

PREFACE

This thesis is the final work of my two years of studies of the International Master in Management of Information Technology conducted at the IAE Graduate School of Management, Turku School of Economics and Tilburg University. The conclusion of this final work also means the beginning of a new and important phase of my life after the excitements of studying in three different countries within less than two years.

My strong computer science and open-source background made it a greater pleasure to write a thesis built around the extremely motivating topics of open-source and open-innovation. Moreover, I am decided to keep close relationships both with the research topic as well with the Nokia Maemo initiative, the unit of analysis of this thesis research.

The first acknowledgments go to my family for their vital support of my master program. I would also like to thank Carlos Guerreiro, Attila Domokos and Peter Vajda from Nokia for making this research possible. I would like to mention the researchers Juho Lindman and Jussi Nissilä who never ceased from contributing to this thesis. Finally, I am obliged to express my immense gratitude to my academic supervisor Timo Leino and extend this gratitude to other Turku School of Economics personnel such as Eija Koskivaara, Douglas Brear, Hannu Salmela and Annukka Vahtera.

TABLE OF CONTENTS

1	INTRODUCTION	7
	1.1 Research background.....	7
	1.2 Research motivation	7
	1.3 Research problem	8
	1.4 Research boundaries	8
	1.5 Thesis structure.....	9
	1.6 Definition of concepts and terminology	9
2	THE OPEN-SOURCE PHENOMENON	12
	2.1 A brief history of open-source.....	12
	2.2 The growing economic impact of open-source	13
	2.3 The open open-innovation concept and its implications.....	16
	2.4 Bringing together open-source and open-innovation	19
3	PLATFORMS WARS AND NETWORK EFFECTS	22
	3.1 Corporate strategy within high technology and high competitive markets .	22
	3.2 Platforms war concept and its application	23
	3.3 The network effects economic principle.....	25
4	THE NOKIA MAEMO INITIATIVE: A REVOLUTIONARY OPEN-SOURCE SOFTWARE PLATFORM.....	29
	4.1 The Maemo Community	29
5	RESEARCH METHODOLOGY	31
	5.1 Selection of research method	31
	5.2 Case study design	31
	5.3 Evidence collection.....	32
6	RESULTS	35
	6.1 The analysis process	35
	6.2 Analysis of evidences related with Maemo development.....	35
	6.3 Analysis of evidences related with open-innovation	39
	6.4 Analysis of evidences related with Maemo competitiveness.....	41
	6.5 Analysis of evidences related with platform wars.....	44

6.6	Analysis of evidences related with network effects	45
7	DISCUSSION.....	48
7.1	Benefits from an open-platform	48
7.2	Competitive impacts	50
7.3	Limitations	51
8	CONCLUSIONS	53
9	REFERENCES	54
10	OTHER MATERIAL SOURCES	56

LIST OF FIGURES

Figure 1	OSSI business evaluation needs.....	15
Figure 2	Open-source use and offering among Finnish software industry.	16
Figure 3	Closed-innovation.	17
Figure 4	Open-innovation.....	18
Figure 5	Open-source as instance of open-innovation.....	20
Figure 6	Porter's competitive advantage strategies.....	22
Figure 7	Hagiu's multi sided platform layers	24
Figure 8	Direct network effects associated with a platform.....	27
Figure 9	Indirect network effects associated with a platform.	28
Figure 10	Maemo open-source initiative.	30

LIST OF TABLES

Table 1	Closed- innovation and open-innovation principles.	19
Table 2	Maemo open-source benefits among the typical phases of software development:.....	36
Table 3	Maemo as an instance of the open-source and open-innovation paradigms:	39
Table 4	Evidences of Maemo open-source competitiveness (extending Porter theory):	41
Table 5	Winning a platform war – Evidences on how open-source is attracting more developers/complementors:	44
Table 6	Platform competition under network effects:	46

LIST OF ABBREVIATIONS

API - Application Programming Interface.

FLOSS - Free Libre Open Source Software.

GNU - GNU's Not Unix.

GPL - GNU General Public License.

IEEE - Institute of Electrical and Electronics Engineers.

OSS - Open-Source Software.

OSSI - OSS as an Integrated part of business.

PIM - Personal Information Management.

PDA- Personal Digital Assistant.

SDK - Software Development Kit.

VOIP – Voice over Internet Protocol

1 INTRODUCTION

1.1 Research background

Open-source not only proved its potential in software development, but it has also been the groundwork of emerging business models that completely shake the high-tech computer based industries (Helander & Vahvanen 2006). Meanwhile, open-innovation continues being a trend that is reshaping how organizations structure innovation processes toward a new “open model” in which they learn how to use ideas wherever they find them, in a more flexible manner (Chesbrough 2005).

This research studies the two previously mentioned “open” phenomena by looking at an open-source software division of Nokia known as Maemo. It is important to mention the high significance of the Nokia corporation, as market leader in the high-tech and high-competitive mobile industry. According to Gartner, the United States based advisory firm, Nokia detained, by the end of the first quarter of 2009, a market-share of 36% of the worldwide sales of mobile terminals to end users and 41% of the worldwide sales of smart-phones to end users, evidencing firm’s leadership in the sales of mobile devices integrating both advanced hardware and advanced software technologies.

The research author perceives that the complexity of mobile devices is increasing, and that the mobile operating systems that empower these devices take a more significant role. This complexity augmentation seem to be correlated with an increase of mobile devices production costs. Many of the players on the high-tech and high-competitive mobile industry seams to carry out crescent investments in software adopting platform based strategies, this lead to platform wars where corporations compete not only for their own products but also for their own platforms.

1.2 Research motivation

This research was developed as part of the Erasmus Mundus International Master in Management of Information Technology, a two year Master program hosted by the IAE Aix Graduate School of Management (France), Turku School of Economics (Finland) and Tilburg University (The Netherlands). The last semester of this program is devoted to research and the writing of a thesis. The semester includes an internship in an internationally operating company.

Being a former open-source developer and advocate since the early start of his academic life and having professional experience on Nokia's open-source based division of the Nokia Research Center in Helsinki, the research author feels himself very familiar

with the conducted research. The author opted to develop his thesis in cooperation with Turku School of Economics and with Nokia, two institutions correspondingly perceived by the author as the best university and firm among many he had contacted with.

1.3 Research problem

The research question is “How an open-platform brings competitive advantage in a high-tech and high-competitive market under network effects?”. It addresses how the open-source and open-innovation paradigms bring competitive advantage to high-tech and high-competitive organizations following platform based strategies.

In computer based industries there is a growing competition between organizations that shifted from product based strategies to platform based strategies, leading to complex and competitive markets where organizations fight for their platform leadership. Managers of organizations involved in these battlegrounds can, in this thesis, find a comprehensive study on the possible positive impacts that could raise with the decision of opening a platform. By opening a platform the thesis author means implementing the open-source and open-innovation paradigms within the platform's organization.

Most of the research made on open-source from an economic perspective, was performed by looking at organizations that produce software following a product based strategy. In this research scholars find a study that involves open-source within organizations following a platform based strategy. In addition, research performed to corporate strategy related topics often ignores the potential of open-source and open-innovations. This research brings the three topics together.

1.4 Research boundaries

This research is mainly applicable in specific cases of high-tech and high-competitive organizations that develop platforms combining both hardware and software, competing in markets under the competitive forces of the network effects economic principle. The research was constructed by looking at an organization developing a mobile device platform and many inherent boundaries are related to the case study nature of the research. Generalizations of findings that could relates to the this research should be taken very carefully.

Moreover the Nokia Maemo initiative, which outcomes include the development of an open-source platform, seems to be a quite singular initiative. The author did not find any other similar case of a big corporation developing a multi-sided and open platform

combining both hardware and software.

Although the author signed a non-disclosure agreement with the research site, this did not significantly impact the research process and its outcomes. Two responsible from the Nokia Maemo software division reviewed this thesis before it has been published.

1.5 Thesis structure

This Master thesis document starts with a comprehensive literature review on a set of related research topics, guiding the reader to a better understanding of the inner research problem. The literature review provides a high-level overview of previous published works on the open-source, open-innovation, competitive strategy, platform-wars and network effects research topics. Since this thesis encompasses a wide set of research topics, the author pursued to provide the reader with a review of the most significant literature at an introductory level.

After presenting a high-level review of previous published literature the author describes the methodology that commanded the research development. The reader can find both the research method and the research design considerations together with a description on how the different research evidences have been collected.

The final part of this thesis is dedicated to the analysis of the collected evidences and its research implications. It includes space for both the presentation and the discussion of the research findings as well as its inner limitations and observations. The conclusions directly address the research problem and possible new research directions are given.

1.6 Definition of concepts and terminology

This research made use of key concepts and terminology widely used in both the information systems and the computer science research areas. To provide the reader with a better understanding of these concepts and terminology, the following section aims to provide the definition of the previous referred concepts and terms:

- FLOSS is the abbreviation refereeing to the Free Libre Open Source Software, it refers to software licensed in very permissive manners allowing users to use, study, change, and improve its design through the availability of its source code. This abbreviation emphasis the null price associated with the free use of software open-source software.
- GNU is a recursive abbreviation for GNU's Not Unix. It refers to a computer

operating system composed entirely of free software. Development of GNU was initiated by Richard Stallman and was the original focus of the Free Software Foundation.

- GPL is the abbreviation of GNU General Public License; it is one of the mostly used open-source software licenses developed by Richard Stallman that uses copy left to ensure that software freedoms are preserved, even when the work is changed.
- OSSII refers to the research project "Managing OSS as an Integrated part of business", a Finnish research project that developed a management framework by examining the open-source phenomena from the perspectives of sociology, technology and business.
- Agile Methodologies are approaches to project management, typically used in software development where requirements and solutions evolve through collaboration between self-organizing cross-functional teams, contrasting from traditional sequential development.
- Bug refers to software bug, the common term used to describe an error, flaw, mistake, failure, or fault in software programs.
- Code repository refers to source code repositories. They are network based databases of software source code necessary to develop computer programs.
- Complementor is usually used to describe firms that do not directly sell their own finished products or services. Instead they develop their business by complementing products provided by other firms adding value to the final customers.
- Internet tablet is a product concept introduced by Nokia that focuses on internet and media features. The product is positioned between a PDA and a portable PC.
- Multi-sided platforms are platforms that bring together two or more interdependent groups of customers dependent on the activities of each other. They are often developed when platform vendors don't have the capabilities and resources to perform the development of all platform components.
- Network operator is a firm providing carrier network services using wired or wireless infrastructures. Telephone companies providing voice network services and ISPs providing internet services are the most frequent examples.
- Patch is small software aimed to fix software bugs. The term is often used to refer to small software aimed to upgrade an existing software version.
- Smartphone is an advanced mobile phone providing an operating system and a SDK that allows software developers to produce mobile applications that can be deployed on the device.
- Software Development Environment is a concept that refers an integrated set of

tools simplifying the construction of software applications.

- Software Testing Environment is a concept that refers an integrated set of tools simplifying the testing of software applications.
- Version Control System refers to a suite of software programs that automate the management of different source code and documentation versions. With such a system it is easier to record the history of sources files and documentation and it is easier to perform collaborative development among geographically dispersed teams.
- Wiki commonly refers to a website that uses Wiki software that allows an easy creation and editing of Internet web pages, using a simplified markup language. Ward Cunningham, an earlier developer of Wiki software, described it as the simplest online database that could possibly work.
- Web-based is a term used to describe technologies built on top of the World Wide Web, a system of interlinked hypertext documents accessed via the Internet. Users of web-based technologies very often need a browser.

2 THE OPEN-SOURCE PHENOMENON

2.1 A brief history of open-source

Many narratives on the history of open-source are available. Perhaps one of the most interesting ones is the one provided by Jarno Huurainen and other researchers from the Lappeenranta University of Technology (2006) that divide the open-source history among three different eras, as the history was influenced by three key different actors. History shows that open-source practice has been used since the development of the first software projects, even before the rise of the internet. Software source code has for example been shared as part of commercially marketed products in the 80's.

