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Professional MBA

Entrepreneurship & Innovation



Open innovation in open source software - how Google balances (or not) openness with taking influence in Android

A Master's Thesis submitted for the degree of "Master of Business Administration"

supervised by

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Bratislava, Slovakia, June 30, 2012

Affidavit

I, **Matúš Serdula**, hereby declare,

1. that I am the sole author of the present master's thesis **Open innovation in open source software - how Google balances (or not) openness with taking influence in Android**, 67 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
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Date

Signature

Abstract

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Abstract

The purpose of this thesis is to investigate open innovation in open source software and more specifically in Android software. Thesis explores how Google balances openness and taking influence in Android operating system. The thesis also investigates competing platforms, their openness and success in the market.

Android system has gained a huge popularity in very short period of time and it became the number one mobile operating system only 3 years after it was released. Thesis examines which are the success factors of Android.

Innovations are the key factor of company's survival. Traditionally closed innovation model was used in companies and knowledge was kept as a secret inside of the company. Further advances in technology changed this approach and knowledge has diffused more radically. Therefore open innovation has become the new approach. Android platform is a great example of this shift and a successful example of open innovation in mobile industry.

Because the open innovation plays important role in this thesis, the thesis also reviews open innovation literature related to the open source software industry. The thesis also reviews market studies about mobile platforms from a developer point of view.

This work examines the open innovation model in mobile software development. Lessons are learned through case studies and market studies from mobile industry. How company can profit from open source system which is basically free is also reviewed in the thesis.

Thesis discusses key factors which contributed to the success of Android platform and its adoption among users which helps to understand which factors should be considered by companies which are planning to utilize open innovation. Android business model is examined in relation to Chesbrough's definition of business model functions.

Table of Contents

AFFIDAVIT	2
ABSTRACT	3
TABLE OF CONTENTS	4
TABLE OF FIGURES.....	5
LIST OF TABLES	6
 PART 1: MAIN PART	 7
1. INTRODUCTION.....	7
2. PROBLEM FORMULATION.....	7
3. OBJECTIVE OF THE MASTER'S THESIS	8
4. LITERATURE PART	8
4.1. OPEN INNOVATION.....	9
5.1.1. Archetypes of open innovation.....	11
5.1.2. Getting value from open innovation.....	12
5.1.3. Android business model functions	14
5.1.4. Innovation and openness.....	16
5.2. OPEN SOURCE SOFTWARE	17
5.2.1. Open source software licenses.....	19
5.3. OPEN SOURCE HARDWARE.....	21
5.4. ANDROID SYSTEM.....	23
5.4.1. Android software components	27
5.4.2. What Android means for Asia and China?.....	28
5.4.3. Android – is it really an open system?	30
5.4.4. Android comparison with iOS	34
5.5. HOW GOOGLE CONTROLS ANDROID.....	35
5.5.1. Compatibility program.....	38
5.6. PATENT WARS.....	39
5.6.1. Is Microsoft the winner in Android case?.....	40
5.6.2. Buying patents.....	42
5.7. PROFITS OF MOBILE OPERATING SYSTEMS	43
5.8. HANDSET MAKERS	45
5.9. APPLICATION DEVELOPERS	47
5.9.1. Regional popularity of platforms among developers.....	49
5.9.2. Android version fragmentation	50
5.9.3. Mobile platform popularity	52
5.9.4. Future of mobile platforms	53
5.9.5. Application stores	54
5.9.6. Success factors of mobile platform	57
5.9.7. Open source software developers	58
6. RESULTS.....	59
 PART 3: INTERPRETATION, DISCUSSION, FUTURE PROSPECTS.....	 60
 PART 4: BIBLIOGRAPHY	 62
 PART 5: APPENDIX	 67

Table of Figures

1. Figure – An open innovation paradigm
2. Figure – Three archetypes of open innovation processes
3. Figure – Arduino board
4. Figure – World Wide Smartphone Sales Share
5. Figure – Major components of the Android software stack
6. Figure – The Open Governance Index
7. Figure – Mobile patent suits
8. Figure – Mobile operating system market share
9. Figure – Apple iPhone quarterly revenue growth
10. Figure – The pyramid of handset maker competition
11. Figure – Volumes, revenues and profits compared in Q1 2011 and Q1 2012
12. Figure – Average cost for application development
13. Figure – Developers primary platform by region
14. Figure – Usage share of the different versions as of June 1, 2012
15. Figure – Operating system version adoption data
16. Figure – Top 10 platforms being used by developers in 2010, 2011 and 2012
17. Figure – Top 8 mobile platforms developers are planning to use
18. Figure – Android and iOS have strong network effects
19. Figure – Weak network effects of Blackberry, Symbian and Windows Phone
20. Figure – Mobile applications store revenue
21. Figure – Top 5 platform adoption criteria for developers
22. Figure – World Wide Smartphone market share outlook

List of Tables

1. Table – Overlap of open source and open innovation
2. Table – Popular open source licenses
3. Table – Mobile platform scoreboards
4. Table – List of mobile platforms
5. Table – Distribution of Time Spent on OSS Development

Part 1: Main Part

1. Introduction

Schumpeter wrote that “the fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates” (Schumpeter, 1942).

As Schumpeter said more than 50 years ago, modern companies are forced to innovate to stay competitive in the process of creative destruction through which innovation is incessantly destroying the old and creating new (Schumpeter, 1942). This has happened in many industries before and has also happened in mobile phone industry. The new technologies enable us to innovate more quickly and are increasing the importance of innovation.

This thesis focuses on open source operating system which is provided for free which does not have much in common with capitalistic approach but even in free software there are ways how to create value and generate profits. One of the chapters discusses which means Android is using to generate profit.

2. Problem Formulation

Google invested huge effort and money into Android platform and offered it for free to phone manufacturers. How is it possible to profit from open source system which is basically for free?

Open source software is usually available for everyone. Based on this we would expect that it is not possible to control something which is completely open. How Google controls Android and how does it balance openness with influence in Android operating system?

3. Objective of the Master's Thesis

The purpose of this thesis is to investigate open innovation in open source software and more specifically how Google balances openness and influence in Android operating system. The thesis also investigates competing platforms, their openness and success in the market.

The thesis at hand attempts to find out more about open source software and open innovation of Android operating system thus, the following research questions are addressed:

1. How to get value from open innovation from products which are free?
2. How Android business model works?
3. How the next development in the field of open source software and hardware might look like?
4. How Google controls the open source operating system Android?

4. Literature Part

Literature review was performed in order to understand what others in the field of research have accomplished. The first literature which was reviewed was within the area of research on open innovation and also within the area of research on open source software.

Also secondary sources were used for the literature review. Information from books and conferences were studied. Information from journal articles provided the most up to date information in relation to current development in open source and mobile industry.

The next step of the literature review was to address and provide answers to the research questions. Literature related to mobile industry and utilization of open innovation was investigated and also case studies were reviewed.

4.1. Open innovation

In the past the view of innovation was more like a process happening within the company. This approach has changed and the new way of thinking is the open innovation with companies cooperating together to create new innovations (Chesbrough, 2003).

Open innovation is a way to acquire and share innovations with others as described in Figure 1. Commercialization of these innovations and knowledge requires cooperation and sharing of knowledge between companies, universities and other research institutions (Engelfriet, 2007). According to Engelfriet (2007) attempts to hoard intellectual property are increasingly counterproductive in current environment with high pace of information flow and instead of this approach, the new knowledge should be put into the market, other way it will seep out.

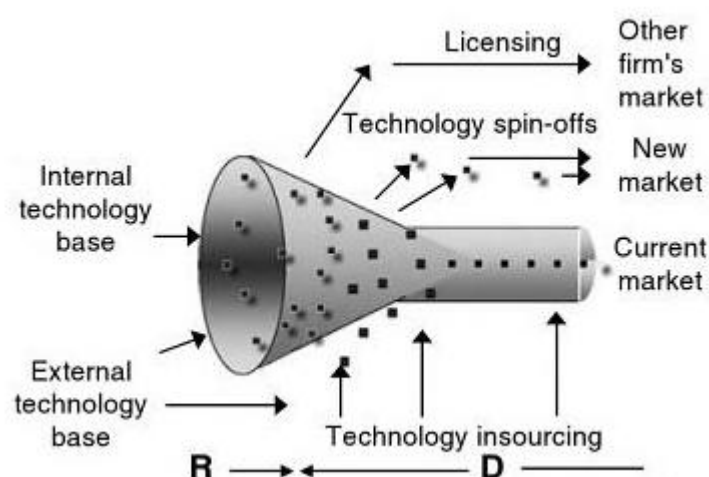


Figure 1 – An open innovation paradigm (source: Chesbrough, 2006)

As defined by Chesbrough et al. (2006), prime goal of open innovation is that firms have a way to capture a private return. Many open source projects aim for public good therefore West (2006) argues if the purest forms of open source or free software mean the open innovation (Chesbrough et al., 2006). But some projects based on open innovation create both public and private gain. For example project Eclipse from IBM which is for profit organization created such outcome.

Openness in open innovation and particularly in open source software means the openness of participation to the innovation process. In big projects this participation cannot represent chaotic activities but has to be organized. Therefore various licensing strategies and governance mechanisms exist.

Companies can acquire innovations also from outside and share these innovations with others. According to Engelfriet (2007) commoditizing of certain technologies by releasing them as open source can be a good supporting strategy to ensure that new innovations become feasible. But proper analysis of the value each feature brings to the product is necessary so the right features are kept open source or proprietary. Every company in the market can use this open source resources and create unique products and services. Open innovation creates new opportunities for every company in the industry (Engelfriet, 2007).

5.1.1. Archetypes of open innovation

Gassmann and Enkel (2004) introduced three archetypes of open innovation processes (Figure 2):

- The outside-in process – which means that external knowledge, technology and intellectual property rights are acquired from the outside and brought into the company. The locus of innovation is within the company.
- The inside-out process – means that unused technology or intellectual property rights are introduced to the market and exploited outside the company. The locus of innovation is still within the company.
- The coupled process – is the combination of outside-in and inside-out processes and the company cooperates with other companies. The locus of innovation is often outside the company.

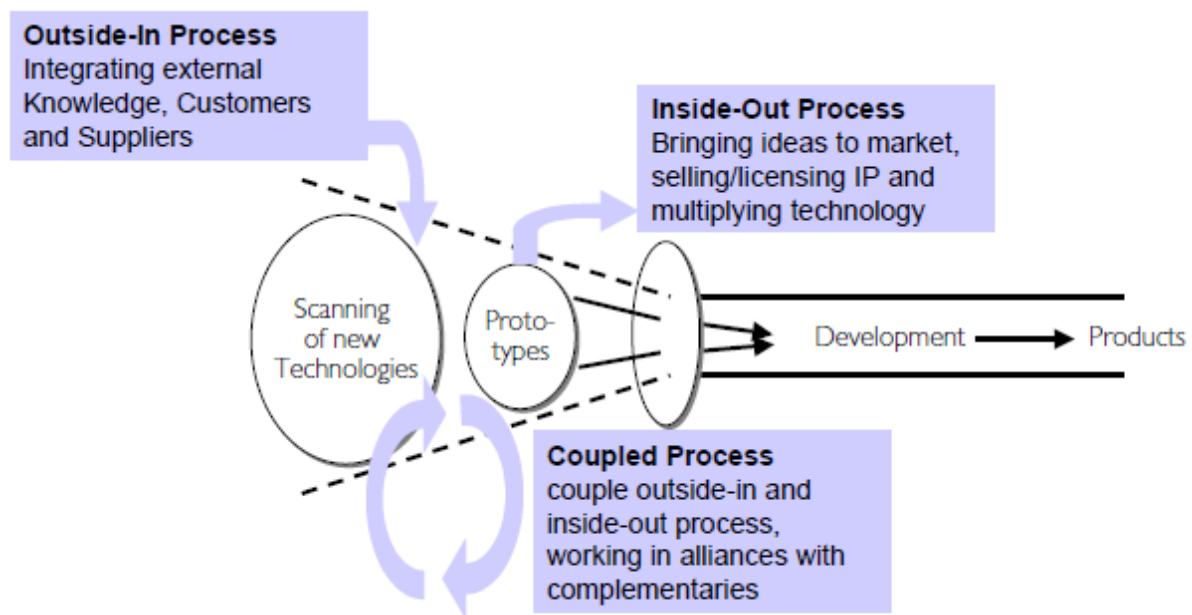


Figure 2 - Three archetypes of open innovation processes (Gassmann & Enkel, 2004)

Knowledge necessary for creating innovations is widespread in many institutions therefore this widespread diffusion of knowledge means that companies have to acquire knowledge from different sources not only within the company (Chesbrough et al., 2006).

5.1.2. Getting value from open innovation

Technology value is not visible until it is converted into a business model. Commercialization of technology reveals the value of technology. Chesbrough (2006) defined three basic ways how company can get a value from new technologies:

- Incorporate the technology in its existing business
- Licensing the technology to other companies
- Launching a new venture in new business arenas that can exploit the new technology

According to West and Gallagher (2006) models of open innovation offer the promise that companies can achieve a higher return on innovative activities and resulting intellectual property. Three fundamental challenges for companies in applying the concept of open innovation have been identified by West and Gallagher (2006):

- Finding creative ways to exploit internal innovation
- Incorporating external innovation into internal development
- Motivating outsiders to supply an ongoing stream of external innovations

West & Gallagher (2006) identified four approaches of companies to open source:

- Pooled R&D/product development - participants jointly contribute to the development of project
- Spinouts - non-commercial technologies are spun out from a parent company for free to support other goals of the company
- Selling complements - the value from open source projects is gained by offering complement products and services
- Donating complements - the open source applications and complements are provided for boosting the core product/technology

Engelfriet (2006) also reminds the rule in economics: make the complement of your own product a commodity. For example digital music complements portable music players so if music will be available online also demand for music players should rise. In our case if

smartphones are more available the demand for Google services should rise as well.

