1 Transition from open to closed source

Makerbot today is the one of the leaders in consumer level 3D printer market. Many criticisms arose from the move on Makerbot to make the second 3D printer version closed-source. This, however, meant that they decided their original works with the additions to the release of the second version were good enough to be able to market as a product.

Since Makerbot has been around since the origin of these consumer 3D printers, it has been able to compete in the market. Even though it was open source from the beginning, it was able to develop into a closed source product by development under open source.

4.2.2 Lessons learned

When looking at the method that Makerbot capitalized on the 3D printing market, it becomes evident on how to be able to compete. There were minor changes to similar consumer 3D printers, which enabled a customized fully functional device that became a leader in the 3D printer market.

By manipulating open source ideas, it is possible to be able to enter the market with Makerbot. Today there are very few competitors with Makerbot, yet this will change as technology and new innovations are created. Community development is a gateway into this market, since ideas are quite sophisticated, and this saves costs on R&D.

4.3 Ubuntu Edge Indiegogo campaign

Canonical has a huge open source community, and there are many numbers of developers supporting it. When the idea for the Ubuntu Edge mobile platform was born, the community was a big part in creating the final product. The vision was there to create it, so it was taken to the community and told this is the goal. A picture was painted, and so worked started on building the phone. Over 150 developers were building applications for the phone [17]. In order to create this dream, funding was needed.

Crowd funding was needed, and eventually a deal with Indiegogo was met to handle this crowd funding. $32 million was the goal of the campaign, yet it eventually ended up with only $19 million [21]. Even though the campaign was a failure, it initiated a

set of opportunities and discussions for future projects, had millions of supporters, which is a stepping stone for the future. The main problem was that the platform was there for the phone to be plugged into a display and create a desktop environment, however that hardware is not there yet (about 2-3 years away), according to Jono Bacon at Canonical [17]. He also still feels that this was a great success, even though what they went out to achieve never happened.

5 OWN OPEN SOURCE BUSINESS IDEAS

Throughout studies at MAMK, I had to chance to meet a colleague whom I worked on several projects with. These ideas transformed into a business model, and today make up the company of PersonTech OY. A proprietary 3D printer is currently in its final stages of development and testing, before it manufactured and sold to the public. Also VPN services and an online marketplace are being implemented as well. Consulting is one final source of income, which is based off the expertise gathered and learned throughout the open source projects worked on together.

The first project that was collaborated on was using GNS3 (an open source software which emulates real Cisco devices) to see if it would be possible to replace costs for buying real devices for VPN services. The second project that was worked on was building up an open source printer from scratch, based on plans of the open source RepRap projects. The goal of this chapter is to show how by using open source ideas and technologies, it was possible to create this enterprise.

5.1 GNS3 Networking

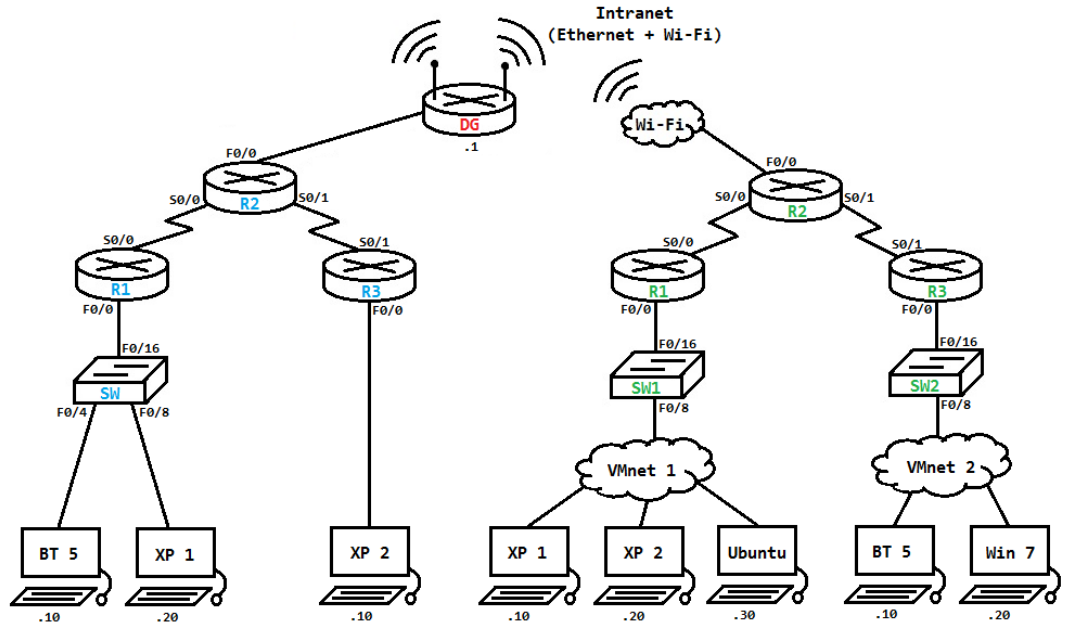
Working with GNS3 was the first time we came together on a project. At this point we were still doing school research, and had no intentions on legitimizing our ideas into a company. This was a project that matured into different stages, and switched focuses throughout the lifetime of the project.

