Aalto University
School of Economics

Mobile Application Ecosystems from the Application Developers' Perspectives: the Cases of App Store and Android Market

International Business

Master's thesis

Maryam Roshan Kokabha

2012

Department of Management and International Business
Aalto University
School of Economics

AALTO UNIVERSITY SCHOOL OF ECONOMICS **ABSTRACT**

INTERNATIONAL BUSINESS MAY 11, 2012

Master's Thesis

Maryam Roshan Kokabha

MOBILE APPLICATION ECOSYSTEMS FROM THE APPLICATION DEVELOPERS' PERSPECTIVES: THE CASES OF APP STORE AND ANDROID MARKET

Objectives

The study provides an insight into the mobile application ecosystems which are shaped around the novel phenomenon of *app stores*. It investigates the important factors that application developers perceive in their interactions with these ecosystems. The motivation for the study stems from scarcity of earlier research on the *app stores* despite their considerable impact on restructuring of the global mobile industry. The aim is to understand the current structure of the ecosystems, and to find out the factors that application developers find important during their activities on these ecosystems.

Methodology

The study undertakes a multiple-case study approach by focusing on the application ecosystems that have shaped around the two largest market players (i.e. App Store by Apple, and Android Market by Google). The empirical data are collected by an original data gathering method on the Internet with is supported by concurrent data analysis. The method allows for collecting immediate, in-depth qualitative data from a large number of developers all across the world.

Findings

Findings are twofold: 1) The study shows that in the current structure of mobile application ecosystems, platform providers, as the keystones, hold most of the traditional roles of the industry into their *app stores'* technological settings. As a critique to the current literature on business ecosystems, the study indicates that the platform providers can apply high entry barriers to the ecosystem for developers even at the early stages of evolution if assured of their app stores' benefits. Additionally, the study contributes to the current literature by introducing a new strategy for integration of application distribution process (*semi-integration*) which is applied by Google. 2) The study finds that application developers are highly influenced by the *network effects* on the *app stores*, and suggests that the *cross-side network effect* has a stronger effect on developers' behaviors. The study contributes to the current research on *app stores* via empirically supported findings on developers' perspectives. It outlines developers' requests for: a reasonable entry barrier to the ecosystem that allows the qualified developers in; a comprehensive documentation affording the expectations of beginner to advanced developers; a flawless development platform with facilities for memory management and fast testing of applications; and a fast review process for quality control of the published applications. It also confirms that the potential for the global economy of scale of a platform is highly acknowledged by developers in their attitudes towards the application ecosystem.

Keywords

Business Ecosystem, Mobile Application Ecosystem, Application developer, app store, Application Store, App Store, Android Market, Apple, Google.

TABLE OF CONTENTS

TECHNICAL ABBREVIATIONS AND DEFINITIONS 5
1. INTRODUCTION 1
1.1. The New Structure of Mobile Application Market 2
1.2. Research Gap 6
1.3. Research Goals and Questions 7
1.4. Thesis Outline 8
2. THEORETICAL FRAMEWORK 9
2.1. Business Ecosystem 9
2.1.1. The Core of a Business Ecosystem 11
2.1.2. The Participants and Composition of a Business Ecosystem 12
2.1.3. The Health of a Business Ecosystem 14
2.1.4. The Life and History of an Ecosystem 15
2.1.5. Business Ecosystems and Competition 15
2.1.6. The Holistic View of the Discussed Analysis Factors 16
2.2. Two-Sided Markets 17
2.2.1. Dynamics of Two-Sided Markets 18
2.2.2. Challenges for a Platform Provider in a Two-Sided Market 19
2.2.3. Two-Sided Market and ICT Intensive Service Innovation 21
2.3. Mobile Ecosystem 21
2.4. A Revision of Moore's Model 27
2.5. Conceptual Framework 30
3. METHODOLOGY 33
3.1. Research Philosophy 33
3.2. Research Design 35
3.3. Data Collection 36
3.4. Data Analysis 40
4. CASE STUDIES 42
4.1. Apple 42
4.2. Apple App Store 43
4.3. Google 52
4.4. Google Android Market 52
5. ANALYSIS AND DISCUSSION 59

5.1. Ecosystems in the Case Companies 60
5.2. Composition of the Ecosystems 64
5.2.1. The Structure of the Ecosystems 65
5.2.2. The Roles of Participants 68
5.3. Comparing the Attributes of the Ecosystems 71
5.3.1. Joining the Ecosystem 71
5.3.2. Documentation and Application Development 74
5.3.3. Publishing the Applications 84
5.3.4. Marketing and Sales 87
6. MOBILE APPLICATION ECOSYSTEMS FROM THE LENS OF INTERNATIONAL BUSINESS 93
7. CONCLUSION 94
7.1. Main Findings and Contributions 94
7.1.1. Structure of Mobile Application Ecosystems 95
7.1.2. Important Factors Perceived by Developers 98
7.2. Managerial Implications 100
7.3. Method Reflection 102
7.4. Validity and Reliability 104
7.5. Research Limitations 105
7.6. Suggestions for Future Research 105
8. REFERENCES 107