Vanhaverbeke (2006) researched open innovation strategies in larger networks and he argues that the value is almost never created alone. Therefore large network of suppliers, buyers and partners is needed for value creation. Vanhaverbeke mentions multiple levels where an analysis can be done:

- Individual
- Organizational
- Dyads (partnerships between two companies)
- Inter organizational networks
- Regional
- National
- International

5.1.3. Android business model functions

When we evaluate Android platform according to Chesbrough's (2006) definition of business model functions we find out the following:

- In terms of value proposition to the end user Android's main advantage is open source system which can be personalized by adding various additional applications and overall control over the system. For developers Android offers easy to use development environment with open source libraries. For phone manufacturers Android platform is a cheap way how to increase their speed to market.
- Android identified their market segment and offered the technology that improves the mobile experience for end users.
- Value chain of Android consists of developers who create applications appealing to the end users. Also phone manufacturers contribute with their innovations in the field of hardware.
- The revenue generation mechanism for developers is application store where software applications are sold. Another revenue channel is advertisement which can be placed in applications. Google receives share from these profits and also cross sells another Google products with Android. For phone manufacturers the revenue comes from the sale of devices.
- At the beginning of the project Google has identified key partners and created Open Handset Alliance which creates environment for cooperation with complementary companies.
- Google has created a competitive strategy to take advantage of other rivals in phone industry and has already exceeded market share of rivals as iOS from Apple or Symbian from Nokia.

By launch of Android project Google stepped into the new business and incorporated both internal and external innovation into Android. Google also stimulates developers to contribute innovations.

To be able to answer a paradox why Google spends money on research and development of Android if the results of this work are available for free and potentially also to competitors we have to examine Google business in more details. More than 90 % of Google revenue comes from advertising therefore the core business of Google is advertising. Other Google

services including Android are complement to the core business (Schuermans, 2011). This approach enables Google to generate more advertising space and increase profits. Android helps Google to find out more about users and collect more information about him to increase targeting of advertising which is in line with Google's core business.

5.1.4. Innovation and openness

Maxwell (2012) points out three assumptions why the open model should provide better conditions for innovation as a closed model:

1. creative acts take place for a variety of reasons
2. the value of a creative work can be increased by sharing the work and allowing, even encouraging, more potential innovators to contribute to its development
3. economic value can be enhanced by such sharing

Analysis of market segmentation studies found out that users have needs for highly heterogeneous products (Franke & Reisinger, 2003). Openness of Android operating system created conditions for more heterogeneous products as more companies were able to step into mobile phone market and create more products which increased heterogeneity. Also users can choose which software applications they want to add to the basic software or create applications by themselves.

The pace of innovation is influenced by the speed of feedback and open source projects have the best feedback loop for innovative software (Delacretaz, 2010). Agile open source projects with internet based communication tools provide better innovation environment as meetings, reports and committees known from corporate world. Communications tools used in open source organizations support effective communication between project members and support this feedback loop.

Android project offers many tools for everyone who is interested in improving Android and there are several ways how to get involved and provide Android feedback:

- contributing to the source code – tools for submitting of changes are available publicly
- reporting bugs – Android offers online tool to report bugs in software or device and to submit feature requests
- applications development – extensive documentation is available for developers and anyone can offer their application in application market

5.2. Open source software

Open source software dates back to the beginning of information technology community when these technologies were mostly used in academic environment. These people produced software for themselves and shared it freely with other colleagues. The community shared software and anybody was free to use it or modify it for their own purposes without any copyright claims. The main purpose was to make information available and receive comments from others.

Open source development model is known mostly from Linux operating system. It means that the the source code of a computer program is made publicly available under a license that gives users the right to modify and redistribute the program. Some licenses require that any additional modifications of the program will be also made publicly available. This approach brings benefits to all parties involved as everyone can benefit from the development of the software and everyone can create innovations.

Developers working in open source development often reveal their work and source code for free. Android is based on Linux and free availability of embedded Linux software was discussed by Henkel (2003). Also Lakhani and Wolf (2005) studied motivation of open source software developers and defined two basic types of motivation as intrinsic motivation and extrinsic motivation.

Later other approaches evolved when companies wanted to own and control the software and the proprietary software was growing. But also major information technology companies contributed to open source software projects including Google, IBM, Sun or Hewlett Packard.

Table 1 shows examples of open source and open innovation:

	Open innovation	Not open innovation
Open source	Apple: Darwin BEA: Beehive IBM: Apache, Eclipse, Jikes OSDL	Project GNU
Not open source	PC makers: CPU Windows Game Mods	Microsoft: applications Intuit: Quicken

Table 1 – Overlap of open source and open innovation (West & Galagher, 2007)

Forrester Research created a study which analyzed the corporate market and found that 60 % of major companies plan to implement open source software in the coming years. There is a close link between open source software and the internet. Internet enables open source software to be created and enables sharing of knowledge. But it is also open source software which enables internet to exist as open source Apache web server is the most used to run internet page, open source Sendmail is used by the most of email servers.

Open source software is built on basic principles of open innovation which is sharing and collaboration when the development of a technology means collaboration and the right to use the technology is shared (West & Gallagher, 2006).

5.2.1. Open source software licenses

The open source licenses are classified into three main categories (Engelfriet, 2007):

- Free for all licenses - these licenses require licensees to give credit to the original authors but derivative works can be proprietary. These licenses are also referred to as academic licenses and examples are BSD and MIT licenses. Apache web server uses this kind of license.
- Keep open licenses - these licenses require any software modifications to be made available as open source as well. Only larger projects can be kept proprietary. The Mozilla Public License used for the Firefox Web browser is this kind of license.
- Share alike licenses – these licenses require any software with this license to be made available as open source. These licenses are also referred to as copyleft. Example is the GNU GPL which is used by Linux operating system.

The most most popular open source license in Table 2 below account for about 70 % of open source projects. When compared with proprietary licenses we find out that there are only a few commonly used open source licenses while there are millions of proprietary licenses.

License	Type	Projects using this license	Usage in OSS projects (est.)
GPL v2.1	Strong copyleft	Linux kernel, Qt	45 %
LGPL v2.1	Weak copyleft	Webkit, Qt	8 %
MPL v1.1	Weak copyleft	Firefox web browser, Thinderbird email client	1 %
EPL v1.0	Weak copyleft	Eclipse projects, Symbian	0.7 %
MIT	Permissive	Xorg (X Window system)	8 %
BSD v2.0	Permissive	WebKit	6 %
Apache v 2.0	Permissive	Android, Apache software foundation, Subversion	5 %

Table 2 – Popular open source licenses (source: VissionMobile 2011)

Term “copyleft” used in Table 2 is defined as a general method for making a program or other work for free, and requiring all modified and extended versions of the program to be free as well. This means creating a free software and make it available in the public domain uncopyrighted. But it also allows to make proprietary software.

5.3. Open source hardware

The open source movement has been very popular in software industry for many years but there are signs that this approach is also rising in hardware industry. Hardware designers cooperate to design new motherboards and chips and provide these designs as open source. Based on these open source hardware designs new devices are created by single users and companies (Lahart, 2009).

Such an example of open source hardware project is Arduino. Arduino is an open source electronics prototyping platform based on flexible hardware and software. It can receive inputs from a variety of sensors and can process these inputs.

Arduino boards can be built by hand or purchased preassembled with source code for the IDE and the on-board library available and released under the GPL license. The hardware reference designs of Arduino are available under an open source license and users have possibility to adapt it. According to the project website the project is open to incorporating work by others into the official product (source: arduino.cc).

According to Boudreau & Lakhani (2009) Android relies on a competitive market of innovation for its hardware but on a collaborative community for software.

Further development of open source movement in hardware industry could bring similar effects as open source in software industry. It might be probably open source projects as Android which would be the first adopters of open source hardware in a large scale.



Figure 3 – Arduino board (photo source: Arduino team, arduino.cc, 2012)

Today the number of open source hardware projects is in hundreds. Companies like Solarbotics or Sparkfun are selling open source hardware robot kits, boards and solar kits. MakerBot Industries sells open source 3D printer kit. Liquidware company has developed open source hardware Android tablet called Amber.

In 2010 there were companies active in open source hardware with revenues above 1 million USD. There are different business models used in these companies. Arduino makes money on consulting and it provides hardware design consulting services thanks to the fact that it has built big community of hardware designer around their products and they keep in touch with all the developments. Other business models are built on manufacturing.

5.4. Android system

Android company was founded in Palo Alto, United States in October 2003 with aim to develop smarter mobile handsets. Two years later, in August 2005, Google acquired Android company. Key employees including founders stayed at the company after the acquisition and developed a mobile device platform powered by the Linux kernel.

This platform was offered to handset manufacturers and Google was very successful in finding partners for the new Android platform. Google also found other partners from hardware and software areas and also cooperated with carriers. In November 2007, Google launched the Android platform publicly. Open Handset Alliance was formed which is a consortium of more than 80 hardware, software, and telecommunication companies aiming to advance open standards for mobile devices (Elgin, 2005). Open Handset Alliance unites Google's mobile industry value chain and the membership is not publicly open.

The first handset built on the Android platform was released in October 2008 in the US by the manufacturer HTC and the operator T-mobile. Five years after the acquisition of Android by Google, Android became the world's leading smartphone platform at the end of 2010 (Figure 4). In 2012 Android had a 59 % smartphone market share worldwide, with a 331 million devices installed base (Bennett, 2012). There is still a huge space for growth as the amount of non-smart phones is more than 50 % according to Gartner.

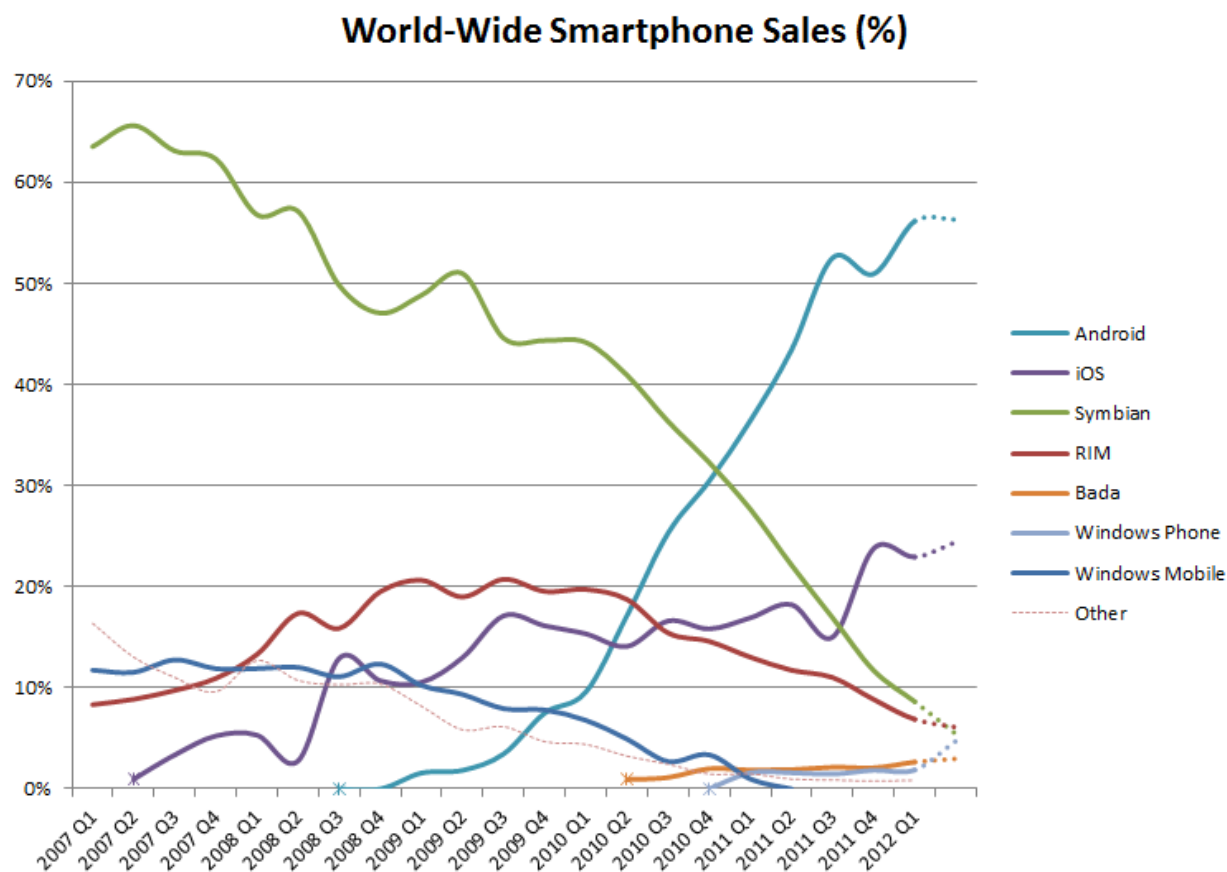


Figure 4 – World Wide Smartphone Sales Share (source: Gartner, 2012)

The Android Open Source Project is led by Google and according to the project website:

“The goal of the Android Open Source Project is to create a successful real-world product that improves the mobile experience for end users”

Android and also other platforms adopted Apple’s approach to applications market where users can buy or download for free additional software applications. Revenues from these applications are shared with developers and 70 % revenue share is what the most used mobile platforms have in common according to Table 3. Competing operating systems are examined in more details in Table 3 – Mobile platform scoreboards.