5.1.1 Starting objectives

When the project started, there was a clear goal: to test the anonymity claims of the TOR network project with GNS3 software, while at the same time understand how the

traffic is encrypted/decrypted. TOR is a free and open sourced project, which is downloadable as a browser, to protect a user's privacy on the internet [10]. It is a network that secures data and communication by encrypting/decrypting it throughout the various network paths it travels. The main drawback though, is that when traffic exits the TOR network through an exit node, all data is unencrypted. This means that any personnel information such as account login/passwords, emails, documents, and even credit cards can be seen if they were used during the TOR session.

This was an interesting topic to research, so it led to the plan of testing how secure the network actually is, and if the data is actually encrypted throughout the network. Since TOR is open source, it would be easy to obtain pertinent information regarding the security aspects of TOR to compare with any findings that resulted from testing the TOR anonymity statement. The next step would be to implement a viable environment to begin the testing, which is shown below in Figure 4.



Jesse, Host OS: Mac OS X Lion		
R1	F0/0	192.168.10.1 /24
	S0/0	10.0.10.2 /30
R2	F0/0	172.169.1.2 /29
	S0/0	10.0.10.1 /30
	S0/1	10.0.20.1 /30
R3	F0/0	192.168.20.1 /24
	S0/1	10.0.20.2 /30

Cheng, Host OS: Windows 7 Pro		
R1	F0/0	192.168.30.1 /24
	S0/0	10.0.30.2 /30
R2	F0/0	172.169.1.3 /29
	S0/0	10.0.30.1 /30
	S0/1	10.0.40.1 /30
R3	F0/0	192.168.40.1 /24
	S0/1	10.0.40.2 /30

FIGURE 4. GNS3 testing environment

5.1.2 GNS3 as a free environment

To be able to test the anonymity claims of TOR, as well as its data encryption methods throughout the network, a large-scale network would need to be designed and implemented. Multiple routers, switches, and computers would be needed to do this, but this would require huge amounts resources to create this environment. That is when it was decided to look into virtualization of both networks and computers.

This is where GNS3 comes in. It is an open source project that is designed to simulate complex networks on a computer, without the need for using real devices [11]. This is ideal since it is also able to connect to real devices (computers, other routers and switches, mobile devices, etc.), and to the Internet as well. GNS3 takes care of the network simulation, but computer virtualization would be needed as well to implement multiple hosts running TOR. In order to achieve this, freeware virtualization programs such as VirtualBox or VMware Player would be used. Unfortunately these programs are not open source, however they are free so they fit into the minimal budget that was provided.

In order to setup the environment that was deemed appropriate to test TOR, two host computers were needed as well as a real device to connect the computers (a wireless router was used in this case), and a modem to connect to the Internet (a DSL modem was used in this case). The virtualization software would be installed on top of the two host computers. This is where all the computers resources would be used to setup the complex network design that was needed to test the TOR anonymity claims.