In 1985 Richard Stallman, in order to promote the idea of freedom, founded the Free Software Foundation launching a new era in the open-source history. The Foundation, which is still very active today, promotes that software should run freely and that corresponding software source code should also be studied, changed, copied, published and distributed freely. In 1989 the Free Software Foundation introduced the GPL (General Public License). Two years later, in 1991, GPLv2 was introduced. The GPL is the most popular license type used both for free software and open-source software (FOSS). Stallman's idea of free or open software is based on ethics and not on technical superiority or business interests.

A few years later in 1998, Eric Raymond claimed that first free operating system known as GNU/Linux, brought a totally new way of developing software by making use of thousands of volunteer developers collaborating over the internet in a distributed "organization" towards a common goal, which proved to be a more efficient way than the traditional hierarchical and controlled way. The main reason for this is that the number of people involved can quickly make short work of identified bugs. In February 1998 Raymond founded the open-source Initiative, and quickly got support during the year when, for example, IBM, Sun Microsystems, Oracle, Informix and Corel announced initiatives to support open-source initiatives. At this time, open-source was generally making way into big businesses and their software practices.

In the year 2005, after several years of steady growth of the popularity of open-source, a new term appeared "Commercial Open Source Software", used by, e.g. Microsoft. This means, mixed source products where the code is partially open and partially proprietary, making it possible to offer own products under the same license fee based model as before, while getting the benefits of open-source code without having to pay a license fee. This of course is distinct from the ethical ideas that originated by Stallman. The initial ethical ideas were replaced by the business interests of both small and large companies, sometimes at the expense of developers' freedom.

Nevertheless, the role of companies in the open-source field is growing, and the next question could perhaps be if open-source becomes business as usual.

Huurinainen concluded the narrative on the three open-source eras with the interesting statement: "One thing is for sure; Open Source is here to stay" (Huurinainen et al. 2006).

2.2 The growing economic impact of open-source

In recent years, the echoes of open-source software development attracted the interest of economic scholars. The economists Lerner and Tirole (2001) made a preliminary exploration of the economics of open-source by assessing the extent to which economics literature on "labour economics" and "industrial organization theory" could explain the open-source phenomenon. The mentioned research brought some answers to what motivates open-source developers, compared the different programming incentives between open-source and proprietary settings and highlighted the favourable organizational and governance characteristics for open-source production. However, the same research raised many new research questions related to open-source on the technological characteristics that are conducive to a smooth open-source software development, on the optimal licensing for open-source software, on the coexistence of open-source and proprietary software and on the transposition of the open-source process to non-software industries. Later all these research questions were further explored, for instance, Paajanen (2007) developed a multiple case study on the licensing for open-source software while Bonaccorsi and Rossi (2003) discussed the coexistence of open-source and proprietary software.

An economics research on the effects of open-source software on software industry business patterns was conducted by Lindman (2004). The author combined existing literature on the history and nature of the open-source phenomenon together with wider discussions of the software industry strategy and its business models. Following a narrative approach on the phenomenon the researcher revealed a change of the competitive environment, a change of customer's expectations and centered attention on the importance of competence and platform thinking. Regarding the changes of the competition environment, the researcher stated that existing proprietary software cannot, in the long run, compete against open-source, forcing incumbents to fight the open-source initiatives using different tactics such as the use of media targeted marketing tactics, the introduction of different lock-ins and copyrights strengthened by lawsuits. The same researcher identified that customers expectations, linked to the change on the competition environment, need enhancements on the credibility and quality of open-source. The researcher also discussed that in a society moving towards

to a knowledge based economy, where markets turn from products to services, different competencies will be needed by open-source developers and the role of software platforms as “market makers” will evolve.

Enabling an easier understanding of the economical impact of open-source, a group of Finnish researchers, studying the open-source phenomenon from different viewpoints, provided a framework identifying the different user roles that companies participating in open-source projects may play. Five stages were identified, from a stage where users simply use open-source technologies to a stage where users are intensity involved in open-source. In Figure 1 we can view the five levels of use of open source from the business viewpoint, where an increase on the level of open-source involvement is correlated with an increase in the complexity on the task of managing such involvement. On the third level entitled “OSS component integration” users have an arbitrage between a considerable possibility of savings on one side and the risk of running a critical business without an explicit firm to rely on product support and upgrades on the other side. The fourth level, entitled “Active participation and management of OSS communities” disrupts from the traditional ways of running business, the traditional contracts could turn in a meritocracy where new and trendy skills are needed to manage relationships with non-contractual partners. Finally, the fifth and most challenging level named “Launching new communities”, includes the difficult task of creating an open-source community and promoting it in order to attract developers that want to take part, and steer it according with the “launcher” needs (Helander, Aaltonen, Mikkonen, Oksanen, Puhakka, Seppänen, Vadén and Vainio 2007).

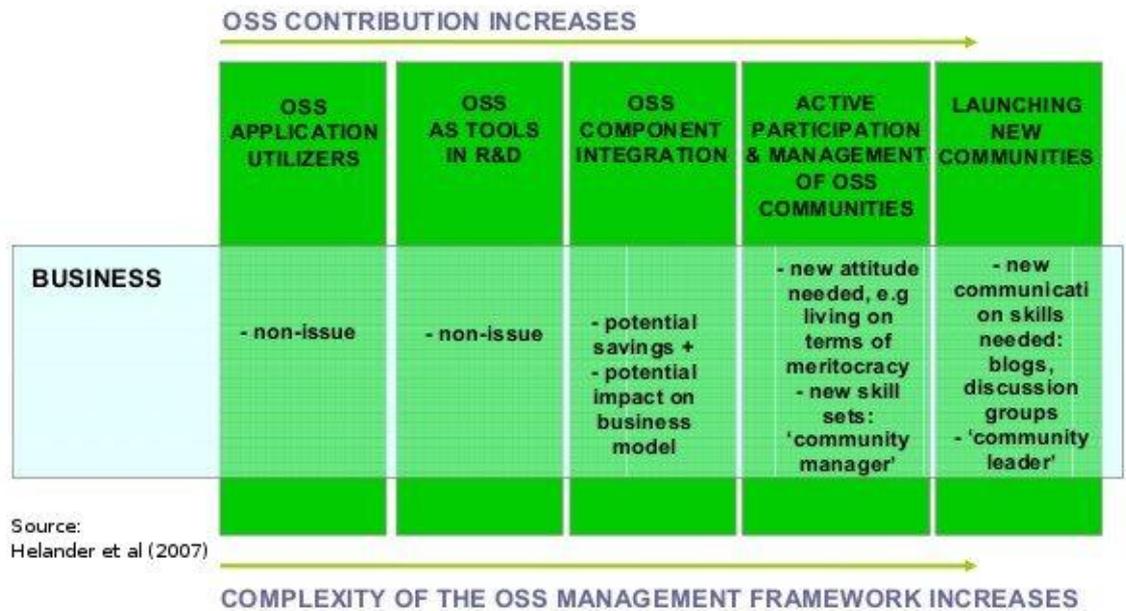


Figure 1 OSSI business evaluation needs.

Perhaps some of the most clear evidences illustrating the growing economic impact of open-source is the result of a survey on the Finnish open-source software business conducted by Helander, Rönkkö and Puhakka (2008), that provides an estimate of the degree of use of open source software in the Finnish software industry, a strong industry that that accounted a revenue of 1.52 billion Euro in the 2007 fiscal year. According to the 2008 survey results, 75% of the studied firms were using open-source software, an enormous increase since only approximately 13% of the firms were using open-source software according an analogous survey in the year 2000.

Figure 2 captures to what extend Finnish software firms use and offer open-source software. The high usage of open-source software together with the considerable number of open-source components offered to the market by companies reveal a Finnish leadership on the open-source business phenomenon.

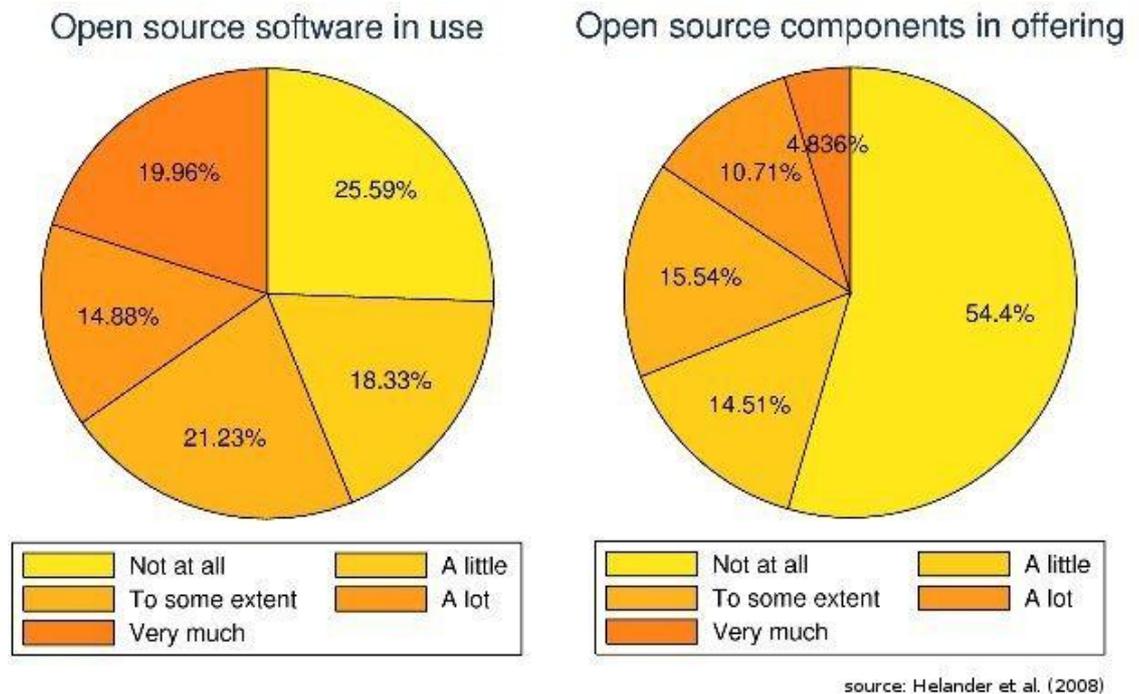


Figure 2 Open-source use and offering among Finnish software industry.

2.3 The open open-innovation concept and its implications

Innovation scholars and practitioners are increasingly promoting the open-innovation concept introduced by Chesbrough (2003) that explains how leading firms evolved from the so called “closed-innovation” processes towards a more open way of innovating called “open-innovation”. Traditionally, innovation's research and development and corresponding marketing processes take part within firm's corporate boundaries. Xerox and its PARC Research Center are a great example of a company that failed to profit from its “in-house” innovations. Xerox PARC innovations have revealed afterwards a high profitability outside firm corporate boundaries within spin-off companies such as Adobe and 3com. The following Figure 3 illustrates the closed innovation paradigm where overall research and development takes place with the firm boundaries.

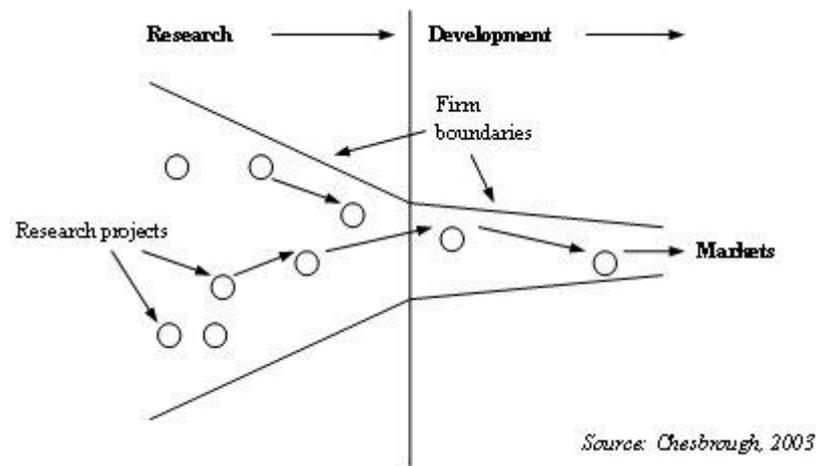


Figure 3 Closed-innovation.