			 Windows phone	
Number of devices shipped since platform launch	396 million	218 million (iPhone only)	11 million	190 million
Number of devices shipped in Q1 2012	81 million	35 million (iPhone only)	3 million	10 million
Native application store	Google Play	Apple App Store	Windows Marketplace	BlackBerry App World
Available applications	600 thousand	650 thousand	70 thousand	70 thousand
Cumulative downloads	14 billion	26 billion	N/A	2 billion
Revenue model	70 % to developer			
Data from Q1 2012				

Table 3 – Mobile platform scoreboards (source: Developer Economics 2012)

Google was not the first company in smartphone industry but despite this late entry it was able to become the market leader. Android was able to solve one of the main issues with smartphones which was high price of devices. When Apple entered the smartphone market it introduced smartphone to a standard user with user friendly interface but the price still remained high. Android was offered to phone manufacturers without license fees which enabled them to lower the price of smartphone as operating system is usually a key licensing cost any device manufacturer. Android provided highly competitive weapon for

phone manufacturers.

Google created well working platform ecosystem by Android. As defined by Vanhaverbeke (2006) the value is almost never created alone but in cooperation with suppliers, buyers and partners. Google created such a network for Android platform. Strength of this ecosystem is another success factor of Android.

5.4.1. Android software components

Android consists of 5 different groups of software explained in Figure 5: application layer, application framework, libraries, Android runtime and Linux Kernel (Holstein, 2011):

- The application layer - includes basic applications like browser, email client, SMS program, maps, calendar, contacts and others.
- The application framework - is used to implement a standard structure of an application for a specific operating system.
- The libraries - handles 2D and 3D graphics, media codecs like MPEG-4 and MP3, the SQL database SQLite and the web browser engine WebKit.
- Android runtime - consists of a set of core libraries and virtual machine Dalvik. Libraries provide most of the functionality which is available in Java. Virtual machine operates like a translator between the application side and the operating system.
- Linux kernel - is used for device drivers, memory management, process management and networking.

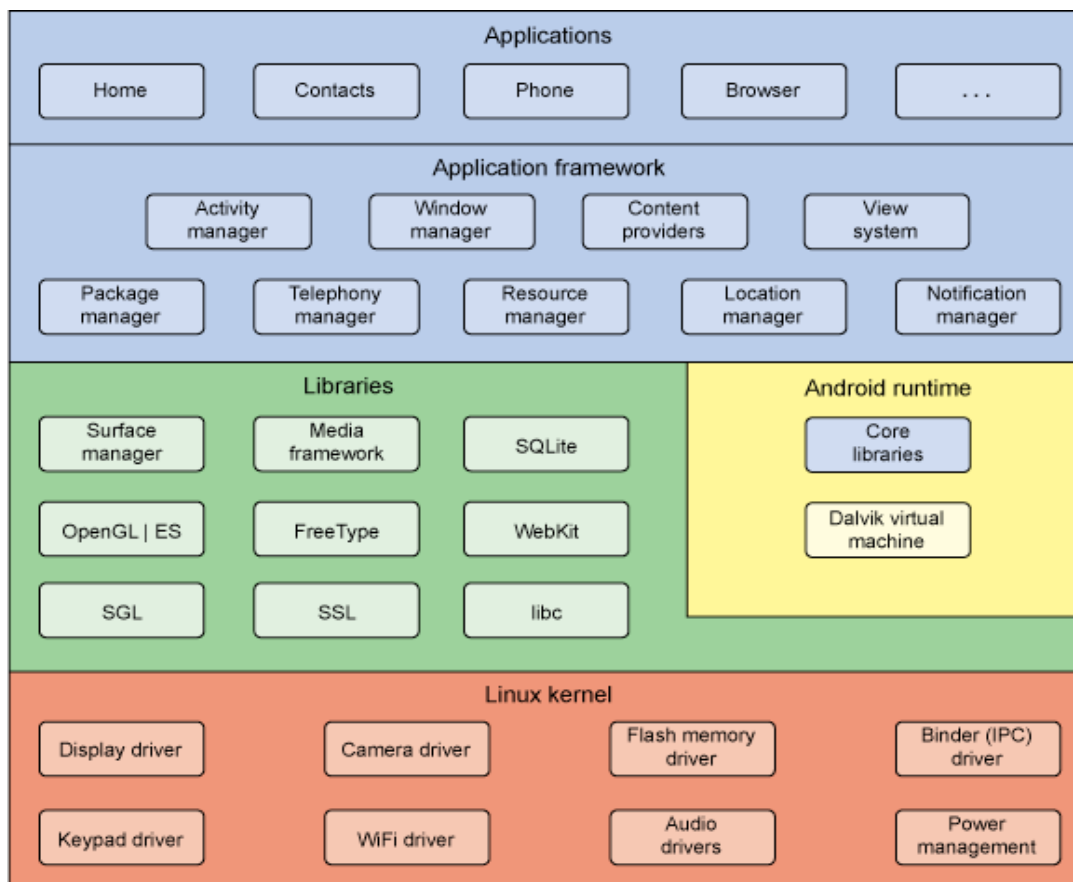


Figure 5 - Major components of the Android software stack (source: Holstein, 2011)

5.4.2. What Android means for Asia and China?

Android has influenced many companies in China including chip manufacturers and also software developers. Chinese producers adopted Android very quickly and used it in mobile phones but also created other Android powered devices like tablets, mobile computers and game consoles. Chinese company MediaTek sells between 300 to 400 million chipsets per year for handsets and mostly for low cost phones in China with prices below 100 USD per device (Wu, 2010).

Chinese companies like Lenovo, Huawei, ZTE and others are producing Android devices primarily for domestic Chinese market but as they are gaining more experience and increasing the quality they will probably try to deliver to foreign markets and it is probably only matter of time until some of these devices will conquer worldwide phone market.

Android enabled Chinese ZTE to become the world's fifth largest device manufacturer by shipment volume after Nokia, Samsung, LG and Apple (Deluca-Smith & Chapman, 2011).

Other benefiterers of Android platform are Korean companies Samsung and LG and Taiwanese HTC. Without Android these companies would not be able to deliver their products to the market as quickly as Android enabled them.

Chinese community of mobile developers conducted a survey between its 1400 members and found out more about demographics, experience or revenues (Wu, 2010). Here are some of the findings:

- Developers are young
Over 80 % of respondents were between 20 to 30 years old, another 10 % between 31 to 35 years.
- Faithful to the Android platform
Half of respondents was with Android platform from the beginning.
- Most developers are professionals
40 % of respondents said they are professional developers, 37 % of respondents were part time developers.
- Mostly individuals
60 % of respondents were individual developers, 90 % of developers worked in teams smaller than 50 people.
- No profit from applications
60 % of developers made no profit on their application but there is also a huge share

of developers who create free apps. 20% of respondents said they are not doing well with application revenues, 18% said they are satisfied with revenue or optimistic about the future revenues.

Android had a great impact on Chinese economy and enabled to make profits to Chinese phone manufacturers but also developers. The importance of Android for the economy will probably rise even more as the market share of Android is still growing.

5.4.3. Android – is it really an open system?

Google bundles other Google services with Android and there is a set of control points that allow Google to do this. These control points enable Google to control software and hardware of almost any device based on Android. While android is completely open for software developers, it is more closed for the handset manufacturers. According to Constantinou (2010) there is no other platform which is so asymmetrical in terms of its governance structures (Constantinou, 2010).

Google offers complete mobile phone software platform with Android. It includes the operating system, software development kit, middleware and basic applications. Other applications are delivered by the third parties and sold by Google through it's application market providing 70 % revenue share to developers. Developers can access core mobile device functionality through standardized interfaces and they can also access the same set of libraries that are used for the development of the core components.

Android operating system competes with other operating system initiatives like Windows mobile from Microsoft which can also be licensed by handset manufacturers and it also competes with closed systems like the iPhone from Apple.

VisionMobile has created The Open Governance Index which measured the openness of open source projects. It quantifies a project's openness, in terms of transparency, decision making, reuse and community structure (VisionMobile, 2011). This Index comprises thirteen metrics across the four areas of governance:

1. Access - availability of the latest source code, developer support mechanisms, public roadmap, and transparency of decision-making
2. Development - the ability of developers to influence the content and direction of the project
3. Derivatives - the ability for developers to create and distribute derivatives of the source code in the form of spinoff projects, handsets or applications
4. Community - a community structure that does not discriminate between developers

Andy Rubin who is the co-founder of Android said: "Android is open sourced but not a community-driven project." He explained it in more details at Google I/O conference in 2011 when he said:

“Open source is different than a community-driven project. Android is light on the community-driven side and heavy on the open source. Everything we do ends up in the open source repository.

We're building a platform, not an app. Developers evolve APIs and deprecate APIs, they are always adding new functionality. When we add new APIs, typically in my opinion community processes don't work. It's really hard to tell when you're done, it's really hard to tell what's a release and what's a beta.

Developers have to have an expectation that all the APIs are done and complete at certain date.

If it was a community process, an OEM could start building devices, then those devices would be incompatible from a third-party developer's perspective. We have to make sure those APIs are on all those devices that adopt those platforms. Going forward, that becomes part of our job, our responsibility. A community process harder to manage. We take submissions from community, but it's a much more controlled way in how it comes out.”

Andy Rubin, co-founder of Android

The Open Governance Index in Figure 6 evaluates open source software. According to The Open Governance Index (2011) Android ranks as the most closed project with 23 % of openness but it is one of the most successful open source projects in history. Is it the proof that The Open Governance Index is not correct or does it mean that Android's success is not based on the openness?



Figure 6 - The Open Governance Index (source: VisionMobile)

Stephen Elop, CEO of Nokia, said in June 2011: “Apple created the conditions necessary for Android” (VisionMobile, 2011). Other reason of Android success is Google business model and financial strength of Google. Android is available for free because Google’s core business is selling advertisement not software. By delivering more handsets into the market Google gets more audience for it’s advertising network. Device manufacturers and network operators also invested billions of dollars in Android in order to compete with Apple.

Grotnes (2008) compared Android and Google’s Open Handset Alliance with The Open Mobile Alliance and studied how standardization can be viewed as an arena for open innovation (Grotnes, 2008). His cases show that the creation of anticipatory standards and common technical platforms are forms of open innovation. Grotnes (2008) also illustrates the different types of openness and third-party involvement utilized by the incumbents and newcomers, and how these influence the innovation process.

According to Grotnes (2008) Android is closer to the open innovation processes of a single company using separate outside-in and inside-out processes while The Open Mobile Alliance uses more formal standardization for the innovation process. He attributes the differences to the openness of the process. While the process of The Open Mobile Alliance is open for all Android and Open Handset Alliance is only for invited parties.

Google's Open Handset Alliance and The Open Mobile Alliance also differ in approach to licensing and royalty fees when Android uses an Open Source license while The Open Mobile Alliance grants licenses on reasonable and nondiscriminatory terms. The Open Mobile Alliance platform is mostly for the members while the Android platform targets third-party developers. Grotnes (2008) concludes that in terms of further innovation, Android's platform is more open than The Open Mobile Alliance platform because of the availability of development tools and third party toolkits. The main conclusions of Grotnes (2008) are that open innovation takes place in neutral arenas like standardization and that outside-in, inside-out and coupled processes are used to create new technological platforms (Grotnes, 2008). An open membership leads to a coupled process, while a more restricted membership gives separate outside-in and inside-out processes (Grotnes, 2008).

Google used Android to build another platform for its own revenue generating services using ad business. According to Constantinou (2010), from the manufacturer perspective Android is no more open and no less closed than licensable operating systems like Windows Mobile, Apple OSX or PalmOS, Symbian and BREW. He also says that Android is the smartest implementation of open source aimed at driving commercial agendas (Constantinou, 2010).

According to Nayyeri (2012) even openness is relative and it is difficult to say if something is absolutely open. He points to example of Microsoft which is also open when compared to Apple, but when compared with Linux and open source it is too adamant.

Mobile platform consists of interacting software, hardware and other related components. To consider it as an open system all the interfaces have to be publicly available and open which means the free usage and possible expandability of the system. This approach allows developers to implement additional functionality to the system through access to application programming interfaces and source code. Open platform is device independent and uses the common standards for communication and connectivity. When considering by this criteria Android operating system is really open. Competing operating systems also offer software development kit for developers to build applications but only Android is based on a free available operating system which is a Linux Kernel.

5.4.4. Android comparison with iOS

The Open Governance Index did not include iOS from Apple so we should compare these two rivals. In terms of open source code Android is more open than iOS which is proprietary. Both systems offer access for developers who can use building block to create new software applications. From hardware point of view Apple controls everything while Google cooperates with several phone manufacturers.

When we compare business models of iOS from Apple and Android from Google we can see major differences:

- Google is not involved in the production of the hardware while Apple controls whole production from software to hardware.
- Google is cooperating with many phone manufacturers who produce hundreds of devices while Apple is only producing approximately two versions of iPhone at time under one brand using one main subcontractor Foxcon.
- Google relies on phone manufacturers to bring the devices to market while Apple spends big budgets on marketing of devices.
- Android devices from different phone manufacturers also differ in user interface while iOS offers the same user interface. This approach of Google is changing and in future user interface should be more unified.
- Google application market offers only applications while Apple offers other digital content like movies and music. Soon Google will imitate Apple's approach and offer digital content also.

5.5. How Google controls Android

Constantinou (2010) spent two months talking to industry sources close to Android commercials to find out how Google controls which software, hardware and services get into Android handset. He found out that Google has created several control points. These are the main Google control points to manage the control of Android handsets (Constantinou, 2010):

1. **Private branches**

Private codelines are available to selected partners and are an estimated 6+ months ahead of the public code.