LIST OF FIGURES

Figure 1. Business Ecosystem Participants (Moore, 1996) 12
Figure 2. The Holistic View of the Discussed Analysis Factors 17
Figure 3. Mobile Commerce Value Chain (Barnes, 2002) 22
Figure 4. Mobile Value Chain (Buellingen & Woerter, 2004) 23
Figure 5. The Ecosystem of Mobile Multimedia Development (Karvonen &Warsta, 2004) 23
Figure 6. Segments in Converging Mobile Ecosystem (Basole, 2009) 24
Figure 7. Mobile Ecosystem Participants – adapted from Moore (1996, 27) 27
Figure 8. Mobile Application Distribution Process (Holzer & Ondrus, 2010) 29

Figure 9. Platform Integration Strategies (Holzer & Ondrus, 2010).....29

Figure 10. A Simplified Mobile Ecosystem Model – adapted from Moore (1996, 27).....31

Figure 11. Conceptual Framework for the Factors Considered by Developers.....32

Figure 12. A Representative Range of Methodologies and their Related Paradigms (Healy & Perry, 2000).....34

Figure 13. The Study Architecture.....36

Figure 15. Apple Mobile Application Ecosystem.....66

Figure 16. Google Mobile Application Ecosystem.....68

LIST OF TABLES

Table 1. Worldwide Installed Base of Mobile Phones by Operating System.....4

Table 2. Worldwide Smartphone Sales to End Users by Operating System.....5

Table 3. Application Stores Provided by Main Mobile OS Developers.....5

Table 4. Participants of a Mobile Ecosystem and/or Value Chain.....26

Table 5. The Forums Used in Data Collection.....39

Table 6. Apple Developer Programs.....45

Table 7. Validity of the Research – adapted from Healy & Perry.....104

TECHNICAL ABBREVIATIONS AND DEFINITIONS

API (Application Programming Interface)

A particular set of rules (codes), protocols, and tools for developing an application. API serves as an interface between different software programs, and facilitates their interaction.

Application

A software product that helps users to perform specific tasks - for example a software product for playing music on a device is an application.

Fragmentation

Here it refers to device fragmentation, i.e. diversity of mobile devices due to factors including but not limited to hardware and software specifications. Device fragmentation can cause an application to show different behaviors than intended on different devices. For instance an application which is developed for a big size mobile screen might function inappropriately on a device with small screen.

Freemium

A business model in which a product or service is provided for free, but a premium is charged for advanced feature, functionalities or related products and services.

GPS: Global Positioning System

A satellite-based navigation and location determination system.

IDE (Integrated Development Environment)

An application that provides the programmers with the facilities for software development, and usually consists of a source code editor, compiler/integrator, build automation tools and debugger.

Platform

In a technological system: The underlying hardware or software which defines the standards for developing applications for the system.

In business ecosystem and two-sided markets: a shared collaborative environment.

SDK (Software Development Kit)

A set of software development tools that enables the development of an application for a specific platform. It might include APIs, IDE, programming tools, and supporting documentation. Usually the SDK is offered to a developer by the development platform.

Wi-Fi

A mechanism that enables an electronic device to connect to a wireless network and exchange data on it; using Wi-Fi, a mobile phone can connect to wireless internet.

1. INTRODUCTION

During the past few years, the world has witnessed a dramatic growth in the field of telecommunication and mobile technology. The number of global-mobile subscriptions had been estimated to reach six billion by the end of 2011 from 2.7 billion in 2006 (International Telecommunication Union, 2011c). It means that only within the last five years, the number of mobile connections has doubled. Furthermore, the sales of mobile sets to end-users reached 1.6 billion units in 2010, a 32 percent increase from 2009 (Gartner, 2011a). Along with the growth in the penetration of mobile phones, the mobile sets have been continuously advancing with regard to their technological capacity. They have changed from simple call-making devices in their early phase of introduction to so-called *smartphones*, which enjoy a combination of features such as high-resolution touchscreens, web browsers, Wi-Fi, GPS, and the typical features of digital cameras and portable music and video players. Additionally, users can install and run applications on them.

Smartphones have become dramatically popular in recent years. According to a leading IT research company, 297 million units of smartphones were sold in 2010, which represents a 72 percent increase compared to 2009 sales (Gartner, 2011a). Gartner expects over 500 million smartphones to be sold in 2012 (Computerworld, 2009). By 2015, the worldwide sales of smartphones is expected to total 2.5 billion units with a compound annual growth rate of 24 percent (Cellular-News, 2010). It is expected that smartphones will comprise 45 percent of total mobile phone shipments in 2015 (International Telecommunication Union, 2011c).