The same researcher identified several factors contributing to the erosion of the closed-innovation paradigm. First of all, the availability and turn-over of high valuable human resources has increased over the past years resulting in a dispersion of knowledge outside of the research laboratories of large companies where employees changing jobs result in flows of knowledge between firms. Secondly, the appetite for risk has increased in the previous years and the correspondent availability of venture capital rose significantly, enabling the good and promising ideas and technologies to be developed outside the boundaries of established firms in the form of entrepreneurial firms, spin-offs, joint-ventures, etc. Finally, the role in the innovation process of companies within the firm's supply chain increased, for instance suppliers started playing a more significant role in the innovation process (Chesbrough 2005).

As a result, firms start seeking alternative ways to increase both the efficiency and effectiveness of their internal innovation processes. Chesbrough (2005) gives the example of the active search of new technologies and ideas outside the firm and the cooperation with suppliers and competitors aiming for a greater customer value. Nowadays it is common to see companies trading research assets within the high-tech market, to see companies launching spin-offs exploiting the potential of new technologies, to see companies establishing joint-ventures with competitors, to see companies forming alliances that develop and promote new technologies, to see companies relying on suppliers on the design of core products, etc.

According to Chesbrough (2005) open-innovation can be described as a way of combining internal and external ideas as well as internal and external paths to market to advance the development of new technologies. This implies that technology firms pursuing continuous innovation must become aware of the increasingly importance of open-innovation, they need to assume that not all good ideas could come from inside the firm boundaries, and that some of this good ideas can be further develop, in a profitable

way, outside the firm's boundaries. The following Figure 4 illustrates the new open-innovation paradigm where the research, the development and market exploration of innovative research projects occurs both inside and outside the firm boundaries.

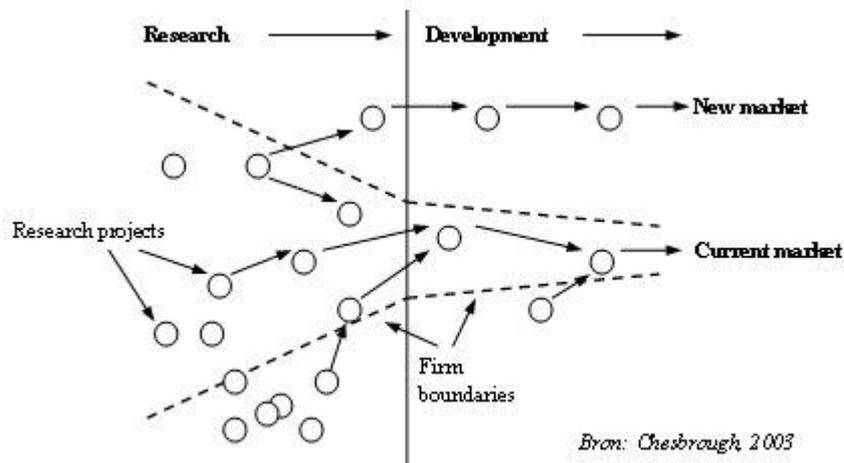


Figure 4 Open-innovation.

The closed-innovation and the open-innovation paradigms can be contrasted using a set of principles presented by Chesbrough (2005) on the way how managers look at the company and its environment. These principles are illustrated in Table 1 below:

Table 1 Closed- innovation and open-innovation principles.

Closed innovation principles	Open innovation principles
The smart people in the field work for us.	Not all the smart people in the field work for us. We need to work with smart people inside and outside the company
To profit from R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create significant value: internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to the market first.	We do not have to originate the research to profit from it.
The company that gets an innovation to the market first will win.	Building a better business model is better than getting to the market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our Intellectual Property, so that our competitors do not profit from our ideas.	We should profit from others' use of our Intellectual Property, and we should buy others' Intellectual Property whenever it advances our business model.

This important shift of innovation paradigms can be reached with the involvement of other parties when developing new products and technologies of high potential. Firms can for instance cooperate with firms in the same sector, with suppliers, with universities, with research institutes and last but not the least with the end-users (Chesbrough 2005).

2.4 Bringing together open-source and open-innovation

Huurinainen and other researchers from the Lappeenranta University of Technology (2006) developed a research report on the motives, circumstances and driving forces for open-innovation. They identified that many corporations attracted by the short design-build-test cycles, low costs of new releases, and a great number of ideas moved near open-source communities, using open-source projects as external sources of their research and development units (Huurinainen et al. 2006). Several market factors, including technological convergence, growing product complexity, and interoperability of the software pushed these corporations towards an open-innovation model; many of them used open-source as a part of this new approach, turning it one of the most prominent examples of using external sources in research and development processes (Huurinainen et al. 2006)

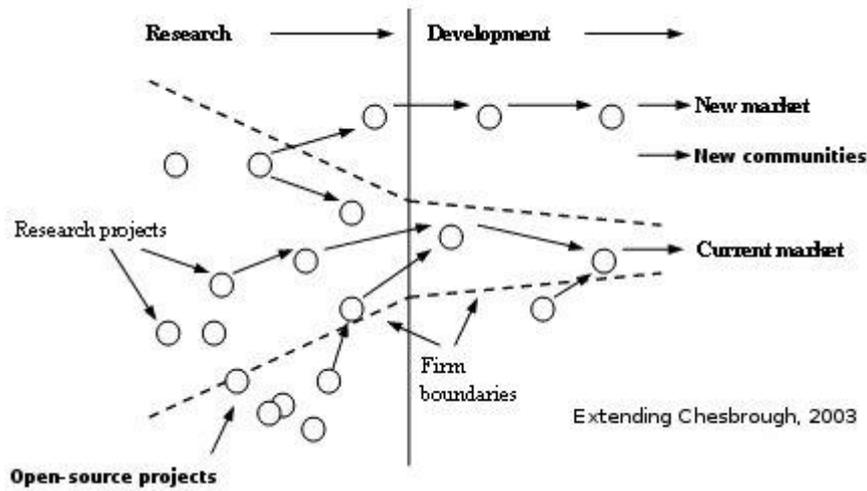


Figure 5 Open-source as instance of open-innovation

The author, created Figure 5 to illustrate how open-source turns to be an instance of open-innovation. Extending a set of principles presented by Chesbrough (2005), the research projects can be made in collaboration with open-source communities outside of firm boundaries, the outcomes of these research projects can be them integrated in firm's market offering. If these outcomes lead to disruptive innovations with potential to establish new markets, open-source could take an important role by enabling new communities around the innovation.

In the case of the implementation of open-source based strategies and business models, managers should be aware of the significance of the communities, especially when open-source communities take big part in the credits of successful products, firm can empower developers to take part on firm's operational and strategic decisions (Onetti & Capobianco, 2005). Considerable part of the operations can actually be managed and created inside the communities, lowering the cost of producing and increasing its quality. The larger communities ensure more ideas and resources that could lead to more business opportunities. However each community has to be managed by effective manners, the open-source benefits do not rise linearly with the size of a community (Huurinainen et al. 2006).

The research author believes that a lot of research can be performed from the managerial perspective of open-source initiatives. For example, organizational studies could be conducted identifying structures that could enable a better collaboration with open-source communities or a better orchestration of open-source initiatives. In addition, with more and more corporations launching open-source operations, human-resources scholars could try to identify the new sets of skills and capabilities that best fit with the new operational roles required by the open-source and the open-innovation paradigms.

The research author also notices that much literature was developed on the in-bound

processes of open-innovation, lacking knowledge on the out-bound processes of open-innovation. This means, using the terms of Chesbrough (2005), that many studies have been conducted on how corporations could bring new technologies and ideas inside the firm boundaries. However there is a lack of knowledge on how companies together with their contributors can deploy and commercialise the results of open-innovations in a profitable manner. This is especially the case in high-tech markets where intellectual copy rights are very difficult to guarantee.

3 PLATFORMS WARS AND NETWORK EFFECTS

3.1 Corporate strategy within high technology and high competitive markets

Much literature has been written regarding corporate strategies addressing firms operating in environments characterized by strong market competition. One of the most cited ones was a book written by Michal Porter that analyzes the basis of competitive advantage and presents the value chain as a framework for diagnosing and enhancing it. According the author, a sustainable competitive advantage is the basis of an above-average performance within an industry (Porter 1998).

Three basic types of competitive advantage have been identified. The first one, known as cost leadership, means that a firm develop their operational capabilities to be able to produce with the lowest cost in the industry. The second one, know as differentiation, refers to firms pursuing the development of unique products very appreciated by buyers that enablers the firm to benefit from premium sales prices. The thirds one, complementary and know as focus, means that a firm concentrate their efforts in selected operations in order to became the best in a group of segments (Porter 1998).

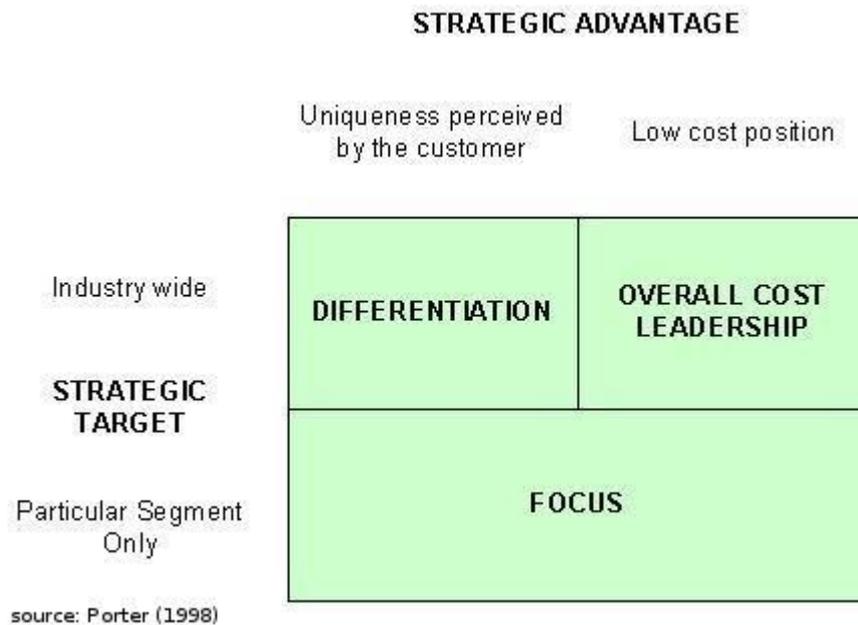


Figure 6 Porter's competitive advantage strategies

Figure 6 presents the three previously mentioned basic types of competitive advantage: First, the overall cost leadership, that could lead to reduced profit margins if all market players follow this strategy; Second, the differentiation, where firms try to

differentiate in different areas such as production, distribution, marketing and services. And finally, the focus, where a firm could cut their offered portfolio to become the best in a specific market segment. However these strategies seem to ignore the role of complementors in the case of firms developing complex technology delivered as platforms.

The strategists Gawer and Cusumano (2007) provide a competitive strategy tool kit for firms pursuing platform based operational models rather than product based operational models. Their proposed strategies, take in high consideration the role of platform complementors and their strategies try to influence both the demand and the supply across particular high-tech markets. They suggest that firms should start by assessing very carefully their offering platform potential and in addition, they warn that dual strategies are very difficult to implement due to opposing logics between the roles of systems assembler and platform leader (Gawer and Cusumano 2007).

3.2 Platforms war concept and its application

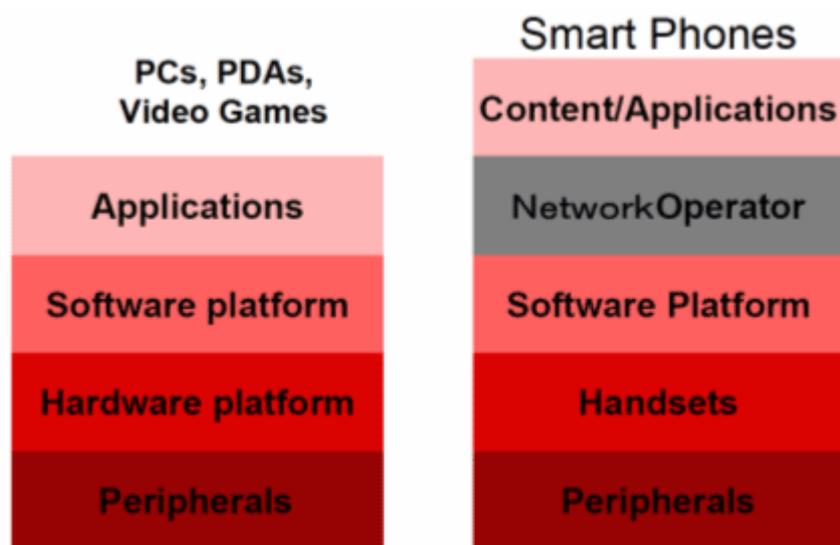
In recent years, high-tech industries have become platform battlegrounds. Examples include, the digital media players (Apple versus Microsoft and Real), the video game consoles (Sony versus Microsoft and Nintendo), the enterprise software (SAP versus IBM, Oracle and Microsoft), and online payment services (PayPal/eBay versus Sony, Microsoft and credit card companies) among many other wars (Gawer and Cusumano 2007).