2. **Closed review process**

Google reviews the code from the community and it is the only authority which can accept it or reject it.

3. **Fast pace of innovation**

Innovation speed of Android platform is very high. Phone manufacturers who want to build on Android have to implement new features and bug fixes released by Google and have to develop to stay up to date.

4. **Incomplete software**

Google only provides parts of the software which are not sufficient to build a handset. Missing parts are for example key building blocks as radio integration, international language packs, operator packs and also closed source apps from Google like Application market and Gmail.

5. **Gated developer community**

Application market is the exclusive distribution channel for Android applications. It is available to phone manufacturers on separate agreement. This provides one of the strongest control points to Google because any handset without access to additional applications would be very hard to sell and probably any phone manufacturer would not produce handset without the ability to install additional applications.

6. **Anti-fragmentation agreement**

The anti-fragmentation agreement is signed by Open Handset Alliance members and it prevents manufacturers from releasing handsets which are not compliant with this agreement.

7. **Private roadmap**

Visibility of Android roadmap is limited.

8. Android trademark

Google is the owner of the trademark to the Android name. Any manufacturer can only use Android brand with approval from Google.

Constantinou (2010) also paraphrases a famous line from Henry Ford's book on the Model-T: "anyone can have Android in their own colour as long as it's black". Android is an example of how a company can use open source to build up interest and community participation, while running a very tight commercial model (Constantinou, 2010).

The Open Handset Alliance provides another control over Android for Google. This organization is sort of a VIP club for major companies. Android certification and compatibility test suite which is the formal testing process by which a handset passes Google requirements gives even more power in the hands of Google. Compatibility test includes API compliance but also performance testing, hardware features, device design, UI specs and bundled services (Constantinou, 2010). Compatibility test aims to ensure baseline compliance and it allows to add features but not to detract. Except compliance testing hardware manufacturers have to fulfill commercial licensing agreements for Google services.

Google still has many ways how to control other companies which use Android, especially hardware manufacturers. Restrictions included in compatibility test suite prevent handset manufacturers from stripping down the functions of Android. If any manufacturer wants to be separate and work with Android without Google it requires more resources as if manufacturer sticks to Google rules.

As a result of Oracle patent lawsuit against Google, Google's internal presentation was disclosed publicly and it says:

"If we gave it away, how can we ensure we get to benefit from it?"

Create policies that allow us to drive the standard:

Be the sheppards of the standard we created – we are in the lead because of our head start. Maintaining the pace will guarantee our lead.

Do not develop in the open. Instead, make source code available after innovation is complete.

Lead device concept: Give early access to the software to partners

who build and distribute devices to our specification (ie. Motorola and Verizon). They get a non-contractual time to market advantage and in return they align to our standard.”

Android is a balance of closed and open governance and while it allows some improvements from developers, some parts stay closed so that the operating system can stay within the control of Google (Cervantes, 2012). Other way the fragmentation in Android would be even higher and it would be difficult to maintain compatibility between many different devices.

5.5.1. Compatibility program

Android compatibility program is a set of rules. It consists of Compatibility definition document which enumerates the requirements that must be met by devices compatible with Android. Another compatibility tool is Compatibility test suite which is a desktop software for executing test cases on attached devices. Its intent is to reveal incompatibilities in software and ensure the software remains compatible throughout the development process.

Compatibility program aims to fulfill these goals:

- Provide a consistent application and hardware environment to application developers
- Enable a consistent application experience for consumers
- Enable device manufacturers to differentiate while being compatible
- Minimize costs and overhead associated with compatibility

Google is increasing control over Android also in the field of user interface. This change in approach to the user interface means that the look of the Android software is getting more unified. In the new versions of Android phone manufacturers will not be able to change the user interface.

Because phone manufacturers are trying to differentiate the look of their devices it creates conflict between Google and phone manufacturers (Hookway, 2010). Phone manufacturers have their own user interface like HTC Sense or Samsung TouchWiz and also carriers like Vodafone or Orange.

This change is partly because of increasing number of devices which are powered by Android. It is not only phone any more but also tablets, televisions or personal computers powered by Android.

5.6. Patent wars

Patents were intended to protect innovation but these days they are used as weapons to hurt competitors or by patent trolls to earn money. Buying patents to sue competitors or amassing them to protect from lawsuits does not have much in common with innovation any more.

Even open source software licenses are based on copyright law. The history of international copyright starts with the Bern Convention in 1880 which was initiated by the French Author Victor Hugo in order to protect the rights of European authors against the illegal copying of their books which took place in USA at that time. Copyright law ensures that the original creator has exclusive rights to reproduce work under condition that the work is original. In today's digital world copying is much different than it used to be in the past and it is not a matter of days anymore but seconds. Even though open source software is publicly available it does not mean that it is available freely in the public domain.

Google and also phone manufacturers who use Android have been the target of patent lawsuits. Oracle sued Google and claimed infringement of copyrights and patents related to the Java programming language in August 2010. The case was resolved in May 2012 when the jury found that Google did not infringe on Oracle's patents. The judge ruled that the structure of the Java API used by Google was not copyrighable (Lowensohn, 2012).

Relationships between companies regarding mobile patent suits are depicted in Figure 7:

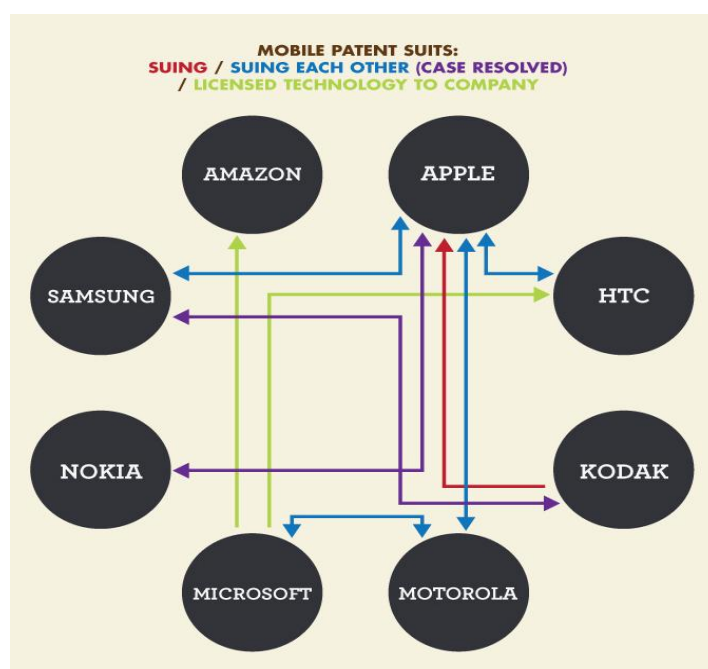


Figure 7 – Mobile patent suits (source: mbaonline.com, 2012)

5.6.1. Is Microsoft the winner in Android case?

In Q2 2011 Microsoft earned 3 times more from Android than from Windows Phone 7 through the use of Microsoft's patents by HTC. Microsoft gets 5 USD for every HTC phone running Android, according to Citi analyst Walter Pritchard (Yarow, 2012). Microsoft is also suing other Android phone makers. Based on these license agreements with Android phone manufacturers Microsoft collects patent licensing fees from 55 % of worldwide revenue for Android devices (Brodin, 2012).

Google publicly accused Apple, Microsoft and Oracle of patent bullying and of trying to take down Android through patent litigation, rather than innovating and competing with better products and services (Cheng, 2011). Therefore purchase of Motorola Mobility including 17 thousand patents was considered as a defense in patent wars to protect Android.

Phone manufacturers who are using Android platform are paying license fees for Android because they don't have many options. Switching to another platform would cost them another money as they have already built their business around Android platform.

Android is not a free mobile operating system. It brings development cost for Google and also spending money on buying patents to protect it. It also brings another cost for phone manufacturers in licensing fees. According to estimates from Manjo (2012), each copy of Android costs phone makers 10 USD to 15 USD in licensing fees to Microsoft. Comparing with Windows Phone 7 license which costs 20 USD to 30 USD per license, Android license is still cheaper (Manjo, 2012).

Nokia and Microsoft were accused by Google of funding patent trolls. "Nokia and Microsoft are colluding to raise the costs of mobile devices for consumers, creating patent trolls that side-step promises both companies have made," Google said in a statement (Green, 2012).

The list of lawsuits and countersuits involving Android:

- March 2010: Apple lawsuit against HTC for allegedly infringing on 20 Apple patents related to user interface and hardware.
- April 2010: Microsoft licensing agreement with handset manufacturer HTC. HTC will pay royalties to Microsoft in exchange for the right to sell Android devices.
- August 2010: Oracle case against Google over the use of Java programming language in Android.
- October 2010: Microsoft case against Motorola for technology related to Microsoft Exchange ActiveSync.

- March 2010: Microsoft against Barnes & Noble who used Android operating system in e-book reader Nook.
- August 2010: Google pays 12.5 billion USD to acquire Motorola Mobility and its extensive portfolio of patents. Google CEO Larry Page says that Android and also it's partners will benefit in patent wars and Google is still dedicated to keep Android an open mobile operating system (Green, 2012).

5.6.2. Buying patents

The largest acquisition Google has made up to date was the purchase of Motorola. This transaction was worth 12.5 billion USD. By purchase of Motorola Google acquired not only the company and its employees but also 17 thousand patents. According to analysts the main reason of purchase were Motorola's patents (Berman, 2012). Google bought these patents to protect Android from legal assaults in patent wars with other companies.

Motorola has more than 20 thousand employees working in 97 countries worldwide (Berman, 2012). According to Berman's (2012) article from the Wall Street Journal, no one at Google really knows what to do with Motorola and there is also possibility that the company will be sold to another buyer but patents will stay at Google. It means that these 17 thousand patents were worth 12.5 billion USD itself. Other patent purchases of Google included 1200 patents from IBM purchased in 2011 and 2012 including pending patent applications (Paul, 2012).

Patents are even bought in consortiums of competitors. For example Rockstar which is a consortium of Microsoft and Apple acquired 6 thousand patents and pending patent applications from the bankrupt Canadian telecom equipment maker Nortel (Green, 2012). Green (2012) also mentions deals in which Nokia and Microsoft transferred patents to other companies specialized in licensing patents and collecting royalties and agreed to share revenue for these patents. These deals include 2 thousand wireless patents and patent applications transferred from Nokia to Canadian patent firm Mosaid, or 450 Nokia patents transferred to Sisvel in 2012.

5.7. Profits of mobile operating systems

Even though Android is the number 1 mobile operating system based on the market share, it is not the most profitable one. Figure 8 below shows market share of 3 leading mobile operating systems in US which were almost identical in December 2010 but despite this fact revenues of Apple from iPhone exceeded revenues of whole Google company.

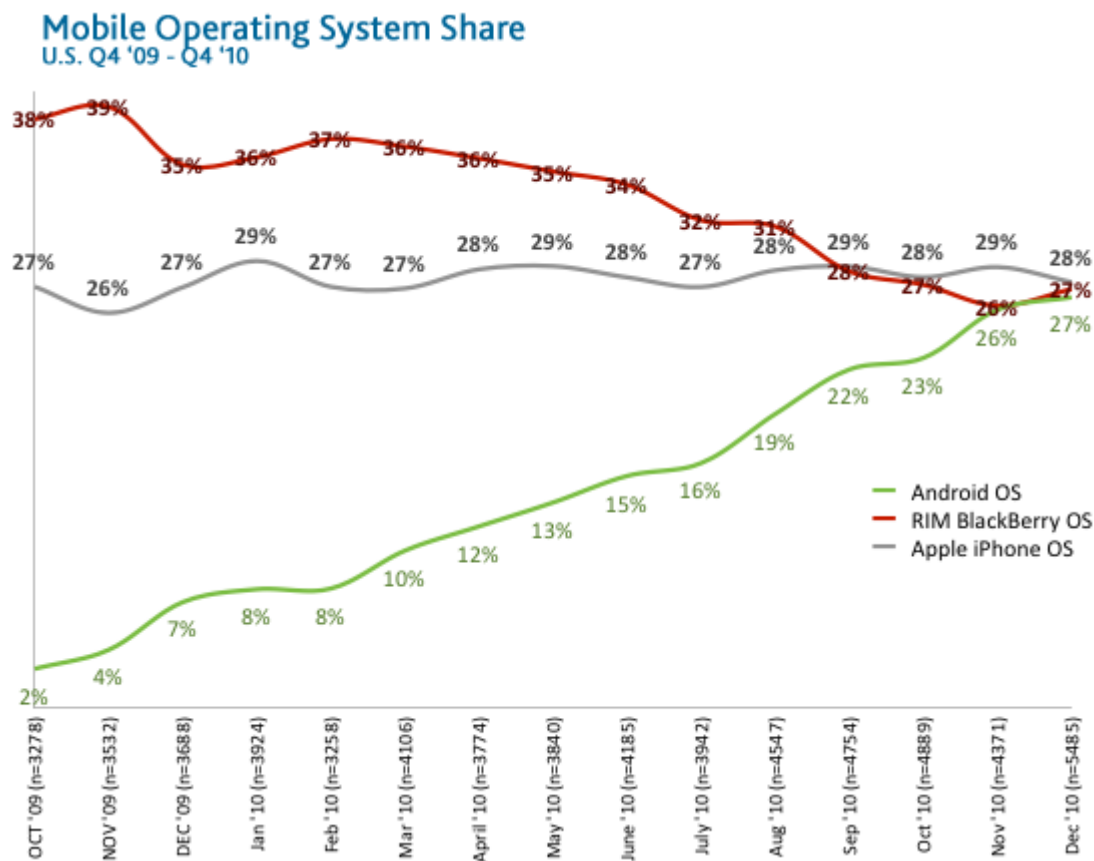


Figure 8 – Mobile operating system market share (source: The Nielsen Company)

If we compare Google's earnings with Apple we find out that Apple's profits surpassed Google's revenues in 2012. Apple's profits were 13.06 billion USD per quarter while Google's revenues 10.58 billion USD per quarter (Woolcock, 2012).