After implementing the network, the focus of the project switched. Security was still to be investigated, but more on the lines of the networks security, and testing client vulnerabilities within this network. In order to this several Windows XP clients would be the victims, and a computer running Linux BackTrack5 (which is open source as well) would be used as the attacker.

At this point the project’s original goals had switched dramatically. TOR testing is still one thing that would eventually be tested, but by being able to use GNS3 it was possible to test out many aspects network security. Penetration tests were run, safely of course in this GNS3 environment. Remote management of the router, security im-

plementations to protect network, and VPN were the main aspects that were investigated and mastered by using this open source software.

The final goal while working with GNS3 was to find out if it was possible replace real devices with dedicated Linux servers running GNS3 (only dynamips/dynagen), using all its resources for it. This would save lots of money by being able to run networking devices on a computer, rather than expensive routing hardware. However, this was proven not possible since VPN connectivity was possible but it would shut down when data was trying to exit the local network to the Internet after a few seconds, and the speeds were also quite slow. This was due to the 1,000 packets/second (which is 100-1,000 times slower than real devices).

5.1.3 Resulting business ideas

This was when the first business idea that was born – selling VPN services. VPN technology is something that is marketed and sold worldwide. By using the open source software GNS3, it was possible to sufficiently and economically test out different methods of VPN implementation, as well as master the security aspects of it at the same time. Without GNS3, there would be high costs on devices and electricity, lots of space needed for devices, and other drawbacks such as heat and noise.

The GNS3 project eventually would lay the foundation for a co-operation that would eventually lead to a partnership of innovating and selling open source based ideas. VPN technology was one aspect that was shaped into the business model, but network security consulting was another service that was practiced and mastered throughout the process of using open source software's of GNS3 and BackTrack5.

GNS3 is not viable to replace real devices, so real networking devices will be required in order to setup a VPN service provider. Another alternative to real devices could be the open source BSD Router Project, which uses a computer's hardware as a router [20].

5.2 3D printing

Throughout the GNS3 project, a co-operation and collaboration of ideas was formed. This can be viewed as one of the benefits of open source: community development. The co-operation from the previous GNS3 project now had moved into utilizing a new set of open source ideas. 3D printing was the next project that would be researched and developed into a business model.

5.2.1 What is open source 3D printing

3D printing is something that has been around in the industrial field for over 20 years, however in the recent years it has been shaped into a consumer product available at reasonable prices. Within the industrial field prices can range anywhere from 5,000 – 20,000 Euros, which depend on the type of technology used. There are many fields that use and benefit from 3D printing, such as: architecture, industrial design, automotive, aerospace, robotics, dental, medical, education, modeling, construction, etc. [12].

RepRap is an open source community, which revolves around the 3D printing realm of technology. All the mechanical designs, software needed, and community are open source; thus providing a perfect environment for development and building up low cost 3D printers.

There is also a large community revolving around the 3D models, which are what is actually being printed out into a physical form. One of the bigger ones is called Thingiverse, and can be seen as a community that supports and provides a mean to share open source ideas. The 3D models that people create are shared here, and can be changed, modified, or customized with 3D modeling software.

Most of the consumer 3D printers today are self-replicating, meaning that they can print out most of their parts (other than the metal rods, nuts/bolts/washers, electronic boards, and a few other parts). This means that once you have a 3D printer, it is possible to print out half of the second one, which also saves a lot of money.

Consumer 3D printers have dropped to reasonable prices over the past few years, and are now quite affordable and popular in households globally. The market is starting to grow, and there are only a handful of company brands making their own products. Makerbot is one of the most famous and larger company providing consumer 3D

printers, and was actually open source on its first design (Makerbot Replicator). Cubify is another large enterprise in the same field. RepRap and Ultimaker are both open source projects, where it is possible to find all the designs/blueprints and software for creating a self-replicating 3D printer.