Platforms can be seen as systems of technologies that combine core components with complementary products and services habitually made by a variety of firms, these are known as complementors. Jointly the platform leader and its complementors form an “ecosystem” for innovation, which increases platform's value and it consequent users' adoption (Gawer and Cusumano 2007). For instance, the current leaders of the video games industry operate by developing the hardware consoles and its peripherals while providing a programmable software platform that allows complementors to develop games on top of their systems. Attracting more game developers to the platform means more and better games, an increase of value for the final users, these are video game players.

The mobile phone industry operates in a similar “platform” mode, especially in the high-end market segment of smart-phones and hand-held devices. Industry vendors not only focus on the development of handsets and peripherals but also on the development of “interfacing” software platforms. This “interfacing” software platform will be used by different entities such as the network operators, mobile devices application developers, mobile service provide and final users. Industry vendors deliver the

platform in many fronts, providing technology that must satisfy network operators (that can dominate the market), application developers (which applications can have a big user base), providers of content (delivering multimedia content) and providers of very popular internet services such as (maps, messaging, video-conference, PIM, VOIP, etc). The thesis author assumes that the compatibility of a device with precious mentioned services is an important factor in the final purchasing decision. In certain cases the final user could prefer compatibility over the “hardware box” individual fit.

Hagiu (2005), based on a case study analysis of the Japanese computer and consumer electronics industries, claims that firms are organized around two-sided platforms with software at their core. The author identifies that within the computer, video-game and PDA industries, the main platforms are currently either pure software platforms (such as the Linux operating systems) or integrated hardware-software platforms (such as the Sony Playstation). The same author claims that the smart-phone industry makes the difference with two software platforms sitting on top of each other (a layer related to device's operating system and other is related with network operator's services). The Figure 7 captures Hagiu's two sided platform layers.



source: Hagiu (2004)

Figure 7 Hagiu's multi sided platform layers

High-tech firms competing in a high-networked economy must adopt platform based strategies versus product based strategies due to firm's impossibility of satisfying by themselves an exceedingly and complex consumer demand. Hagiu (2004), in a column dedicated to the software platforms in Japan's high-tech computer based industries, illustrate the fact of providing all the products (such as content, application, games, etc) demanded by consumers isn't necessary nor sufficient for achieving success. The author remarks that an “all in house” strategy is not economically visible in most of the cases

and expressly recommends firms to focus efforts on the highest value-added components of the platform, making it attractive to all market participants, and let the market to supply the needed complementary products. The previously cited column refers the failure of the telecommunications third-generation platform Vizzavi, a joint venture between Vodafone and Vivendi, which relied on exclusively on in-house content provided by Vivendi Universal.

Gawer and Cusumano (2007), in a strategy article pointed to firms pursuing a platform leadership, highlight the key economic role of platforms as “engines of innovations”. The strategy researchers claims that there is a shift from a vision narrowly limited to products or services with pre-determined uses, to a new one fuelled by continuous innovation brought by third-parties.

The same researchers argue that there are two fundamental strategies for platform-leader wannabes to follow either by themselves or in combination. The first strategy named “Coring”, tackles the problem of how to create or establish a new platform where no one has existed before, the second strategy named “Tipping” must be deployed in a context of platforms that are already competing between themselves. Very briefly, the “Coring” strategy starts with the identification or design of elements (such as technologies, products and services) escorting them to the core of a technological system with a associated new market; this strategy efforts in re-architect technological and business relationships in a power structure among firms. On another hand, the “Tipping” strategy (build on earlier economic insights on standard wars) set out to influence platform's dynamics helping managers to construct a market momentum to win a platform battle.

3.3 The network effects economic principle

As mention by Heide (2000) in a economics research that looks at the role of network effects in telecommunications market, the network effects economic principle is said to be present when an existing user of a network benefits from any new user that join the network. The Fax communication devices are a classic example of a market subject to network effects, in the sense that the value of a Fax device depends on the number of other users with a compatible Fax device. It is important to notice that the value of a single fax in the world as communication device is null, because there is no other compatible fax device to communicate with; However with millions of compatible Fax devices adopted worldwide a fax device turn to be a very valuable communication device.

The thesis author highlights that platform wars take place in market-battlegrounds subjected to the economic principle of network effects. This means that the different

users could prefer compatibility over the individual fit of an available platform, giving a considerable advantage to platforms with a larger user-base. The competition between different social networking media platforms evidences it; a new user prefers compatibility with the platform (i.e. the number of close friends that already joined the network) over the individual fit of the platform (i.e. the platform website design features). Saphiro and Varian (1999) explain how to recognize and exploit the dynamics of competing under network effects, they argue that consumers value information technologies that are widely used and if a vendor attracts a large user base, it can extract premium rents making its products more valuable.

In a survey conducted on the economic role of software platforms in computer-based industries conducted by Evans, Hagiu and Schmalensee (2004), several direct and indirect network effects are associated with software platforms. Software platforms are associated with direct network effects because an increase in the number of users for a platform makes the platform more valuable to each user, typically only using a common platform enables users to work together and share information. The authors gave the example of the so called “Palm Economy”, the once popular PalmOne PDAs attracted many developers of small applications and hardware add-ons, the consequent availability of thousands of Palm-related products made its device more valuable to its users. The indirect network effects are also present because many platform components are complements developed by third parties, so indirect network effects are linked to its presence on this complements, meaning that an increase in the number of users of a component could make that component more valuable as a complement to other complements. The authors gave of the example of Sony's Internet-based game center for its Playstation2 games console, the Internet-base game center drew more users, more Playstation2 owners wanted to buy games supported by the Internet service and more consumers preferred Playstation 2 consoles to competitors’ models.

The thesis author tried to capture the previously referred direct and indirect effects mechanisms within the following two figures. The Figure 8 aims to capture the direct network effects that constrain the adoption of technological platforms: an increasing number of platform's users imply a higher platform value and vice-versa within a positive feedback loop; however and decreasing number of users implies a lower platform value and vice-versa within negative feedback loop.

The current Apple Iphone phenomenon is an example of platform characterized by network effects: while providing a trendy mobile phone hardware device, a free SDK and many associated internet services, the Apple Corporation attracted a high number of application developers that resulted in a high number of available I-phone applications contributing to increasing device sales and correspondent device users.

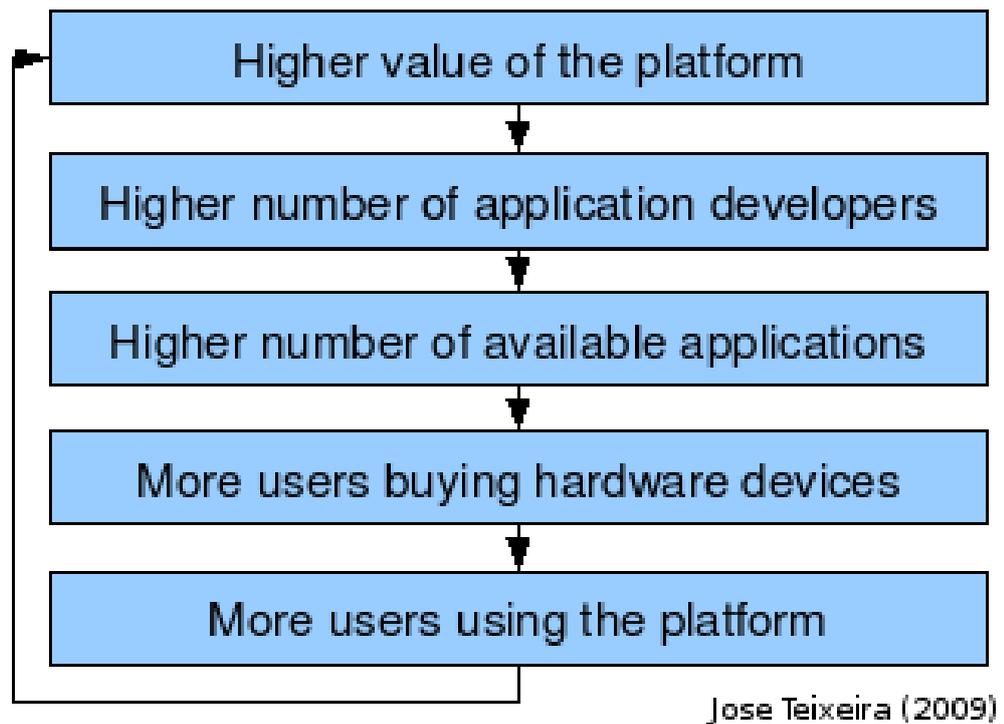


Figure 8 Direct network effects associated with a platform.

The second and complementary Figure 9 aims to capture the indirect network effects that constrain the adoption of technological platforms: A component developed by a platform third party i.e. complementors, can have potential to attract a higher number platform users turning the platform more valuable. The popular VOIP provider Skype is known worldwide for offering communication services at a lower cost, this means that communication devices enabled with software applications supporting this service will be very attractive to the final users, being a example on how a platform can indirectly benefit from components developed by a third party.

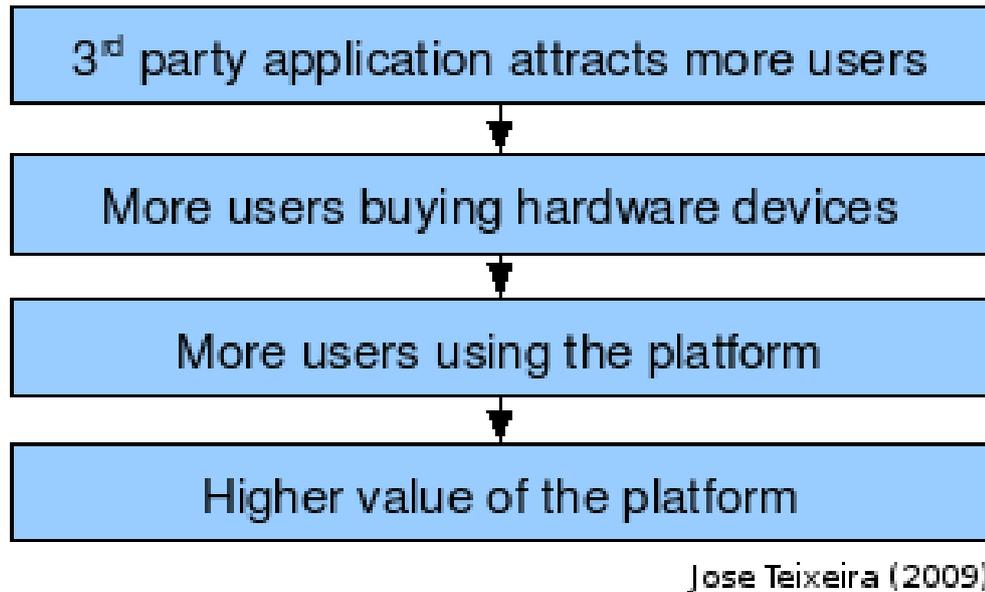


Figure 9 Indirect network effects associated with a platform.

In the specific case of the mobile device software platforms, network effects take a high importance because there are a considerable number of competing platforms that aims to be used globally by millions of users, however due its nature, the software applications are not portable from platform to platform forcing software application developers to concentrate efforts on top of a selected platform. The thesis author believe that available software applications is very important factor when a user purchase a mobile device, meaning that the success of a software platform's and correspondent devices is correlated with the vendor capacity of attracting software application developers to code applications on top of its platform. Peter Vadja reinforces the thesis author believe by highlighting that many of the past successful winners in the computer based industry were the ones that invested more in software (Vadja 2009).