Figure 9 shows quarterly revenue growth of Apple iPhone:

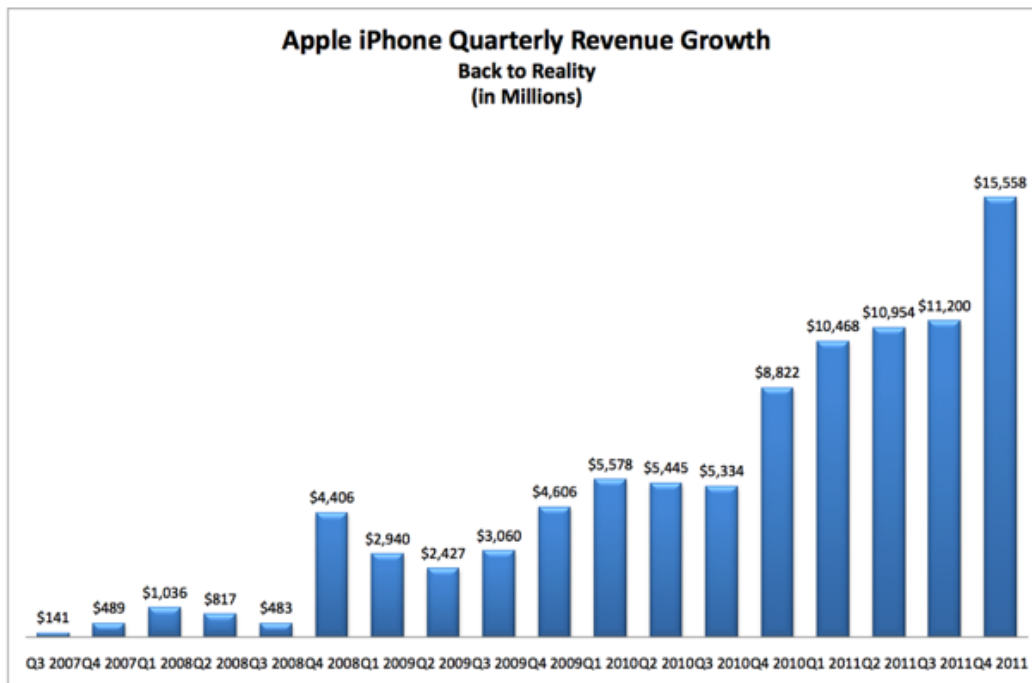


Figure 9 – Apple iPhone quarterly revenue growth (source: Fortune 2011)

Even comparison of Apple's single iPhone division is in favour of Apple when compared with Google's whole business. Apple's profits from iPhone are 67 % of total Apple's profits according to estimate by analyst Toni Sacconaghi which is 9 billion USD. Compared with Google's 3.51 billion USD of total profits Apple is the winner here. Google only earns on ad revenues from Android devices which is about 10 USD per user per year (Woolcock, 2012).

5.8. Handset makers

Apple and Google mobile platforms changed the mobile industry and competing conditions for incumbents like Nokia. Fast followers like Samsung and HTC or even cheaper producers like Chinese ZTE are profiting from the new Android platform. Samsung shipped 94 million handsets, including 42 million smartphones, while Nokia shipped 83 million handsets, including 12 million smartphones in Q1 2012 (Developer Economics 2012).

The traditional phone maker business has been commoditized by Google who lowered barriers of entry for new, mostly Asian producers and enabled them to step in to the smartphone industry. Chinese assemblers like Huawei and ZTE became highly competitive with Android in the terms of price but when we look at the profits it is reversed pyramid where Apple makes more profit from smartphones than all other handset manufacturers combined (Developer Economics 2012).

The pyramid of handset maker competition

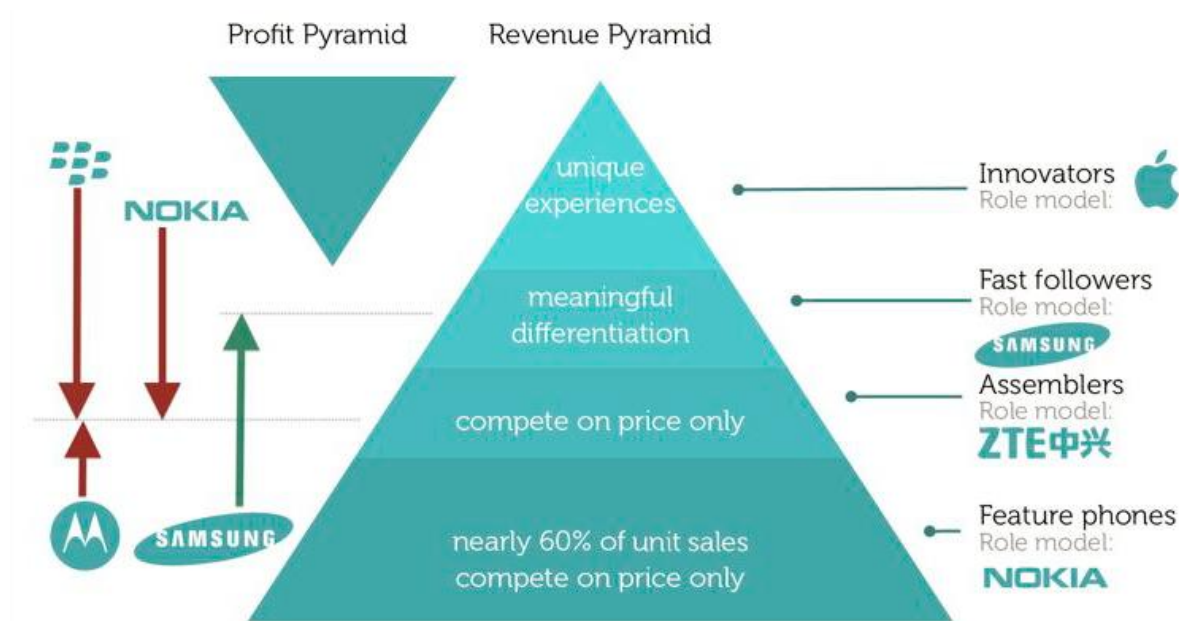


Figure 10 – The pyramid of handset maker competition (source: Developer Economics 2012)

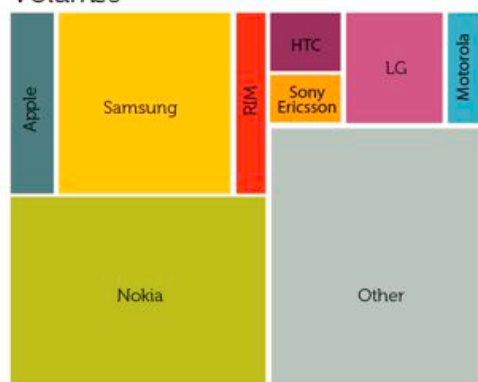
But there is also a threat for Google. Anybody can take Android software for free for example as Amazon did. Amazon has taken Google's freely available operating system and used it for the new Amazon Fire tablet. Amazon will receive all the benefits from this free software while Google gets no advertising revenue (Woolcock, 2012).

Figure 11 shows comparison of volumes, revenues and profits compared in Q1 2011 and Q1 2012 shows that the most handsets were produced by other brands in 2012 which signals more players in this market and commoditization. But these other brands mostly produce cheap handsets therefore the highest profit is still at Apple.

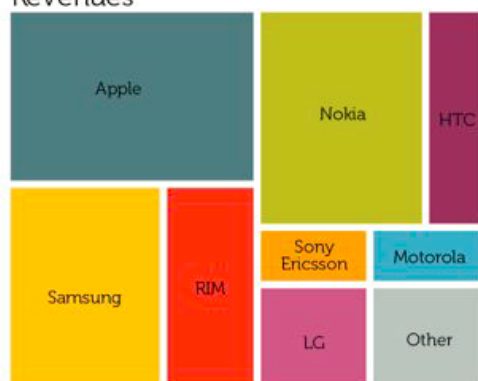
Volumes, revenues and profits

For Q1 2011

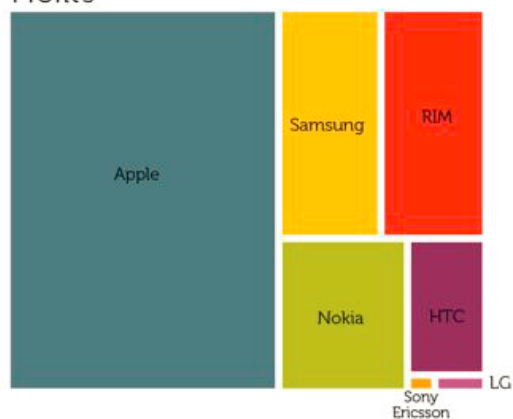
Volumes



Revenues

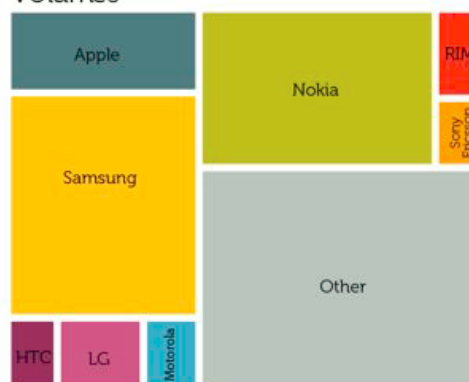


Profits

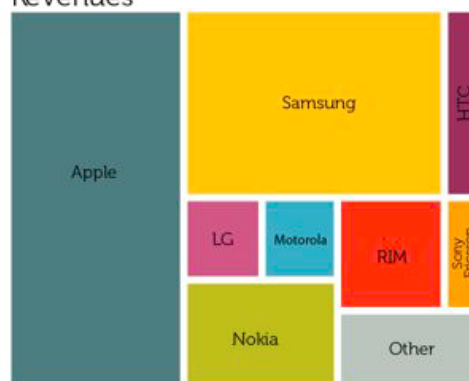


For Q1 2012

Volumes



Revenues



Profits

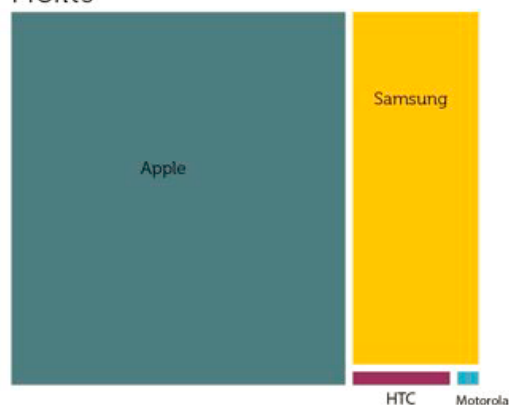


Figure 11 – Volumes, revenues and profits (source: Developer Economics 2012)

5.9. Application developers

At the beginning Google had to attract more developers to create applications for the new operating system Android so it has created Android developer challenge. It awarded developers of Android applications with 10 million USD prizes for the best applications.

All the members of the Open Handset Alliance have intentions to create Android platform more successful. When developers create innovative new applications phone manufacturers will be able more devices and it will also drive up the use of mobile services which is beneficial for the mobile network operators (Grotnes, 2008).

Android platform is open source and it's source code was made available as open source software in October 2008. But the application developer who create additional software for Android can decide if they make their work available as open source or they can decide to distribute it as proprietary applications. This is up to the developer's decision and defined in Apache license. Also some of the Open Handset Alliance members have contributed their intellectual property to the project (Leon, 2008).

Further innovations are created by software developers on Android platform who develop new software based on the software development kit provided by Android. This approach when a toolkit is used for new development of additional software products is part of an open innovation strategy used in gaming software development (Prugl & Schreier, 2006).

Android application market is a kind of idea competition toolkit as mentioned by Piller and Walcher (2006) where many Android users send their applications and make them available to others, some for free and some ask for a fee. Android has provided awards for the best applications to reward developers and to increase the quality of the submissions.

Figure 12 shows the average cost for application development on 4 different operating systems. It reveals significant differences between development cost on different platforms. BlackBerry and Windows Phone are the platforms with the fastest development time and therefore development cost is lower if compared with Android and iOS.

Average cost for application development



Figure 12 – Average cost for application development (source: Developer Economics 2012)

5.9.1. Regional popularity of platforms among developers

Research from market analysis and strategy firm VisionMobile (2012) explored regional support for different mobile platforms among developers and found out, that Android platform is very popular in Asia and Africa where it is the leading platform for developers (Figure 13 shows more details including other regions). On the other hand developers from the markets in North America and Europe prefer Apple's iOS. This can be caused by the lower popularity of paid applications among Android users but also by lower price of Android devices which are therefore more available in price sensitive markets.