5.2.2 Business ideas from open source 3D printing

After doing research and communication within the 3D printing community, the realization of building an open source designed 3D printer was in the realm of possibilities. This would require a small investment, time, and hard work to complete a working 3D printer. Eventually the RepRap Prusa Mendel i2 was built up, which is shown in Figure 5 below.

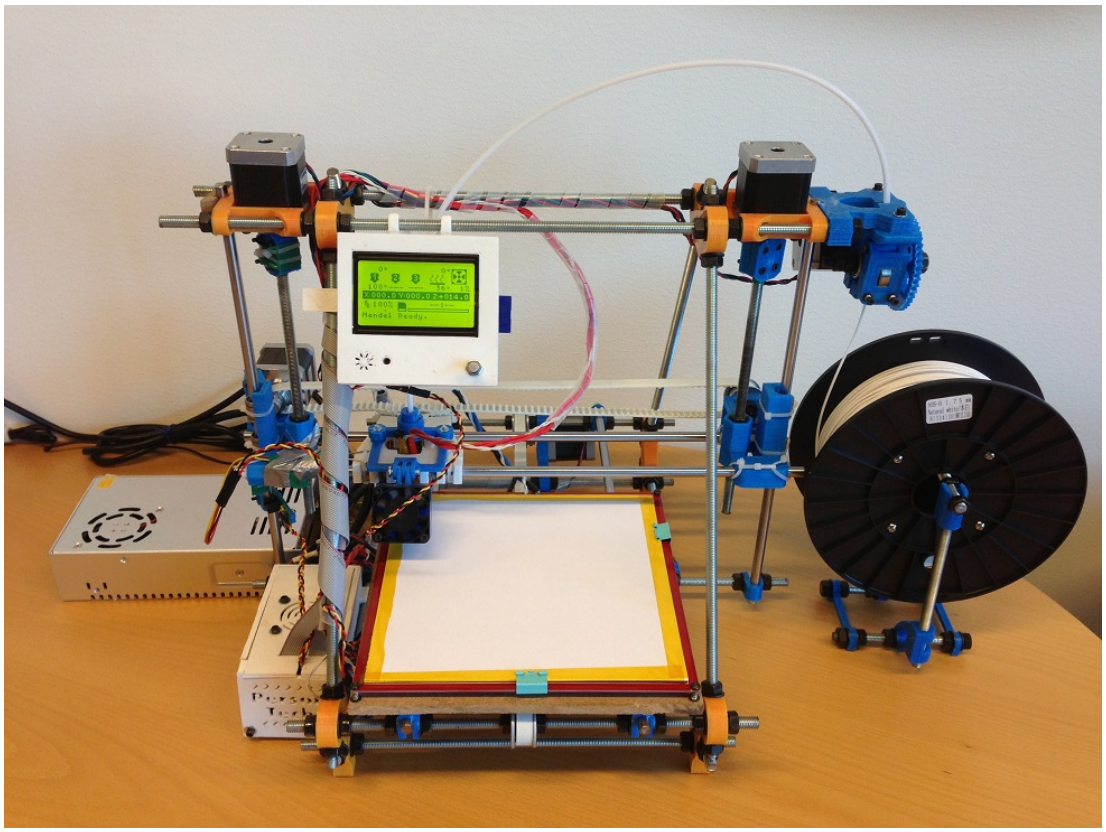


FIGURE 5. Final build of the Prusa Mendel i2

After this first 3D printer was built and tested, it was decided to create a proprietary 3D printer based on the knowledge learned from building and using the open sourced RepRap printer. As mentioned earlier, it is in the final stages of development and will be ready for sale soon. Figure 6 below shows its progress so far.

FIGURE 6. PersonTech OY proprietary printer in production

The main focus of the newly founded company, is selling the ‘under production’ proprietary 3D printer, and integration into other fields close to 3D printing (such as robotics, drones, and even medical field in the future). All of these will require different business strategies, but the main thing they all have in common is the basis that they were all created from open source ideology.