4 THE NOKIA MAEMO INITIATIVE: A REVOLUTIONARY OPEN-SOURCE SOFTWARE PLATFORM

4.1 The Maemo Community

The Maemo community is analyzed from many viewpoints within this research. Perhaps there is not better introduction on the Maemo community than the one hosted on their website at <http://maemo.org/>:

“Maemo Community is an open source community developing software around the Maemo platform. The Maemo community has over 16.000 registered members that contribute to more than 700 development projects. We work with open source tools and processes. We develop new software for both the platform itself and on top of the platform. Applications developed with the Maemo SDK are used today by thousands of consumers.

Maemo is a software platform that is mostly based on open source code and powers mobile devices such as the Nokia N810 Internet Tablet. Maemo platform has been developed by Nokia in collaboration with many open source projects such as the Linux kernel , Debian , GNOME , and many more.” (Maemo 2009)

As referred in the previous quotation, Maemo is constructed in collaboration with many another open-source communities outside Nokia boundaries. The following Figure 10 captures some of the key communities contributing towards Maemo development.

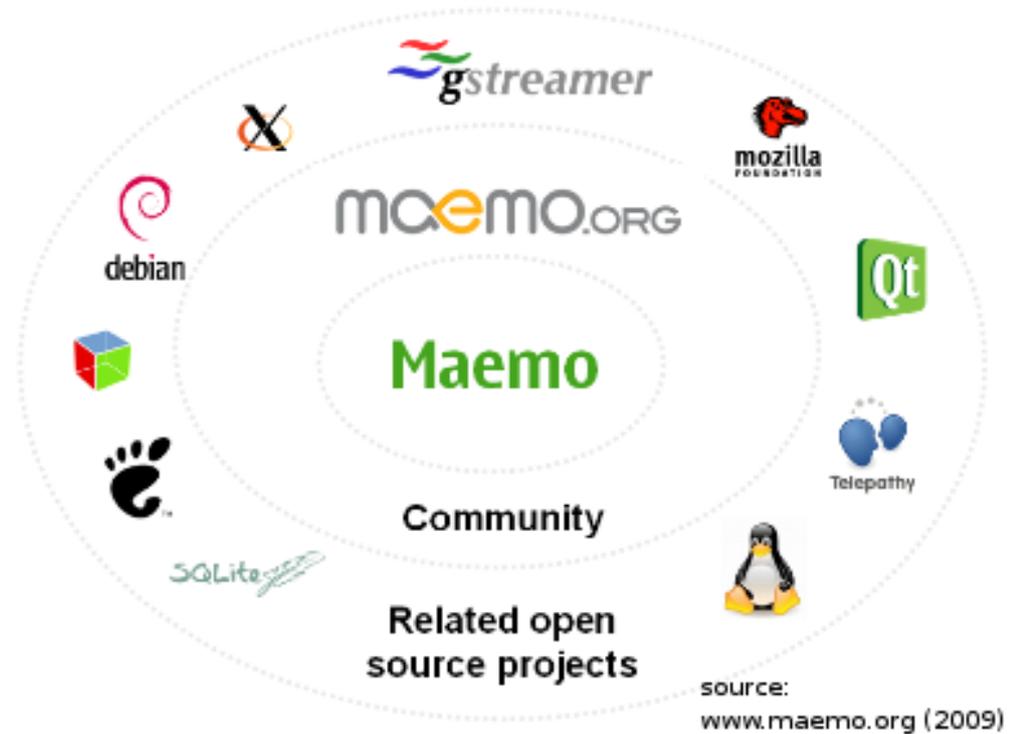


Figure 10 Maemo open-source initiative.

As highlighted in the previous Figure, the Nokia Maemo initiative is related with many key open-source projects such as the Linux Kernel, Telepathy, Gnome, Qt, Mozilla, Gstreamer, Xfree, Debian and SQLite. All these projects are already well known within the open-source world, and thousands of worldwide users benefit daily from the technological outcomes of these community projects. The Maemo community meets at least once a year in the Maemo Summit and also in another open-source related events such as the Gnome conference aka GUADEC, the annual meeting of the KDE community aka AKADEMY and the open source in mobile conference aka OSIM.

The Maemo community is built around its website <http://maemo.org/>. The site introduces the Maemo community, provides different software for both application developers and end-users, hosts documentation and keep Maemo community informed on related news and events. The section named garage.maemo.org allows different public to see what others are developing around Maemo platform and invites some public to contribute with their own source code.

Well known open-source technologies support the web-based collaborative environment required to enhance developer's communication and platform development. Conversation technologies, mailing lists, bug-tracking tools, forums and code repositories are provided to support the community build around the website <http://maemo.org/>.

5 RESEARCH METHODOLOGY

5.1 Selection of research method

The research question of this study assesses “how?” an open-platform brings competitive advantage in a high-tech and high-competitive market under network effects. According Yin (1991) the case study research method typically answers questions like “how” or “why”, in the same form of the posted research question.

In addition, the research author has tiny or no control over behavioural events within the complex market of mobile device platforms being studied. Moreover, this research focus on contemporary phenomena in a real-life context, once again according Robert Yin (1991) these are sufficient conditions to select a case study research methodology. Finally, according Dul and Hak (2008) a case study is an empirical inquiry that investigates a phenomenon within its real-life context especially when the boundaries between phenomenon and context are not obvious; reinforce the selection of a case study research methodology.

Yin (1991) defines case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life environment, especially when the boundaries between phenomenon and context are not clear. Following the same author basic types of design for case studies, this research was conducted by means of a holistic single case study; see (Yin 1991, 46-61).

5.2 Case study design

The author pursued a simple but comprehensive case study design trying to keep the research as simple as possible, however the author points out that the complex nature of the topic tuned it not easy to achieve such simplicity.

The case study unit of analysis of this research is the “Maemo open-source initiative” as it is on the second quarter of year 2009. The “Maemo open-source initiative” is a very rare instance of an organization developing a platform that blends hardware with open-source software in for a high-tech and high-competitive market, it was selected as unit of analysis in accordance with author’s professional and academic motivations. It is also important to note that the author studied the global nature of Maemo's open-source phenomenon as a single unit. The rareness of phenomenon being studied together with author's view of the unit of analysis as a single system explain why according Robert Yin (1991) this research was conducted by means of a holistic single case study.

After reviewing related literature and discussing with investigators on the field, the

author did not find significant early theoretical knowledge addressed the research problem. Facing the lack of theoretical propositions that could allow an explanatory designs, the author according Robert Yin (1991) procedure for elaborating a case study research design decided for an exploratory case study research design. The goal of an exploratory case study research design is to construct some new academic knowledge, ideas or theories (Paajanen, 2005).

The author believes that it is important to mention that a set of information system tools were used to support the conduct of the research. The most relevant was the creation of a public available Wiki content management system that hosted the development of this research: Professors and colleagues among others were invited to review, comment and steer the development of this research by using an embedded discussion mechanism. The last referred Wiki is public available on internet at the following web address <http://joseimmitthesis.wikispaces.com>.

5.3 Evidence collection

The previously mentioned exploratory nature of the study recommended a qualitative approach and in addition, the research topic nature turned impractical to gather any numerical data that could lead to findings by statistical methods, forcing the author gather and base conclusions on qualitative data only (see Lindman 2004). Qualitative research differs from quantitative research by having words as central analysis variable rather than numbers. Qualitative research is mainly used when the knowledge of the research topic us to be further investigated and deepened. As in this research, qualitative research is more associated with studies of smaller scale and requires more involvement from the researcher than quantitative research (Ahlgren and Dahlberg 2008).

In order to bring more trustworthiness to this research, different sources of evidence were used. Firstly, relevant public available documentation were collected from many Internet sites such as <http://maemo.org> and <http://nokia.com> . Secondly, semi-structured interviews were conducted with specialists who have a deep practical knowledge on the field. And finally, the researcher involvement with the unit of analysis allowed some direct observations within the real context of the phenomenon being studied. In addition, this research involved a long literature review phase during which writing sources were explored, this included media in many forms such as books, conference papers, internet available discussion papers, journals, magazine articles, institutional research reports, internet blogs and forums, etc.

The author searched from outside of Nokia corporate boundaries for public available documentation that could be relevant to the conducted research. The author made use of

internet search engines trying to find documents containing evidences that link the open-source and open-innovation topics with the Maemo initiative. Found documents include Nokia corporate events presentation slides, Nokia technical documentation, financial statements among others that are listed in appendix 1.

The author conducted five semi-structured interviews with five Nokia employees involved in the Maemo initiative who have a deep practical knowledge on the field. The interviews were ranged along different themes and the different roles of the interviewees allowed evidence collection from different viewpoints including marketing, corporate strategy, technology strategy, software production, software testing and product line management. In order to ameliorate the final evidences collection, the author conducted a case study pilot session before sending the semi-structured interview form to the interviewees. The author conducted the session with Phil Barrett, an open-source enthusiast working in an expertise firm in Turku, resulting in considerable refinements to the research data collection plans.

The interviews were designed by manners that a later researcher following a similar procedure when conducting the same case study should arrive to the same findings (Yin 2004). They were conducted by the research author between 27 of April and 12 of May of 2009 within the Nokia Research Center location in Helsinki. The interview form developed by the author to conduct the interviews was sent with a few days in advance to the interviewees via email, and in accordance with Paaanen (2007) the research author allowed the possibility of an open-discussion with the interviewees due to the exploratory nature of the case study. The previously referred interview form is available in appendix 2. An interview report was developed and sent to each interviewees a few hours after the interview time for validation. These reports are not available within this thesis document due author non disclosure agreements with Nokia, although the content of these reports was combined, rearranged and presented within this thesis in a more general and common understandable way.

By making several field visits to the case study “site”, the researcher had the opportunity to perform some direct observations of relevant behaviors and environment conditions that provided additional information about the topic being studied. The author highlights that this direct observation had less impact on this research findings when compared with the other two previously mentioned sources of evidences.

The evidence collection research benefits were maximized by following the three principles of data collection (Yin 1991, 95-103). Firstly, the principle of using multiple sources of evidence was followed making any finding or conclusion likely to be more convincing and accurate; Secondly, the principle of creating a case study data base was followed by developing a formal and retrievable data base that other investigators can use to review the evidences directly. Finally, the principle of maintaining a chain of evidence was followed, meaning that regardless the complexity of the topic, it is easy to

follow the derivation of any evidence from the initial research questions to the ultimate case study findings and conclusions.

6 RESULTS

6.1 The analysis process

The evidence analysis consist of examining, categorizing, tabulating, or otherwise recombining the evidence, to addresses the initial propositions of a study (Yin 1991, 105-108). An general analytic strategy was followed and various analytic techniques such as: putting information in different arrays; making a matrix of categories and place the evidences within it; and the creation of data displays were used (see Miles & Huberman, 1984). These mentioned analytic techniques allowed the research author to put the evidences in order prior to the actual analysis.

In a first phase, different raw evidences were compiled in a set of tables and displays bringing together data from the different sources to a more structured format. In the second phase, the author rewrote these set of tables and displays in a more general and common understandable language avoiding the frequent technological terminologies present in the different sources. In the third phase, the author sent the last referred tables and displays back to the interviewees asking them to verify if the data is according the previous conversational interviews and to censure any data that could violate the non-discloser agreements with Nokia. No issues were raised by the interviewees and the third phase didn't have any effect on the set of tables aggregating the collected evidences available in Appendix 3

This section finish with a compressive analysis on the previous referred set of tables performed one week after the third phase. For each of the five tables, the author carefully explained the structure and content of the tables while looking for evidence patterns that could lead to interesting findings.

6.2 Analysis of evidences related with Maemo development

Within Table 2 evidences that highlight the inherent benefits of open-source within the development of Maemo's platform are aligned among the typical phases of software development as in the IEEE Guide to the Software Engineering Body of Knowledge (Abran et al. 2004). These inherent benefits are distinguished between benefits resulting from the usage of existing open-source assets in the platform development and the benefits resulting from a direct cooperation with the open-source community.