Developers primary platform by region

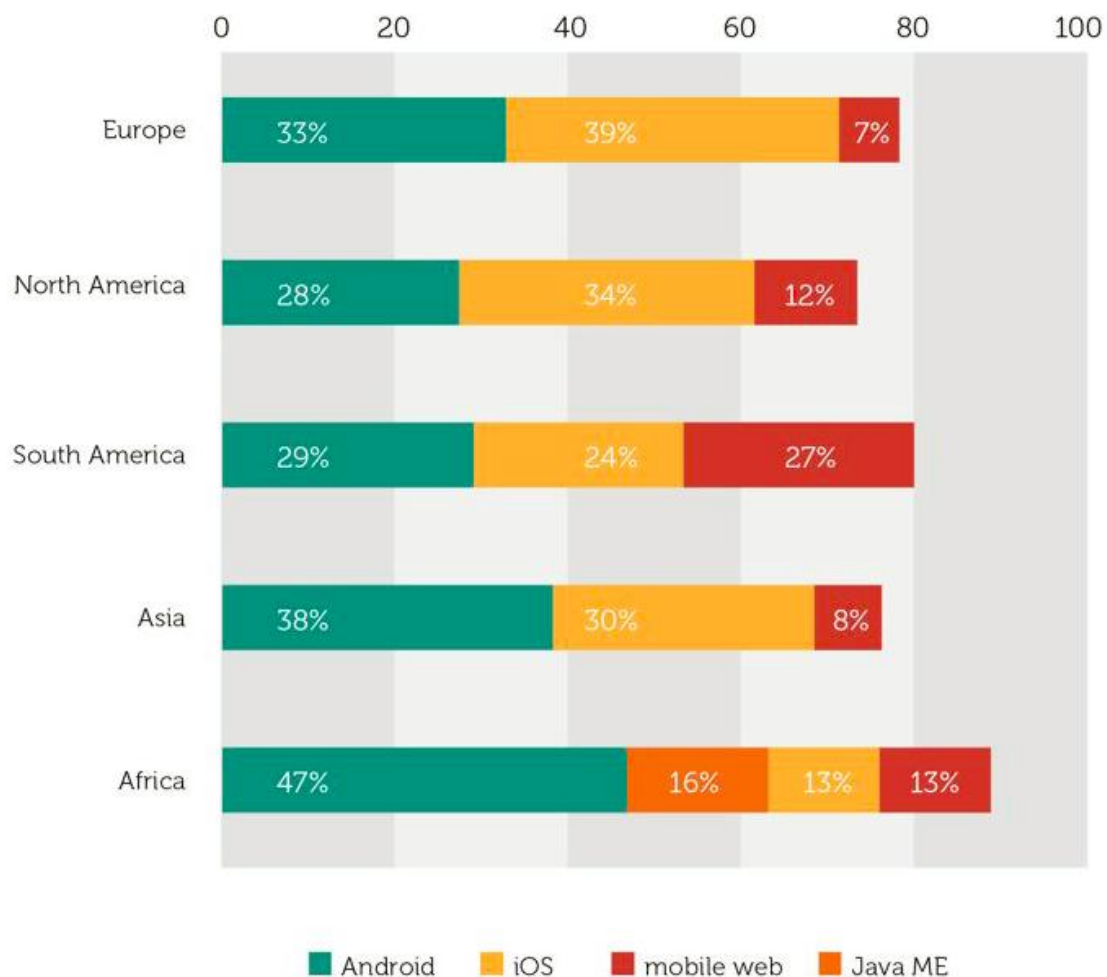


Figure 13 – Developers primary platform by region (source: VisionMobile 2012)

5.9.2. Android version fragmentation

According to Google usage share of the different versions from June 2012, most Android devices run the older version of operation system (2.3.x Gingerbread) which was released in December 2010, even though the newest Android version (4.0.x Ice Cream Sandwich) has been released for over 6 months. Figure 14 show fragmentation of Android versions with share as of June 1, 2012.

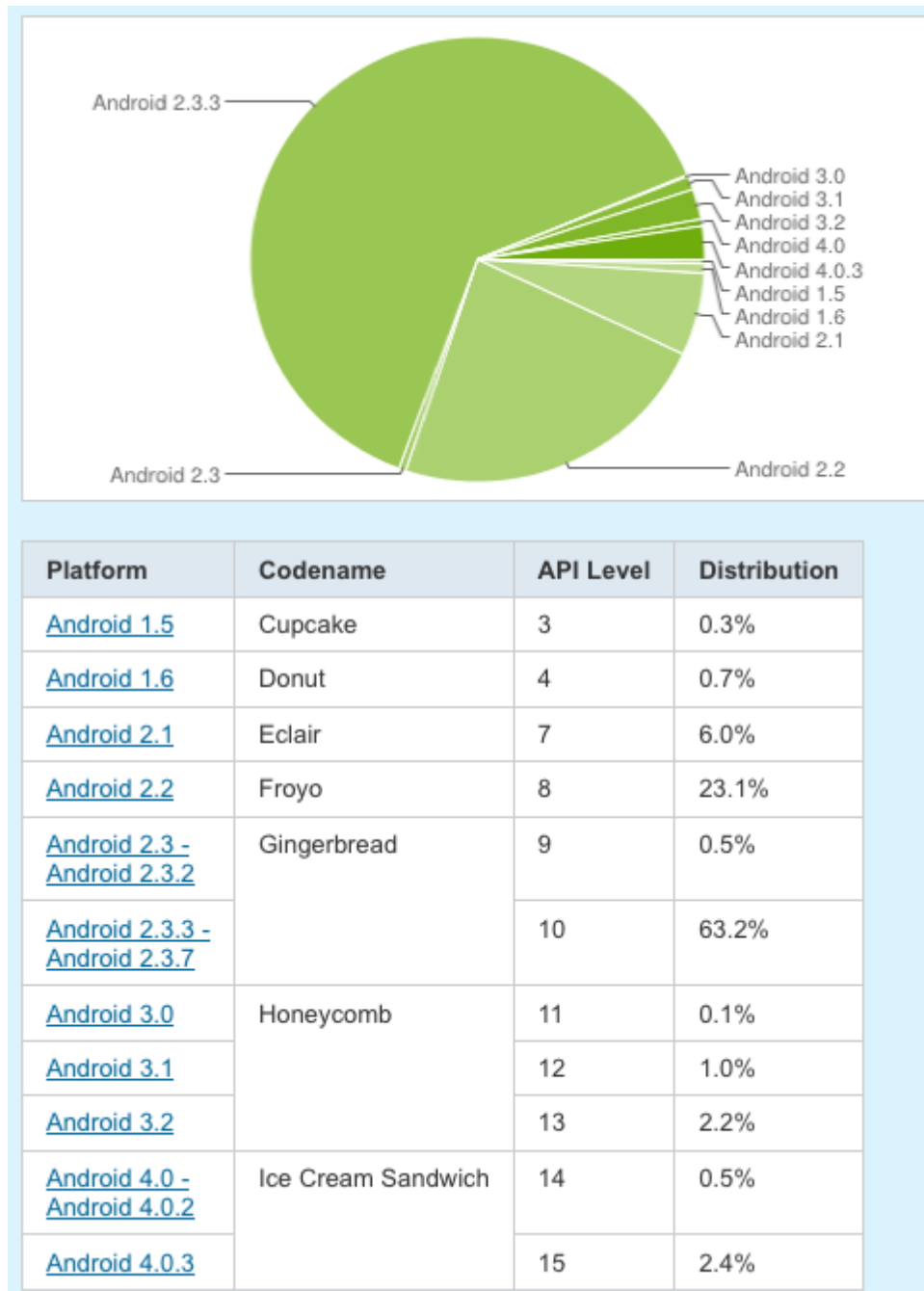


Figure 14 – Usage share of the different versions as of June 1, 2012 (source: Google)

High fragmentation of Android versions is one of the main issues Android developers have to solve. With many different software versions on the market the development is more complicated and increases cost. Another issue for developers is also hardware fragmentation. While Apple platform has only few types of devices, Android has various devices with various specifications from many manufacturers. Android application OpenSignalMaps has tracked over 600 thousand devices which is only 0.2 % of the Android installed base and has identified nearly 600 device models and 4 thousand device variants.

Comparing with Apple, the adoption rate of the newest software version is completely different on Apple and Android platforms. 15 weeks after latest software release from Apple 60 % of users adopted it while only 1 % of Android users adopted the latest software release in the same amount of time as shown in figure 15 (Epstein, 2012). Apple has already taken steps to speed up adoption rate of future software releases by implementing new update system with online backup and without requirement to connect the device to the computer. This will enable users to have access to the most current software version immediately after release and it also creates better environment for developers.

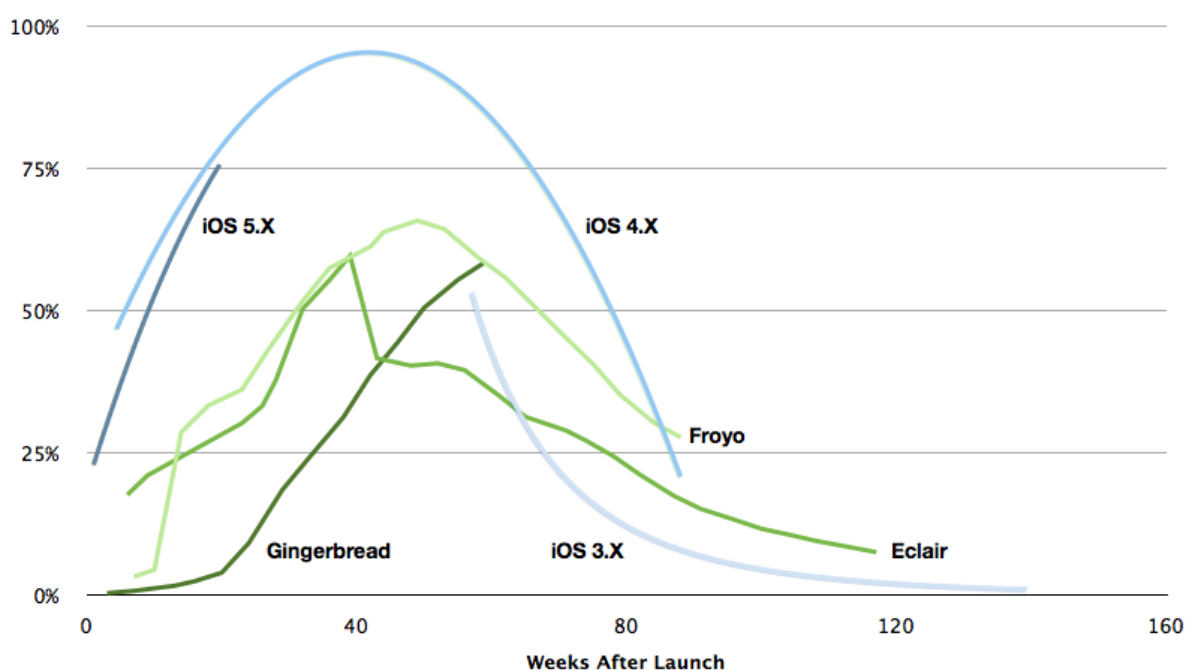


Figure 15 – Operating system version adoption data (source: Epstein, 2012)

5.9.3. Mobile platform popularity

Software developers develop for more platforms to reach more customers. This approach means higher development cost so we can see consolidation in this field and developers are limiting the amount of platforms they support to those with most users. According to Developer Economic 2012 research developers used on average 2.7 platforms while on year before it was 3.2 platforms. Research shows decline in platforms like Symbian and transition to more popular platforms like Android and iOS. 76 % of developers included in the research used Android and 66 % of developers used iOS as shown in Figure 16 in more details.

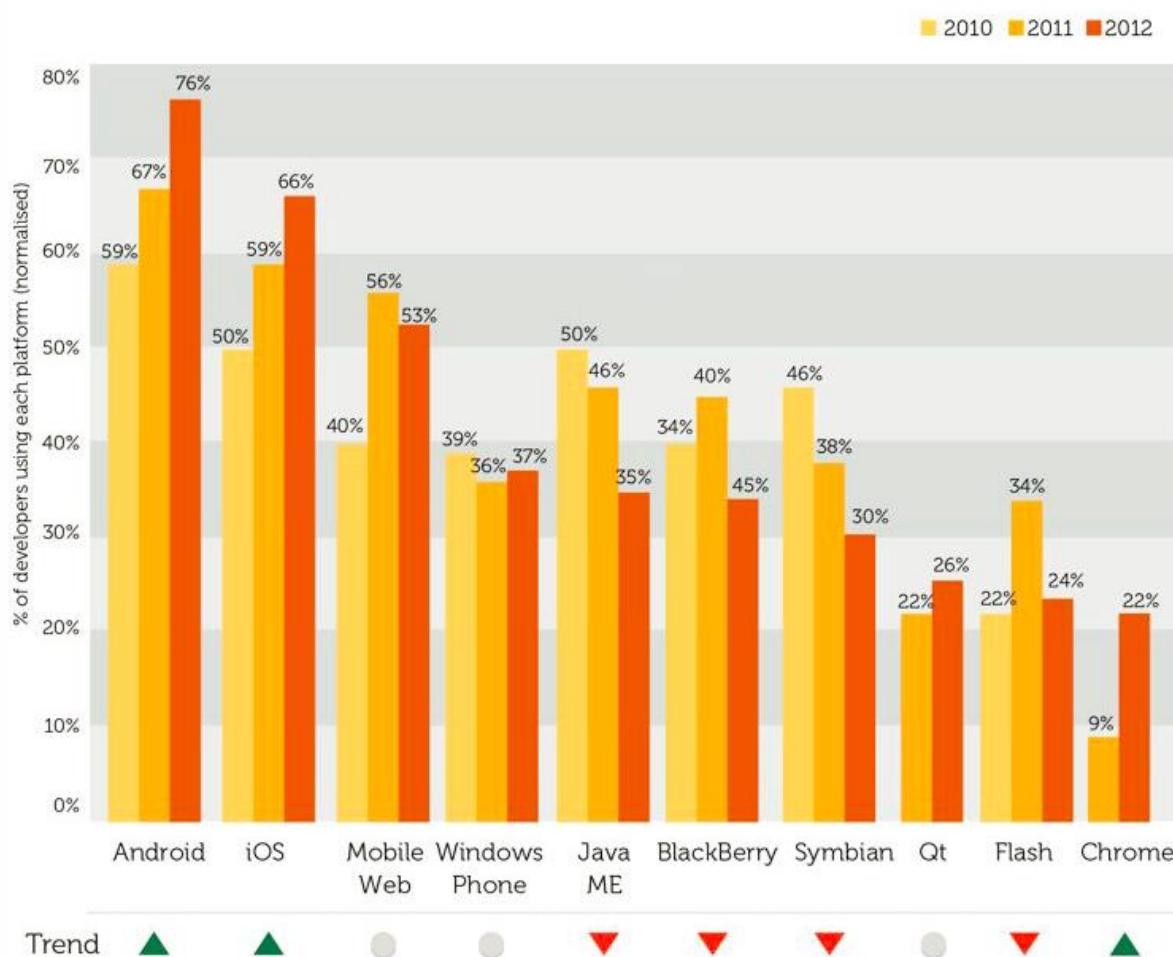


Figure 16 – Top 10 platforms being used by developers in 2010, 2011 and 2012 (source: Developer Economics 2012)

5.9.4. Future of mobile platforms

Developer Economic 2012 research also asked developers which platform they plan to use and the most of them answered this question with Windows Phone which sales have been disappointing up to today with 2.6 million devices sold in Q1 2012 according to Gartner. Despite this 57 % of developer plan to use Windows Phone platform in the future as shown in Figure 17 in more details.