In order to be able to sell any of the services mentioned above, a legitimate company is required first. The second step is to have an online shop, and the third thing is to have a supply of the equipment needed to build, manufacture, and ship the product. Research into other companies in the field is required as well, to understand the prices that other competitors are selling at, and adjust own pricing schemes accordingly.

5.3 CMS Web-design

In order to market products and services, as well as get out company information globally, a company website must be developed. This requires product software, do-

main name registration, and web hosting service. Altogether, a substantial amount of investment will be needed in order to get a professional website. So how is it possible to cut some of these costs?

Well, of course open source again is one possibility to cut costs of purchasing expensive software or hiring a web designer. There are many different open source platforms for building up webpages. Joomla, Wordpress, and Drupal are three of the most famous engines for designing webpages. These have prebuilt templates where it is possible to modify and add content, menus, designs, and plugins. Also there are many communities that are dedicated to various templates and plugins for these environments. Some of these cost money, while others are free or have trial periods.

The main benefit with these platforms is of course the fact that they are free. They also are easy to use, and have constant updates to improve the web design environment, making it easier to use and customize. Also while building webpages from scratch, a lot of knowledge about HTML, PHP, Java, SQL, etc. is required in order to produce a professional webpage. With these open source platforms, they have prebuilt templates and are really easy to use and edit code. This means that for an end user of this open source platform, it is possible to work with what is given to design a professional looking website.

In this case, Joomla was used to create a homepage, OpenCart was used to create an online store, and Wordpress was used to create the blog. This cut costs of hiring an external web designer, as well as purchasing expensive software to build the webpage up on.

5.4 Future of company

The above-mentioned ideas are the solid backbone of the business plan for this company. VPN will be a self-sustainable, slow income service that requires little to no work at all. 3D printing, and its related technologies, will be the main focus of the business and will require new development, innovations, and lots of marketing. IT consulting also fits in where time is available to provide solid income to support the rest of the business model. All of these ideas were based on work done with open source projects.

In the future, as mentioned earlier, work with open source drone and robot projects will begin. They relate a lot to the 3D printing projects as they use the same types of circuit boards, and they are also able to have their parts 3D printed out. The TOR testing project also introduced Bitcoin, which is now currently being mined for profits as well. The open sourced Raspberry Pi is also something being investigated for future projects as well. It is a very useful piece of hardware that can be utilized in many projects as well.

All-in-all, open source has facilitated and enable the company's progress in many ways. Cost savings, innovating ideas, and research and support from communities all helped build the company. In many ways it would not be possible to achieve what has been done so far without open source.

6 CONCLUSION

Continuous growth of open source is happening constantly. While new ideas are developed, and previous technologies improved, all effort put into the open source communities helps strengthen its reputation as reliable and free of restrictions. Proprietary technologies will always exist, yet the competition of open source will definitely grow exponentially, as it has ever since its origins.

New business models will be developed, and more and more people will start projects under or based on open source licenses. There are many new developers, new possibilities for communities, and more resources to facilitate this growth. Open source philosophy is getting more attention from future generations as well.

In order to keep the momentum going behind the open source movement, a few things need to happen as well. There are two main groups involved: platform developers (the people who build the open source communities, or the open source communities themselves), and the application developers (the people who build content). Both of these groups have different views, and it is important to unite these groups in order to create something better.

One limitation that is being threatened is the fact of growing restrictions on the Internet. New laws regarding commerce, freedom of speech, and invasion of privacy are happening as well. These are all factors that affect many aspects of open source, yet this still is not enough of a threat that will affect open source on such a high level.

Mobile devices, computers, cloud databases, technological innovations, mechanical, medical, and aerospace are all areas in which open source is having a huge effect on research and development. These areas will see increase in new technologies and ideas, which result from environments of open source. There are many other areas that will grow as well as a result of open source communities.

This documentation was aimed to understand philosophy of open source, understand the working principles of open source, evaluate several business models, analyze a few open source companies, and provide a working business model. There are many aspects and viewpoints, which have not been covered, yet the material provided maintains a more business focus of methodology. There are many in depth material that is also relevant to this documentation, but for clearer overall understanding, this is substantial enough to provide the knowledge needed for understanding business model implementation of open source.