Table 2 Maemo open-source benefits among the typical phases of software development:

	Requirements and Design	Construction	Testing	Maintenance
From using open-source assets		<ul style="list-style-type: none"> - Ready made and high quality software assets can be used. - Open-source software development tools are widely available, reliable, smooth and easy to use with a good learning curve. - Easy integration of open-source software development tools and repositories within the software development environment. - No licensing nightmares to setup a software development environment. - Open-source software development tools integrate better with agile methodologies. 	<ul style="list-style-type: none"> - Open-source testing tools are much more accessible. - Open-source testing tools are easier to evaluate, customize and integrate with the software testing environment. - Open-source testing tools documentation is good. Many people document them in a very dynamic process. - No licensing nightmares to setup a software testing environment. - Open-source software testing tools integrate better with agile methodologies. 	
From working together with the community	<ul style="list-style-type: none"> - Plenty of ideas. - Plenty of experimentation. - Find the needs together. - Define next steps together. 	<ul style="list-style-type: none"> - Easy and smooth for new developers joining an open-source project, to start working immediately. - Everything looks more visible and available. - No contracts and legal departments. - Symbiotic relationships with different open-source project communities. - Ampler communication and collaboration with communities lead to fast quality increases. 	<ul style="list-style-type: none"> - Contributions to communities will be tested. - Communities also find report and fix bugs. 	<ul style="list-style-type: none"> - Many platform bugs are reported by the community. - Communities provide more “eyes” to see bugs and possible improvements. - Large maintenance activity outside corporate boundaries. - Some advantages associated with the hardware and software “cult” such as back-porting, creation of add-ons, etc

The benefits that arise with the usage of existing open-source assets in Maemo's platform development are only visible among the construction and testing phases, while the benefits of working together with the open-source community are visible among all the phases of software development.

Many software construction benefits are related with the usage of open-source assets: Many already made and high quality open-source components can be easily ported and integrated into the platform; In addition, many open-source software development reliable tools are widely available with a smooth and easy to use learning curve;

Considerable software testing benefits also relates with usage of open-source assets: Firstly, the open-source software testing tools are much more accessible due high-price of commercial testing tools; Secondly the nature of the open-source software testing tools turn them easier to evaluate, customize and integrate with software test environments. Finally, the documentation of these tools is very good thanks to the effort of many authors continuously contributing to their very dynamic documentation process.

One of the most significant benefits that relates to the usage of open-source assets is the easier integration of open-source tools. Both the open-source software development tools and the software testing tools are easier to integrate within the development and testing environments: There are no lock-in mechanisms within these tools, they are more easily customized and they support natively the most popular code repositories and version control systems.

The usage of open-source components, development and testing tools reduce many "license nightmares". This means that it is easier to ensure that the platform, its development environment and its testing environment will not raise legal problems related with software licenses and royalties that need purchased, renewed, reported, renegotiated, etc. allowing development teams to keep their focus on the development and testing of the platform.

Another benefit that comes with the usage of open-source software development and testing tools is an easier integration with agile methodologies. Teams pursuing to develop and test software in an agile manner find on open-source tools an ally partially due to agile methodologies popularity among some open-source communities.

An high contribution from working together with open-source communities come on the requirements gathering and design phases: Firstly, by working together with many open-source communities, platform vendors can find new ideas, new concepts, plenty of experimentation that could result in platform innovations leading to its differentiation. Secondly, new requirements, new needs are defined together with the open-source community allowing an easier definition of the next steps on platform development.

The setup of platform development partnerships with open-source communities is possible without the traditional contracts and legal departments. It is easy to start,

evolve or end partnerships in a very dynamic way with open-source communities, note that some of these communities are aggregated in the traditional corporate environment meaning that sometimes there are corporate entities behind an open-source community. In addition, it is also easy for a new individual developer to join an open-source project and start working immediately; this because most of open-source projects combine a collaborative internet based environment with free and easy to use software development tools.

Benefits come with availability, visibility and transparency characteristics of the open-source communities, meaning that assets developed by an open-source community are much more accessible and its quality is easier to assess by entities interested on integrating these assets. An ampler communication and collaboration are also characteristics of open-source communities leading to faster quality increases of assets developed by open-source communities.

Most of the platform development partnerships with open-source communities and individual developers are symbiotic by addressing the inner motivations of the platform vendor and its open-source partners: For example the Bluez open-source community developing an Bluetooth wireless technology protocol stack for Linux benefit with having a set of qualified products based on their technologies together with bugs and patches sent back by the platform vendor; On the other hand the platform vendor benefits by integrating Bluez technology as a key platform component.

Working together with open-source communities also brings many platform development benefits within the testing and maintenance phases. Firstly, software components develop by the vendor while contributing to the open-source community are more likely to be tested, especially in the case of disruptive components with potential to grab the attention of many community members. Secondly, open-source communities are very active on finding, reporting and fixing software bugs, open-source communities are also software users but they role on the testing and maintenance is much more active when compared with the traditional software users. Finally, the open-source community software users are not only “eyes to see bugs” but also identifies, suggest and implement possible improvements keeping some of the development efforts outside the corporate boundaries of a platform vendor.

Finally, it is also important to refer that with open-source, the advantages associated with the hardware and software “cult” phenomenon are easier exploited. This means that fans of hardware and software can more easily be involved in activities such as back-porting, creation of plug-ins and add-ons, personal customization among many other activities associated with the hardware and software “cult”.

6.3 Analysis of evidences related with open-innovation

Addressing both the open-source and the open-innovation paradigms, Table 3 evidences how open-source enables Nokia to implement the open-innovation inbound and outbound processes according Chesbrough (2005). It highlights how open-source promotes the collection external ideas and technologies together with evidences and it highlights how open-source allows Nokia to promote their own ideas and technologies worldwide within the Maemo initiative.

Table 3 Maemo as an instance of the open-source and open-innovation paradigms:

How open-source helps bringing new ideas and technologies inside Nokia?	How open-source helps Nokia deploying new ideas and technologies worldwide?
<ul style="list-style-type: none"> - Plenty of readymade open-source technologies can be used (ex: kernel). - Plenty of new ideas, new needs, and new requirements relates to the community events such as Maemo Summit, GUADEC, FOSDEM, BOSSA conference, Akademy among others. - A lot of experimentation going on among open-source communities. Many ideas, concepts, demos, prototypes can be picked-up. - Open-source brings together people with different profiles, cultures, interests, etc. Lot of new things could come from that. 	<ul style="list-style-type: none"> - Some free advertising comes with open-source since the “word passes”. - Creating new market with new product concepts; the Internet tablet market was created as result of Maemo open-source initiative. - Commoditization of open-source technologies directly impact competitive environments.

First of all, open-source software technologies are widely and freely accessible on internet for who would like to use them with very permissive licenses. This means that it easier for platform developers, to download, install, review, test, evaluate, benchmark, parameterize, customize and modify these technologies with the existing possibility of contributing back to the communities of developers responsible by these technologies. Some of these open-source technologies are used and tested worldwide by thousands of users meaning that they are already very stable to be ported and integrated within a platform. This is the example of the Linux Kernel, the most popular open-source operating system developed by community of thousands of developers worldwide that became a key component in the Nokia Maemo platform. Another example is the XWindows windows management system made by an open-source community, but with a very high disruptive potential for platform complementors seeking the development of

visually rich and animated user interfaces in embedded devices.

Secondly, the open-source initiatives often lead to community events such as conferences, seminars and summits such as the Maemo Summit, GUADEC, FOSDEM, BOSSA conference, Akademy among others. These events bring together an open-source project community in a single geographical location from where plenty of new ideas, new needs, and new requirements are raised. These events also lead to the definition of priorities and the next steps in the technology development and platform vendors could be interested in participating and steering in these processes for their own benefit.

Another point is that, the freedom nature of the open-source projects enables a lot of experimentation. This means that open-source developers are encouraged to try new things, differencing from the current line or trend. Many open-source developers launch a new projects competing with a well established community and sometimes some of these projects built an entire community pursuing the development of something new or better. This phenomenon, that can be seen for instance in different communities associated with many Linux operating system distributions, lead to many new ideas, new concepts, new demos and prototypes that can be picked-up and further developed.

Within the process of bringing new ideas and new technologies into a corporation it is important to notice that open-source brings together people with very different profiles, cultures and interests. This contrasts with the more homogeneous environment of traditional corporate research and development departments and it is arguable that a more heterogeneous environment aggregating different academic and professional backgrounds, different cultures, different point of views, etc. could take an important role in the innovation processes.

The collected evidences suggest a more significant role of open-source as enabler on the collection of external ideas and technologies to the firm, and a less significant role on the promotion of ideas and technologies from the firm. However there are evidences highlighting an easier deployment of ideas and technologies that relates to an open-source initiative as below mentioned.

Firstly, there are some promotion effects within the open-source phenomenon. The deployment of technology as open-source comes with some free advertising within the open-source community channels, sometimes grabbing the attention of a wider internet public. Within last decade, the image associated with open-source products is relatively good.

Secondly, open-source can turn high-tech technologies in commodities. This means that in a high-competitive market, a vendor could win with the commoditization of technologies by avoiding a competitor to charge high premium in highly differentiated proprietary technology. This commoditization can ultimately benefit complementors and final users with a creation with a standard based on open-source technologies.

At last, it is important to refer that the open-source initiatives could lead to new product concepts. This is the example of the Nokia 770, resulting from an open-source initiative that successfully created the “internet tablet” market. Other vendors followed the concept and the incumbent PDA market seems to be eroding with the new internet tablets devices.

6.4 Analysis of evidences related with Maemo competitiveness

Within Table 4 many evidences illustrate the Maemo open-source initiative competitiveness. According Michel Porter (1998) firm's above average performance on an industry comes from two types of competitive advantages: First by achieving cost leadership, meaning that a firm set out to become able to produce cheaper than its competitors; And secondly by differentiation, meaning that firm's products seeks to be unique in its industry in dimensions that are widely appreciated by buyers. However in high contrast with products, platforms include much more stakeholders that influence the platform performance. The author argues that Porter competitive advantage model should be extended with a new type of competitive advantage type within markets requiring platform thinking rather than product thinking. The collaboration among platform stakeholders has a huge impact in the platform success, and it was included by the author as a competitive advantage basic type within this research.

Table 4 Evidences of Maemo open-source competitiveness (extending Porter theory):

Cost advantage	Differentiation	Collaboration among platform stakeholders
<ul style="list-style-type: none"> - Some cost and time-to-market gains are visible on development of mobile internet browsing technologies. - Some cost and time-to-market gains are visible on the development of Bluetooth connectivity technologies. 	<ul style="list-style-type: none"> - Maemo internet tablets are successfully slumping existing PDA market. - Maemo internet tables are quite unique; there are no similar products available on the market. 	<ul style="list-style-type: none"> - Easy collaboration with distributors, other hardware/accessories vendors and even other platform vendors. - Easier to solve problems together. - Backward compatibility of open-source.

With Maemo open-source initiative, buyers of Nokia internet tablets can browse on internet achieving a very similar experience as browsing on the traditional PC by using the popular Mozilla Firefox (browser that according the website market-

share.hitslink.com had 22.48% of market share in April 2009). Maemo initiative made use of browsing technologies from the Mozilla foundation open-source projects, allowing the company to deploy on the market on a very good time to market a unique internet browser without the huge costs associated with the development of the complex browsing software technology.

A similar situation occur with the development of Maemo Bluetooth connectivity technologies, Nokia in a partnership with the Bluez open-source community empowered its devices with features allowing a better connectivity between its internet tablets and other devices such as computers and mobile phones implementing the Bluetooth low-cost radio solution. Once again instead of developing all the technology in house, Nokia together with other firms such as Intel, TomTom BV, Ricoh and Xerox sponsored the Bluez open-source community dividing development costs on the implementation of full and complex communication protocol stack.

In spite of the cost benefits that come with open-source, an analysis of evidences suggests that Maemo open-source initiative seems to have a higher role on the firm's differentiation rather than cost leadership. Evidences collected from interview sources suggest that Maemo open-source initiative follows a differentiation strategy even if many cost benefits come attached within it. Greater indication of that differentiation strategy comes with the Maemo platform internet tablets that created a new market without strong competitors on the field; they are a quite unique product on the market without strong direct competitor. Evidences of this differentiation relates to the Maemo browsing technologies with unique features supporting the animation and interactivity of web pages using Adobe Flash technologies and with Maemo unique support of a wide set of VOIP communication technologies such a SIP, Skype, Gizmo, etc. A comprehensive data analysis suggests that open-source can lead to cost benefits in the many components of the platform and an important lead to the differentiation of the overall platform.