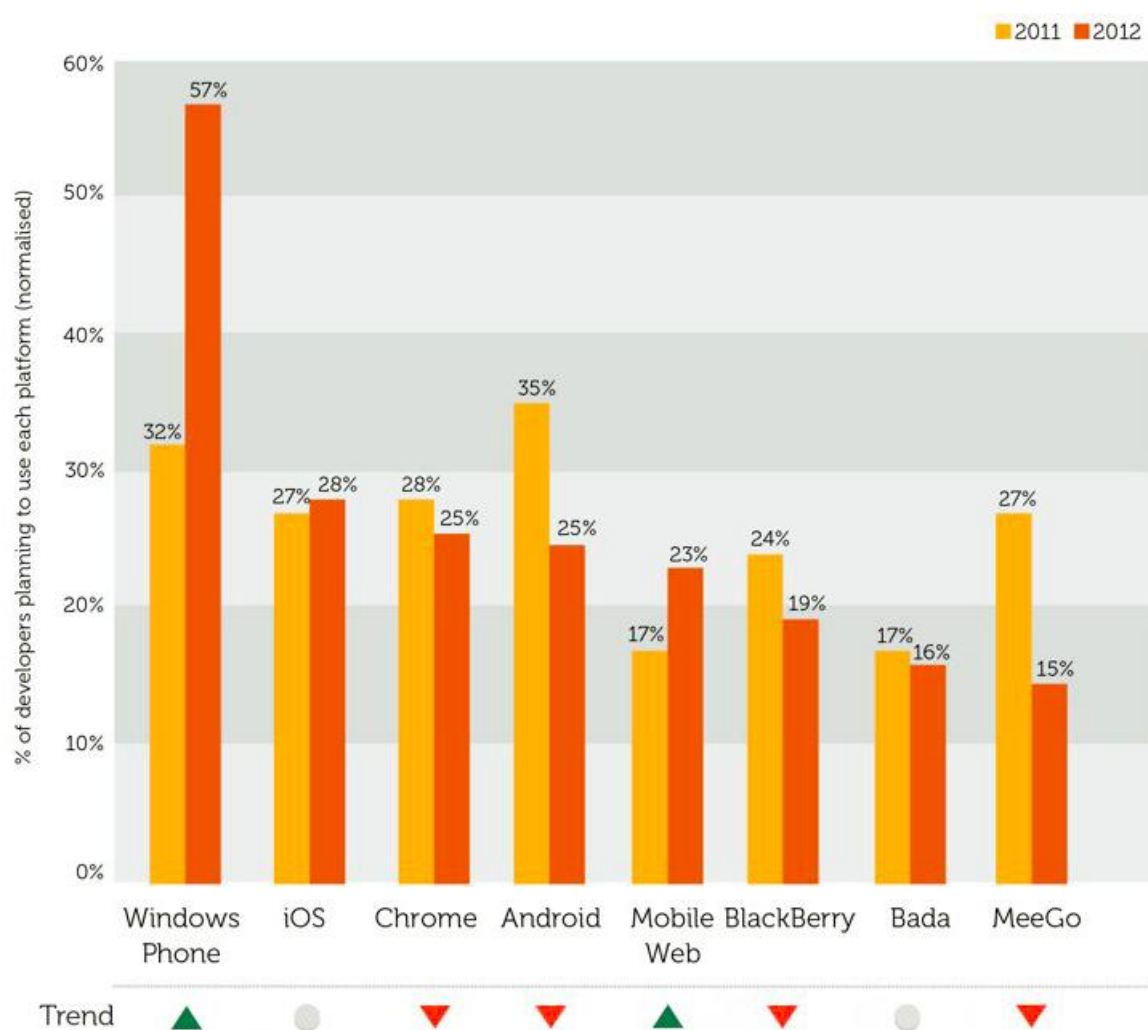


Figure 17 – Top 8 mobile platforms developers are planning to use (source: Developer Economics 2012)

5.9.5. Application stores

Mobile phone application stores are also places for user innovation. Anybody can create software application for Android and publish it in the Android application store for free or for a fee. Android only makes a few basic applications available in Android devices and the rest can be downloaded from application store. To make programming of applications easier Android offers toolkits for creating applications.

This kind of user innovation and contribution to the application store is one of the success factors of mobile operating systems. The low number of applications available is one of the biggest disadvantages of Windows phone system while Apple and Google offer much more applications in their stores. It is a kind of network effect between the success of operating system and number of applications available.

Figure 18 below shows relation between the amount of available applications and the number of devices sold. This network effect is even stronger for Android than for Apple iOS. The number of devices sold shows us the popularity for users and the number of available applications says how the platform is attractive for developers.

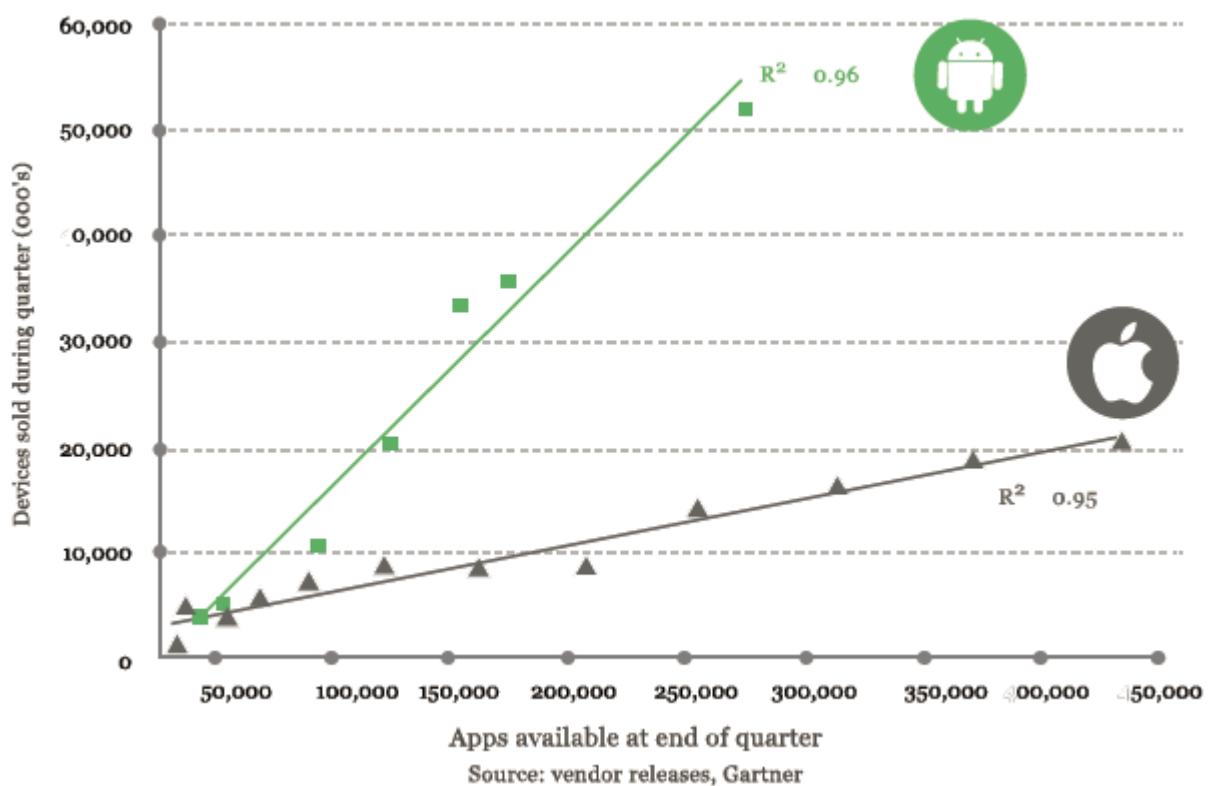


Figure 18 – Android and iOS have strong network effects (source: Mobile software: The clash of ecosystems 2011)

Competing systems like Windows Phone, Symbian or BlackBerry have weak network effects according to VisionMobile research as shown in Figure 19 below. Nokia dismissed Symbian and adopted Windows Phone but there any network effect visible yet. Microsoft has still a lot of work to do to imitate Apple's platform and make Windows Phone platform more attractive to developers and users.

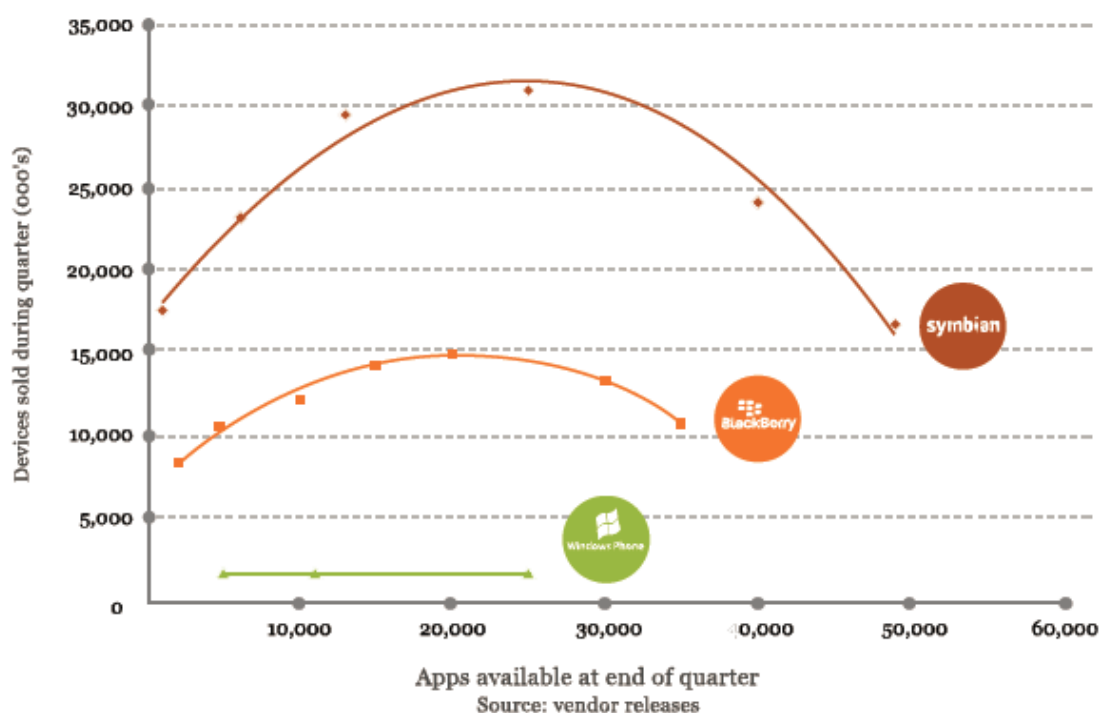


Figure 19 – Weak network effects of BlackBerry, Symbian and Windows Phone (source: Mobile software: The clash of ecosystems 2011)

Apple has created very successful application platform and all the others who came later are trying to replicate this success. But as shown in Table 4 below iOS is still leading in the number of available applications. Android application market called Play Store consists of more than 600 thousand applications which have been downloaded 20 billion times. Monthly there is about 1.5 billion downloads.

Platform	Number of applications	Originally designed as
Android	600.000	Application platform
Bada	15.000	Application platform
BlackBerry OS	35.000	Communication platform
BREW	N/A	Software platform
iOS	650.000	Application platform
Symbian	25.000	Software platform
Windows Phone	30.000	Application platform
webOS	7.000	Application platform

Table 4 – List of mobile platforms (source: VisionMobile 2011)

Application markets of 4 leading mobile platforms from Apple, Google, Nokia and RIM had revenue of 829 million USD in 2009 as shown in Figure 20 below. Apple reached 90 % share in 2009. In 2010 the revenue grew by 160 % and reached 2.154 billion USD with accounting for 80 % of these revenues. Apple's revenue from the application store was 10 times higher than Google's revenue in 2010. The revenue model of all application stores is the same. They share 70 % of the revenue from applications with developers.