APPENDIX 1

Bibliography

BIBLIOGRAPHY

[1] 'Open Source', by: Wikipedia [Nov. 24, 2013]
Available in www-format
<URL: http://en.wikipedia.org/wiki/Open_source >

[2] 'Freeware vs Shareware vs Open Source', by: Si Chen [Sep. 13, 2005]
Available in www-format
<URL: http://opensourcestrategies.blogspot.fi/2005/09/freeware-vs-shareware-vs-open-source.html >

[3] 'The Open Source Definition', by: Open Source Initiative [unknown]
Available in www-format
<URL: http://opensource.org/docs/osd#fields-of-endeavor >

[4] 'Frequently Asked Questions', by: Open Source Initiative [unknown]
Available in www-format
<URL: http://opensource.org/faq#commercial >

[5] 'Permissive free software license', by: Wikipedia [Aug. 11, 2013]
Available in www-format
<URL: http://en.wikipedia.org/wiki/Permissive_free_software_licence >

[6] 'The License Review Process', by: Open Source Initiative [unknown]
Available in www-format
<URL: http://opensource.org/approval >

[7] 'Linux', by: Wikipedia [Nov. 27, 2013]
Available in www-format
<URL: http://en.wikipedia.org/wiki/Linux >

[8] 'MySQL', by: Wikipedia [Nov. 25, 2013]
Available in www-format
<URL: https://en.wikipedia.org/wiki/MySQL >

[9] 'Sun acquisition by oracle', by: Wikipedia [Nov. 18, 2013]
Available in www-format
<URL: http://en.wikipedia.org/wiki/Sun_acquisition_by_Oracle >

[10] 'Tor', by: Tor [unknown]
Available in www-format
<URL: https://www.torproject.org >

[11] 'GNS3', by: GNS3 [unknown]
Available in www-format
<URL: http://www.gns3.net >

[12] '3D printing', by: Wikipedia [Nov. 27, 2013]
Available in www-format
<URL: http://en.wikipedia.org/wiki/3D_printing >

APPENDIX 1

Bibliography

[13] 'Linus's Law', by: Wikipedia [Sep. 24, 2013]
Available in www-format
<URL: http://en.wikipedia.org/wiki/Linus%27s_Law >

[14] '10 Reasons Open Source Is Good For Business', by: Katherine Noyes [Nov. 10, 2010]
Available in www-format
<URL:
http://www.pcworld.com/article/209891/10_reasons_open_source_is_good_for_business.html >

[15] 'The Benefits of Open Source', by: Montepelier Open Source [unknown]
Available in www-format
<URL: http://www.montpelieropensource.com/benefits.htm >

[16] 'Five Pros and Five Cons of Open Source Software', by: Dennis McCafferty [Jan. 9 2013]
Available in www-format
<URL: http://www.cioinsight.com/it-strategy/linux-open-source/slideshows/five-pros-and-five-cons-of-open-source-software >

[17] 'The Open-Source Revolution | Engadget Expand 2013', by: Engadget [Nov. 11, 2013]
Available in www-video-format
<URL: http://www.youtube.com/watch?v=TpZ2bHC5HIY >

[18] 'Linux Distro Timeline', by: withfriendship.com [unknown]
Available in www-format
<URL: http://withfriendship.com/images/d/16812/linux-distribution-icons.jpg >

[19] 'OpenLogic', by: OpenLogic [unknown]
Available in www-format
<URL: http://www.openlogic.com/solutions/technical-support/ >

[20] 'BSD Router Project: Open Source Router Distribution', by:bsdrp.net [Oct. 30, 2013]
Available in www-format
<URL: http://bsdrp.net/ >

[21] 'Ubuntu Edge Indiegogo campaign ends with over $19 million outstanding', by: Jamie Rigg [Aug. 2013]
Available in www-format
<URL: http://www.engadget.com/2013/08/22/ubuntu-edge-indiegogo-campaign-fails >