Moreover, open-source can enable an easier collaboration among platform stakeholders. The platform vendors, network operators, application developers, service operators among many others could benefit from the nature of an open-source. Some of these collaboration benefits are inherited from the traditional benefits of using open standards that allows organizations to focus on the development in their expertise areas while reeling on open standards for an easier and transparent integration with other organizations components. Collected evidences suggest that open-source enables an easier collaboration with other hardware and software vendors and distributors. It is argued that problems involving many stakeholders are more easily solved due the nature of open-source platform. Moreover, it is a customary pattern of open-source technologies to not include lock-in mechanisms and to support backward compatibility easing the integration and maintenance of software, especially when many stakeholders

are involved.

6.5 Analysis of evidences related with platform wars

The Table 5 list evidences on how open-source attracts more developers and other complementors within the Maemo platform. After an analysis of such evidences, the author claims that an open-platform seems to address both the motivations of the stereotyped open-source software developers and traditional commercial software organizations.

Table 5 Winning a platform war – Evidences on how open-source is attracting more developers/complementors:

- Developers are provided with a free API.
- Developers are more empowered; they participate also in analysis and requirements.
- Developers communicate more; they feel more relevant and free.
- There is an open-source “cool” effect among young developers. They claim that it is easy to learn.
- Hardware and software “cult” associated advantages are easier to achieve with open-source.

First of all, an open-source platform is often distributed with very permissive software licenses, providing an API that can be freely download, freely installed and freely used. Not high costs are associated with the setup of a software development environment by possible developers and other complementors. Add-on components for the Maemo platform can be developed using open-source, standard and free tools wide available on internet, turning the platform very attractive for cost sensitive software development individuals and organizations.

In addition, many developers feel more empowered with open-source. Compared with many other forms of software development, open-source developers participate in the requirements definition and analysis software development phases. Many software developers could feel their role less significant if they just implement software according functional and technical specification documents made by other actors. Many open-source software result from individuals that facing quotidian problems decide to develop and share with others software solutions addressing the same problems, very often the open-source developers feel very realized if their solution became used by many other individuals.

Open-source development mainly happens on very collaborative way supported by the internet. It connects people from different geographies, different cultures and different backgrounds and it is characterized by an extensive communication. Many individuals prefer open-source over traditional software development because they are able to

communicate more, they can steer the project outcomes under a low constrained environment. Many open-source developers claim to be more “free” when comparing themselves with software developers in the traditional software houses.

Evidences collected also suggest that open-source is very popular among young developers. There is a “cool” effect among students of computer science and other computer related courses. Several students participate in open-source projects and initiatives claiming that open-source technologies are easy to learn. Many young developers participate within open-source projects seeking posteriori appraisal for their contributions by colleagues, communities, entrepreneurs and recruiters among others.

Finally, it is very important to mention that some of the evidences that both hardware and software “cult” associated advantages are easier to capture and retain with open-source. Exceptionally, some users became fans of hardware and software products in such degree that they modify, complement and develop add-ons to the products. In the case of open-source based products such “cult” users can much more easily perform such activities that could add higher value to the products. In the case of Maemo, there are users contributing with add-ons to the most popular software applications, other are providing themes that change the layout of Maemo's internet tablets user interface, some others are even back-porting software to older Maemo internet tablets such as the Nokia 770 product version.

6.6 Analysis of evidences related with network effects

The Table 6 grabs together evidences related with platform's adoption within high-competitive markets subject to network effects. Potential user's seems to not only consider the individual fit of the platform but also the compatibility of the platform before deciding to adopt and start using it. This means that platform software layers have a growing influence within buyer's purchasing decision because users seek to acquire a device compatible with its previously adopted software applications and internet services. For instance an active user of the popular social networking service Facebook will take in consideration while purchasing a new devices if the service is supported or not, and the same could occur with many popular software applications and internet services wide spread in the computer based industry.

Table 6 Platform competition under network effects:

	Minimizing platform adoption switching costs	Winning a large user base
How to?	<ul style="list-style-type: none"> - Support most popular application and services. - Provide easy to use data import mechanisms for the most popular software applications. - Provide easy to use migration mechanism for the most popular internet services. 	<ul style="list-style-type: none"> - Attractive hardware. - Attractive software platform for complementors. - Attractive software applications and services for final users. - Lock in initiatives are a double-edged sword, they should be explored.
Open-source role?	<ul style="list-style-type: none"> - Some popular open-source application can be more easily ported. - The needed import/migration mechanisms can be identified, developed and maintained by open-source communities. 	<ul style="list-style-type: none"> - Open-source high availability and transparency forces higher attractiveness of the software. - There are many popular open-source applications. For most of the popular closed-source software applications, there is an open-source version. - For most of the popular closed internet services, there is also a more open and free internet service.

The author strongly believes that two key aspects should be addresses when launching a platform on high-tech and high-completive market: Firstly, the design of the platform should minimize users adoption switching costs ensuring that platform adopters could easily and smoothly use or migrate from its popular software applications and internet services. Secondly, the design of the platform should enable a fast and large adoption of users ensuring platform attractiveness that could win and retain a large user base. The tables 5 contain evidences on how to minimize platform adoption switching costs and how to win a large platform user base and it open-source role on it.

The identification of the most popular software application internet services and posteriori built-in support by the platform vendor should minimize the user adoption switching costs due the huge number of users using the top software applications and internet services. Additionally, if the built-in support is not possible or doesn't interest the platform vendor, easy data import mechanisms should be provided for the most popular software applications. The same case for Internet services, where easy to use migration mechanism for the most popular internet services should be provided. A device combining good hardware and good software is not so valuable for users, if no interface mechanisms are provided with software applications and internet services already widely used worldwide.

Evidences suggest that open-source could have a positive role on the minimization of user adoption switching costs because several instances of open-source software are themselves very popular among users. Moreover, open-source software applications are easier to port to a platform due its openness. This is the case of Maemo internet browsing technologies based on the popular Mozilla foundation open-source projects that support most of the available web-based applications via the Mozilla browser. In addition, open-source communities showed potential in the identification, implementation and maintenance of needed data import mechanisms for open-source software.

Regarding the early conquering and maintenance of a large user base, the hardware attractiveness could have the needed disruptive potential to create a large user base. However, since significant value of a platform could come from assets developed by complementors, it is very important to insure a very attractive software platform and correspondent incentives to attract complementors. Most of the success factors coming with a platform are related with the end-user attraction of software applications and internet services forcing platform vendors to provide incentive mechanisms to attract software developers and service providers to the platform. Some market players use lock-in technical mechanisms to retain their user base such as: one way import mechanisms, absence of integration interfaces, patented specifications among many others; However these lock-in initiatives are a “double-edged sword” meaning that firms embedding these referred mechanisms could benefit by retaining their user base network, but with the emergence of more appealing technologies, the same mechanisms can turn themselves in factors forcing a very fast user adoption of competing emerging technologies. In the last decade, many players in the computer based industries successfully maintained and increased market-share with lock-in mechanisms; however with the product obsolescence these lock-in mechanisms became contributors for a very fast erosion of market-share. The Ethernet computer networking technologies and the Adobe Postscript document description technologies successfully replaced dominant technologies with lock-in mechanisms becoming factual standards in the industry.

The open-source technologies have potential to enable the creation of a large user base thanks to the attractiveness of many of its products. It is important to notice that for the most popular software applications and popular internet versions, there are often “open-versions” allowing users to experience alternatives, often more transparent and at a lower price.

7 DISCUSSION

7.1 Benefits from an open-platform

Directly addressing the research question on how an open-platform brings competitive advantage to a firm competing in a high-tech and high-competitive market under network effects, a set of findings are further announced and explored. These findings map several patterns found during the analysis of evidences and they bear witness of the benefits that come with to the implementation of the open-source and open-innovation paradigms, as source of competitive advantage of the Nokia's Maemo platform case.

First finding claims an easy integration of open-source software components and tools within the platform. This means that there are on the market plenty of high-quality open-source software components that can be more easily integrated within the platform when compared with proprietary closed-source software. In addition many open-source software development and software testing tools are widely available and accessible, being also easier to integrate within the platform construction environments. Compressively, the author claims that many valuable open-source parts and tools can enrich the platforms adopting them.

Second finding relates to the ease of use and favorable learning curve characteristics of open-source technologies. This is especially important in high-competitive environments where the time-to-market constraints generously benefit players that perform a faster development of the necessary platform components. Evidences show that open-source technologies allow developers to achieve a profitable productivity earlier.

The third finding comes with to the absence of licenses and contracts characteristic of open-source production. Considerable advantages are associated with the extinction of software licenses management issues among the setup of the platform production environment; and with the reduction of contract management issues within the setup of platform development partnerships. Comprehensively, the author also claims that open-source could reduce legal costs and risks during platform development due to open-source permissive licensing.

The forth finding highlights a better integration between open-source software development and agile methodologies. Previously analyzed literature together with a few evidences collected within this research claim that open-source development and agile methodologies embrace a common number of principles and values that can be explored by corporations pursuing more agility in their procedures. By focusing on transparent development processes and by enabling the delivery of software product artifacts anytime, together with the empowerment of the software developers, agility seems to bring advantage to open-source development.

The fifth finding asserts that the documentation quality of assets implementing the open-source and open-innovation paradigms. When compared with traditional development, the open-source documentation process is much more dynamic, involves much more authors or contributors and provides more commonly different documentation for different level of users' expertise. As in some analyzed research literature, more "brains" increase the quality of the software code, several collected evidences suggest also that more "brains" increase the quality of software documentation that could take an important role in a platform development.

The sixth finding is the easy procurement process attached to open-source technologies. Many of the collected evidences suggest that it is rather easy and cheap to get, test, evaluate and benchmark open-source software components and tools. The research author adds to previous claims, that many valuable open-source parts and tools can be more easily procured when compared with traditionally proprietary ones.

The seventh finding points that with the implementation of an open-source and open-innovation paradigms, firms can setup a more favorable environment to the raise of new ideas that could lead to successful innovative commercial products. An open-firm is characterized by allowing more experimentation, development of new concepts that could lead to innovative prototypes. Once again, evidences suggest that more "brains" could lead to plenty of new ideas and platform vendors can be challenged with the digestion of a considerable number of ideas rather than the absence of them.

The eighth finding centers attention that it is easier to establish symbiotic partnerships with communities and individuals that contribute towards a open-platform development. Many evidences suggested it is easy for platform vendors, the open-source community and individual developers to establish cooperation without the formalities required within traditional partnerships. Some of these partnerships happen naturally, without the memorandums, contracts and capital characteristics of traditional corporate partnerships. Many symbiotic partnerships are raised due to the interest of platform vendors in software complements and the interest of software complementors in platforms with high potential.

The ninth finding suggests that with open-source and open-innovation, a community of consumers stop being mere passive purchasers and become themselves active members of an innovation ecosystem. Open-platforms eases user contributions toward the platform and evidences suggest that while open-source software development became less complex and demystified, more user will became users that contribute towards the continuous platform value enrichment.

The last finding refers to the good image associated with open-source products. Many evidences show that a "free-promotion" effect comes with open-source, which is already explored by many players in the market. Moreover an open-platform significantly enablers "cults" by turning software and hardware fans in high active

contributors. The author argues that many potential contributions associated with the users “cult” of hardware and software are displaced in closed platforms.

7.2 Competitive impacts

A second set of findings revealed impacts of the open-platforms on the overall competitive environment. The traditional proprietary and closed-platform vendors cannot profit directly from the previous mentioned benefits of an open-platform and in addition, they face many negative impacts as revealed by the following set of findings.

Firstly, a research finding hints that open-source could lead to the strategic commoditization of platform components. Open-platform vendors could damage competition by opening their “in-house” technologies to the open-source community. This could have a strategic impact in competitors used to extract premium rents on products perceived as unique as unexpectedly became perceived as commodity.