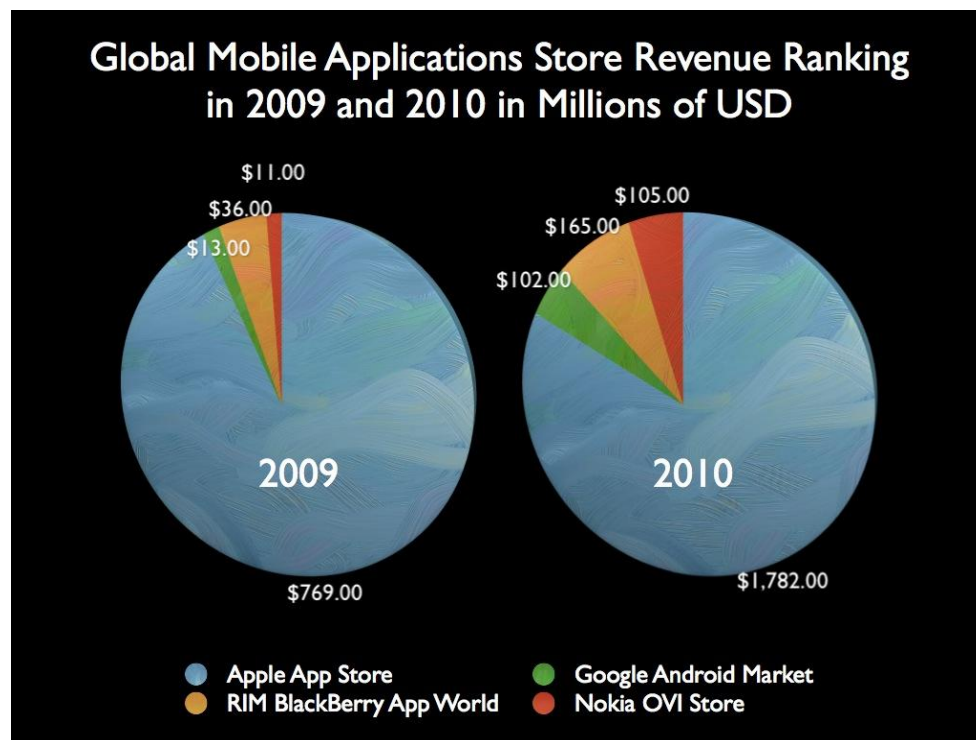


Figure 20 – Mobile applications store revenue (source: Surgeworks)

5.9.6. Success factors of mobile platform

As found out by Developer Economics research in 2012 by VisionMobile, the top adoption criteria for software developers is the size of installed base of devices which is the top criteria for 54 % of respondents. There is also a correlation between the amount of applications available and the size of installed base of devices as bigger installed base of devices creates network effect. Figure 22 shows top 5 platform adoption criteria for developers and proves that reach dominates as root cause for platform selection.

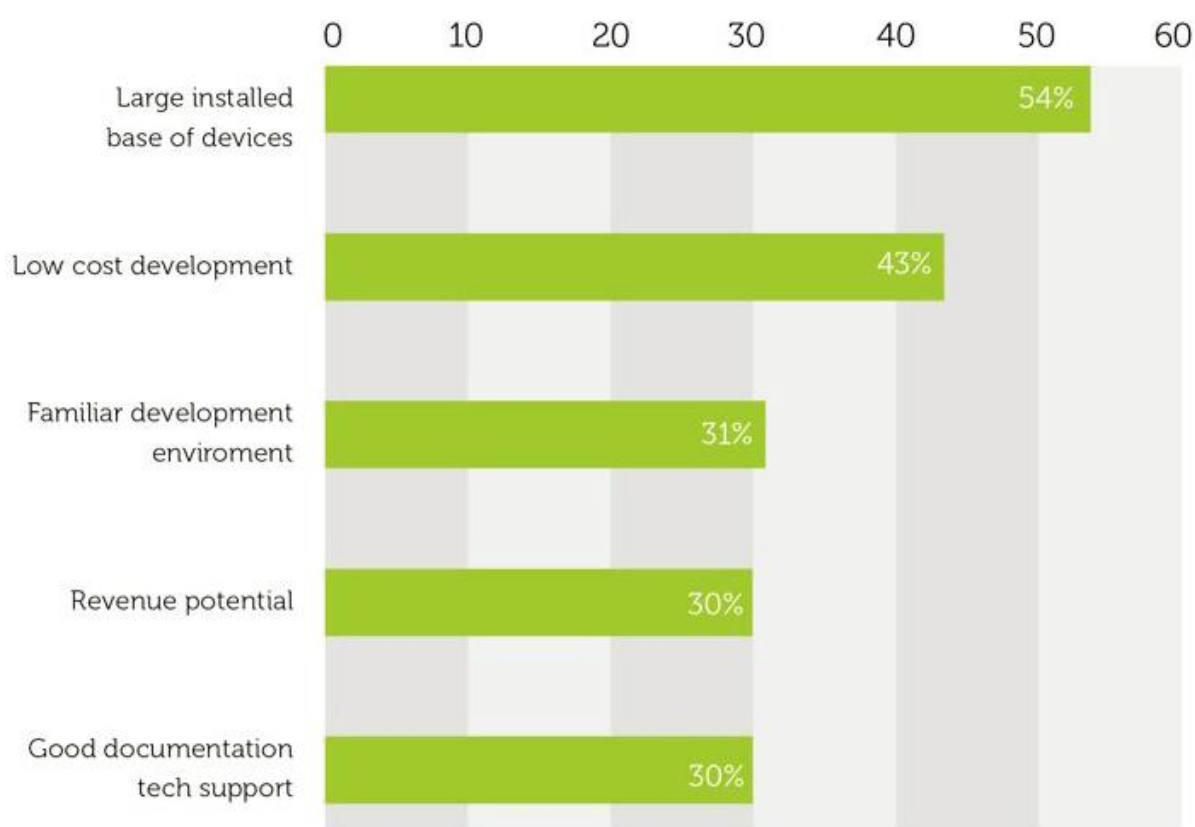


Figure 21 – Top 5 platform adoption criteria for developers (source: Developer Economic 2012)

Google as the mobile platform owner can do very little in the terms of how large installed base of devices is. It can be influenced by the pricing policy and marketing of handsets but it is always end user who decides which mobile platform to choose. But criteria as development environment, low cost of development, documentation and technical support can be directly influenced by the Android platform owner which is Google in our case.

5.9.7. Open source software developers

Wichmann (2002) presented a survey conducted between open source software developers and the results are presented in Table 5 which shows the distribution of time spent on open source software development by developers. It shows that developers spent significant amount of time on open source projects. This proves that open source projects are appealing for the community of developers.

Amount of time per week	Percent of survey respondents
< 2 hours	22.5%
2 - 5 hours	26.1%
6 - 10 hours	20.9%
11 - 20 hours	14.3%
21 - 40 hours	9.1%
> 40 hours	7.1%

Table 5 - Distribution of time spent on OSS development (Wichmann, 2002)

Lin et al. (2009) introduced a game theoretic model to capture the competition between two platforms. They considered two competing platforms, one of them proprietary platform which does not distribute the source code. The other considered platform used an open source platform with public source code. They examined the role of growth of the open community in this competition and tried to answer question whether the open platform necessarily benefits from increasingly mature open community and how it impacts the competing proprietary platform.

The key finding was that the open community growth mitigates the competition and increases the equilibrium membership fees up for both platforms. The other finding was that it balances the developer network sizes on two platforms and developers are shifting away from the more dominant platform and total welfare is improved with growth of the open community (Lin et al., 2009).

6. Results

Research and market studies show that Android is a partly open source system and Google keeps control over Android in some aspects. As Android is a huge project with many involved parties some control from the major player who is Google in this case is reasonable to keep Android system working.

Because of the fact that Android is an open source operating system, Android source code is publicly available and any company can use it and even customize it without any control from Google. But as it was mentioned already this is something what probably only big companies can do. The reason is that for small companies it would be too difficult to build the whole ecosystem around as Google did. Amazon decided to use Android as a software base and built Amazon Kindle Fire tablet with customized Android operating system. Amazon also created own ecosystem of services as application store, browser and cloud solution.

Proposed hypothesis that Google is open system has been tested also by market research studies and Open Governance Index where it was found out that Android is not as open as it seems and it is rather partly open and partly closed system than completely open system.

Part 3: Interpretation, Discussion, Future prospects

If we want to evaluate openness of Android we can evaluate it from 3 different points of view. From users perspective, from developers perspective and from phone manufacturers perspective. The degree of openness of Android is different for all of these groups. While end users and developers perceive Android to be completely open, there are some limitations for phone manufacturers which make Android system not completely open for them.

Figure 23 shows the outlook for worldwide smartphone market share which expects Android to be market leader with market share above 50 % and second nearest competitor with 20 % market share.

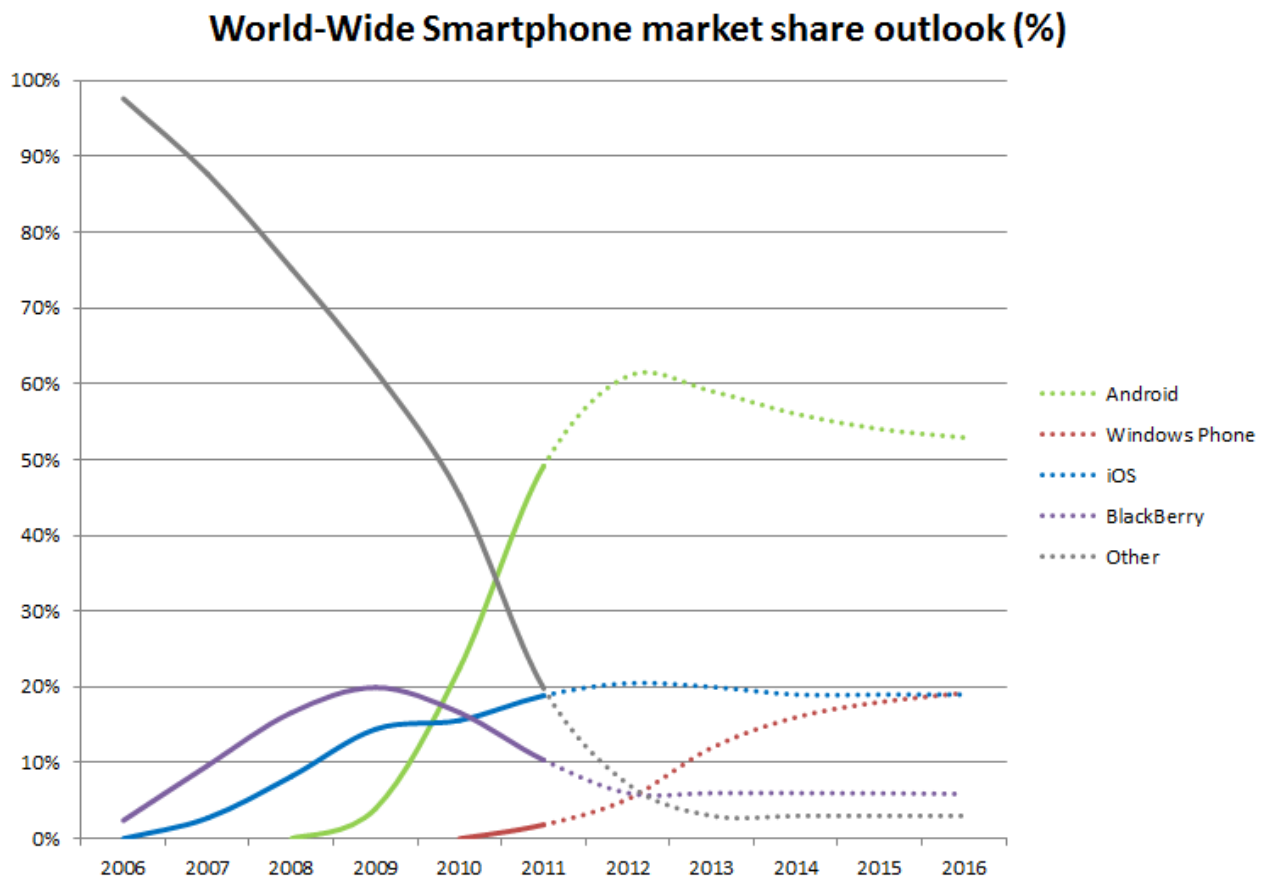


Figure 22 – World Wide Smartphone market share outlook (source: Gartner & IDC, 2012)

Google's approach with open source software has been proved as Android is currently the most used mobile operating system. Future position of Android should become even better as the amount of different systems using Android is increasing and Android is spreading into

televisions, digital cameras, portable game consoles, TV set top boxes and netbooks.

Oversupply of applications can become an issue for developers as oversupply degrades the value of applications. With increasing supply of applications it is more difficult for developers to make money on applications. Just to get users attention has become a struggle in hundreds thousands of applications available.

With new tools for applications development barriers of entry are lowering and programming an application becomes easier. New tools make it even possible to create an application by people who do not know to program.

According to Chesbrough et al. (2006) open source software is an example of how companies can manage complex ecosystem to combine external and internal innovations. Open source software illustrates how open innovation can significantly transform an industry.

The mobile industry is defined by the high pace of changes. Innovation is a key for survival for any participant. Nokia remains the market leader of mobile industry in the number of sold devices but has been replaced in the terms of revenue and profit by producers focused on smartphones. Margins are declining in general and keep high only for those few on the top of the innovation process. It will be very interesting to see the result of Nokia and Microsoft cooperation in the next few years.

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Part 5: Appendix