Secondly, an additional research finding suggests that an open-platform leads to differentiation. Even if most of the platform components consist of commodities, several evidences highlight the differentiation of the open-platform as a whole. There is plenty of space for open-platform vendors to differentiate in the integration of the several layers and components of the platform. Open-platform vendors, while integrating different components together with its complementors could lead to high product differentiation on the market, reinforcing their market position.

Another finding evokes an easier collaboration of different platform stakeholders with open-source. Network operators, software developers, service providers, regulators among many others could have their collaborative tasks eased with an open-source based platform. Several evidences suggest that different stakeholders could perform a better integration of platform assets, and also suggest that problems can be more easily solved together with open-source. The success of the platform does not depend only on the platform features but also on a successful collaboration between different stakeholders; the traditional proprietary and closed-platform vendors must find other ways to enable this crucial collaboration.

The last evidence is related to the impacts that an open-platform could have within a competitive market subjected to the forces of network effects. The author argues that open-source could lead to the erosion of competitors providing platforms with embedded lock-in mechanisms. Research literature suggest that lock-in mechanisms successfully retain and expand an existing user base, however lock-in mechanisms are a “double-edged sword” and open-platform vendors could exploit these lock-in mechanisms that are very unpopular among conscientious users. This requires a high attractiveness of the overall platform and built-in platform mechanisms that could mi-

nimize the switching costs of users adopting a new platform. This warns the traditional proprietary vendors of platform with embedded lock-in mechanism, about the potential fall of market share with a rise of an attractive open-platform without the unpopular embedded lock-in mechanisms.

7.3 Limitations

The author strongly believes that the significance of the research can be augmented if more data could be collected for analysis. The analyzed public available documentation, the five semi-structured interviews and some direct observations lead to interesting findings on the inherent competitive advantages of open-platforms; however more available documentation, more semi-structured interviews involving different actors and more available time to perform direct observation could raise newer and even more significant findings.

The use of multiple sources of evidences allowed the author to search converging findings from different sources increasing the validity of this case study research. In addition, a constant review of this case study development by the thesis supervisors, supported by the previously referred Wiki information system, enabled greater research validity (Yin 1991).

Addressing the reliability of the case study, the author decided to deliver in the research site a case study protocol following the guidelines of Dul and Hak (2008). An informal document was sent via electronic mail containing and overview of the research project, the desired field procedures to perform in the research site, a preliminary semi-structured interview form and a preliminary structure of this research paper. The Wiki information system helped in the organization of a case study database aggregating all digital materials used in the research, future researchers addressing the same or similar research questions are invited to use these materials.

During the evidence collection phase of this research, there was a concern for the adequate representation of diversity, guiding the selection of different types of documentation and the selection of different interviewee profiles. Moreover, during the analysis of evidences the findings seemed convincing enough for appropriate release as conclusions, but the exploratory case study nature of this research discourage generalizations outside the unit of the analysis. The nature of this research also warns about generalizations outside the rare instances of vendors developing multi-sided platforms combining both hardware and software.

The amount of open-source and open-innovation benefits mentioned in this research should not create a notion that these two paradigms have its own drawbacks, limitations and constraints not referred in this research. The author perceives that open-source and

open-innovation bring considerable competitive advantage in the Maemo case, however many known and unknown risks are associated with the implementation of the open-source and open-innovation paradigms within a corporation. Moreover, there are no significance managerial expertise on the area due to its freshness and immaturity.

8 CONCLUSIONS

The open-source and open-innovation paradigms have a huge impact on the way firms organize their research and development. They seem to have very positive impacts on firms developing multi-sided platforms combining both hardware and software. Most of the open-source benefits commonly found on the development of software products and solutions seem to be applicable in the development of software platforms as well. This research complemented these benefits with other novel benefits more specific to firms developing multi-sided platforms by combining hardware and software, such as Nokia with the Maemo open-source initiative.

The inherent competitive advantages of open-platforms seems to not only relates to the integration of open-source wide available assets, but also with the straight collaboration between platform vendors, open-source communities, complementors and many other platform stakeholders. Open-source and open-innovation benefits enable internal performance enhancements on the development and commercialization of multi-side platforms, but they have potential to damage directly the market share of closed-platform competitors.

Many new research opportunities can be further developed on the area of open-platforms; such as the examination, modeling and simulations of interactions between the open-platform vendors, open-source communities and other platform stakeholders. Many organizational and human resources studies could provide an better understanding of the research phenomenon, providing important insights to managers and other conductors of open-platform initiatives. This study on a greater degree targeted the special interest of vendors of open-platforms; however the perspectives from other stakeholders such as network operators, software developers, service providers, final users and market regulators could raise very interesting responses. The author observed a high interest from open-source communities, on the research of paths and strategies towards the fighting of incumbent closed-platforms. Many of the findings of this research, such as an easier integration between open-source and agile methodologies require further research validation outside of the context of this case study.

Based on the findings of this research, Maemo open-source initiative is a winning move revealing many competitive advantages for Nokia's devices, services and software success. Moreover, with the Maemo initiative, Nokia created a new trend that changed the competition environment, influenced the customers and created positive network effects. The author concludes this thesis by warning on the validity of possible generalizations for a larger universe than the rare instances of vendors developing multi-sided platforms combining both hardware and software.

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Appendixes

Appendix 1 List of public documentation used for evidence collection

- How Nokia approaches open source for maemo.
 - Available online at <http://maemo.org>
- Ari Jaaksi Handsets World 2008.
 - Available online at <http://www.slideshare.net/qgil>
- OSiM World, Maemo DevSesh.
 - Available online at <http://www.slideshare.net/qgil>
- Building consumer products with open source communities: Maemo and 770 experiences.
 - Available online at http://www.kotiposti.net/jaaksi/ME9_LinuxWorld_2006_AriJaaksi_.pdf
- Linux in Consumer Products: Nokia Learnings & Experiences.
 - Available online at http://www.linuxdevices.com/files/misc/LW2007_Jaaksi.pdf
- Nokia, maemo, and stuff.
 - Available online at http://www.kotiposti.net/jaaksi/GUADEC_Jaaksi.pdf
- Maemo Community Support.
 - Available online at <http://www.slideshare.net/silpol>
- Form 20-F 2007 Nokia.
 - Available online at <http://www.nokia.com/A41259028>

Appendix 2 Interview form used to conduct semi-structured interviews

Here it is the list of questions that I would like to ask within If... (pilot case study) / Nokia Maemo (unit of research).

Remember the thesis research question: “How an open-platform brings competitive advantage in a high-tech and high-competitive market under network effects?”

Remember that there are many stakeholders involved, not only Nokia but also developers, service providers, telecommunication operators, final users, regulators, etc.

1. Questions related with open-source production of the Maemo platform:
 - From the Maemo software development point of view, what are the inherent benefits of using open-source?
 - Can these benefits be narrowed to the typical phases of software development such as requirements, design, construction, testing and maintenance?
 - What are the advantages of working together with open-source communities?
 - Are these last benefits expandable to other stakeholders such as application developers, service providers, telecommunication operators, final users, etc?
2. Questions related with open-innovation:
 - How open-source helps bringing new ideas and technologies inside Nokia?
 - How open-source helps deploying new ideas and technologies worldwide? in a profitable way ?
3. Questions related with overall Nokia competitive advantage (Porter):
 - Can open-source help Nokia reducing overall costs? Where?
 - Can open-source help Nokia to differentiate his offer from main competitors? Turning Maemo more special, more appetizing to different stakeholders?
 - Can open-source enhance collaboration among different stakeholders?
4. Questions related with platform wars:
 - Being open-source, how can Maemo attract more developers, content providers and other service providers?
5. Questions related with the adoption of technology under network effects:
 - How open-source can minimize the platform adoption switching costs? Across different stakeholders?
 - Did Maemo ever faced lock-in strategies of other products and services on the market?

A set of tables can be developed to summary the results, gathering the contribution of everyone.

Appendix 3 Set of tables aggregating the collected evidences

Table 1 - Maemo's development open-source benefits among the typical phases of software development:

	Requirements and Design	Construction	Testing	Maintenance
From using open-source assets		<ul style="list-style-type: none"> - Ready made and high quality software assets can be used. - Open-source software development tools are widely available, reliable, smooth and easy to use with a good learning curve. - Easy integration of open-source software development tools and repositories within the software development environment. - No licensing nightmares to setup a software development environment. - Open-source software development tools integrate better with agile methodologies. 	<ul style="list-style-type: none"> - Open-source testing tools are much more accessible. - Open-source testing tools are easier to evaluate, customize and integrate with the software testing environment. - Open-source testing tools documentation is good. Many people document them in a very dynamic process. - No licensing nightmares to setup a software testing environment. - Open-source software testing tools integrate better with agile methodologies. 	
From working together with the community	<ul style="list-style-type: none"> - Plenty of ideas. - Plenty of experimentation. - Find the needs together. - Define next steps together. 	<ul style="list-style-type: none"> - Easy and smooth for new developers joining a open-source project, to start working immediately. - Everything looks more visible and available. - No contracts and legal departments. - Symbiotic relationships with different open-source project communities. - Ampler communication and collaboration with communities lead to fast quality increases. 	<ul style="list-style-type: none"> - Contributions to communities will be tested. - Communities also find, report and fix bugs. 	<ul style="list-style-type: none"> - Many platform bugs are reported by the community. - Communities provide more "eyes" to see bugs and possible improvements. - Large maintenance activity outside corporate boundaries. - Some advantages associated with the hardware and software "cult" such as back-porting, creation of add-ons, etc

Table 2 - Maemo, open-source and the open-innovation paradigm:

How open-source helps bringing new ideas	How open-source helps Nokia
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and technologies inside Nokia?	deploying new ideas and technologies worldwide?
<ul style="list-style-type: none"> - Plenty of ready made open-source technologies can be used (ex: kernel). - Plenty of new ideas, new needs and new requirements relates to the community events such as Maemo Summit, GUADEC, FOSDEM, BOSSA conference, Akademy among others. - A lot of experimentation going on among open-source communities. Many ideas, concepts, demos, prototypes can be picked-up. - Open-source bring together people with different profiles, cultures, interests, etc. Lot of new things could come from that. 	<ul style="list-style-type: none"> - Some free advertising comes with open-source since the “word passes”. - Creating new market with new product concepts; the Internet tablet market was created as result of Maemo open-source initiative. - Commoditisation of open-source technologies directly impact competitive environments.

Table 3 - Evidences of Maemo open-source competitiveness (extending Porter theory):

Cost advantage	Differentiation	Collaboration among platform stakeholders
<ul style="list-style-type: none"> - Some cost and time-to-market gains are visible on development of mobile internet browsing technologies. - Some cost and time-to-market gains are visible on the development of Bluetooth connectivity technologies. 	<ul style="list-style-type: none"> - Maemo internet tablets are successfully slumping existing PDA market. - Maemo internet tables are quite unique, there are not similar products available on the market. 	<ul style="list-style-type: none"> - Easy collaboration with distributors, other hardware/accessories vendors and even other platform vendors. - Easier to solve problems together. - Backward compatibility of open-source.

Table 4 - Winning a platform wars – Evidences on how open-source is attracting more developers/complementors ?

<ul style="list-style-type: none"> - Developers are provided with a free API. - Developers are more empowered, they participate also in analysis and requirements. - Developers communicate more, they feel more relevant and free. - There is an open-source “cool” effect among young developers. They claims that it is easy to learn. - Hardware and software “cult” associated advantages are easier to achieve with open-source
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Table 5 - About a platform competing under network effects:

	Minimizing platform adoption switching costs	Winning a large user base
How to ?	<ul style="list-style-type: none"> - Support most popular application and services. - Provide easy to use data import mechanisms for the most popular software applications. - Provide easy to use migration mechanism for the most popular internet services. 	<ul style="list-style-type: none"> - Attractive hardware. - Attractive software platform for complementors. - Attractive software applications and services for final users. - Lock in initiatives are a double-edged sword, they should be explored.
Open-source role ?	<ul style="list-style-type: none"> - Some popular open-source application can be more easily ported. - The needed import/migration mechanisms can be identified, developed and maintained by open-source communities. 	<ul style="list-style-type: none"> - Open-source high availability and transparency forces higher attractiveness of the software. - There are many popular open-source applications. For most of the popular closed-source software applications, there is an open-source version. - For most of the popular closed internet services, there is also a more open and free internet service.