The increase in the number of smartphones indicates the change of users' demand from their mobile phones. Users want much more than a humble call possibility and are interested in the wider range of features that a smartphone can offer. The ability to install and run desired applications is one of the features. The International Telecommunication Union (ITU) reports the download of eight billion applications in 2010 (International Telecommunication Union, 2011a) and expects the downloads to reach nearly 48 billion in 2015 (International Telecommunication Union, 2011b). A study on 2100 smartphone users in the US and UK during January 2011 points out that

each of the users on average spends 667 minutes per month using applications, just a little less than 671 minutes messaging, and quite ahead of 531 minutes voice calling and 422 minutes web browsing (Wireless Intelligence, 2011).

The trend of the market indicates the evolution of an economy based on mobile applications, built mainly on top of smartphone capabilities. It is estimated that the market for mobile application development services - which includes the services related to creation, management, and distribution of applications – will reach US 100 billion dollars by 2015 (Read Write Mobile, 2011). Many players have taken an initiative to be part of the market, from application developers, to application development platform providers, to the companies who have considered the benefits of using mobile applications to connect with their consumers. In fact, the application market has affected the businesses and has created new opportunities for application developers and entrepreneurs. A study by Tech Net, the industry network, shows that since 2007, approximately 466 thousand new jobs have been created in the US based on the application economy (BBC News Technology, 2012).

1.1. The New Structure of Mobile Application Market

The evolution of the application economy coincides with the structural changes of mobile application market. For many years mobile services were developed and controlled mostly by mobile network operators, mobile device manufacturers, and some mobile content providers and application developers (Holzer & Ondrus, 2010) where each was responsible for only part(s) of the process. Mobile operators, who had a strong relation with mobile manufacturers, had a strict control on the mobile services (Ibid), and benefitted from the gatekeeping power that they had by having application providers on one side and the mass of consumers on the other. Further, the mobile technological platforms were closed and only a limited number of application providers had access to platform sources (Le Bodic & Lennartz, 2009). The structure started to change with the launch of open mobile platforms through which developers could get access to the device resources in less restricted ways (Ibid), and could develop advanced applications. With the direct access of developers to the mobile platform resources,

mobile operators lost part of their controlling power (Holzer & Ondrus, 2010). Their roles became limited, and the mobile development platform providers took their positions by offering application portals as anticipated by Basole (2009).

The concept of *app store* was the next step in restructuring of the market. It was initiated by Apple in July 2008 when it set up its application store for its devices that were running on iOS operating system (i.e. iPhone, iPod touch and iPad). Apple took control of the entire process from application development to application distribution in a seamless way. In other words, it provided a shared platform between the application developers and application consumers through App Store on top of its operating system. Consumers were connected to the platform by their iOS-based devices, and developers could reach the consumers simply by developing iOS-based applications and distributing them on App Store. Apple motivated the third-party and freelance developers to provide applications on App Store via a revenue sharing business model.

Apple's new business model soon attracted some other large software companies and mobile manufacturers who followed it either on their own or in partnerships, and provided application stores (generally known as *app store*). In August 2008, Google Internet company introduced its *Android Market* for the Android-based mobile phones (Chu, 2008). Less than a year later in April 2009, Research in Motion (RIM) took its *BlackBerry App World* online for the BlackBerry devices (Mashable Tech, 2009). A month later in May 2009, Nokia entered the application market through its *Ovi Store* for Symbian-based mobile phones (Engadget, 2009). Other large firms such as Microsoft (The Telegraph, 2012) and Amazon (Techcrunch, 2012) joined the competition recently. The competition among application stores has expanded to other areas such as tablet computers and desktop systems. For instance, Microsoft announced its plan to launch its Windows 8 app store in February 2012 for Windows-based devices (ZDNet, 2012).

Nowadays large global networks of mobile services shape the structure of mobile domain competition (Tuunainen et al., 2011). The networks comprise of individuals and firms of various types and sizes coevolving and aiming for survival, both independently and as a network (Moore, 1993). Such networks simulate the behavior of an ecosystem

in which different species exist (Ibid). The species compete and cooperate, emerge and disappear, and yet try to keep the entire network robust and resilient towards competitors (Ibid). Large global firms lead these ecosystems by providing the platform around which the ecosystems shape. The firms engage freelance developers from all across the world to the platform; provide them with the development tools and the distribution channel to sell their applications to the mass of consumers who use platform-compatible devices. In return the developers get a share from the generated revenue.

The platform-based environment indicates the existence of a typical two-sided market (Zhu & Iansity, 2011), where developers and consumers are attracted to each other. Thus, the platform provider needs to take the appropriate strategies to motivate the developers and consumers to join the platform and retain them.

The platform is defined on the basis of mobile operating system. As mentioned earlier, consumers join the platform by buying mobile phones running on the operating system and developers join the platform through developing applications with the development tools compatible with the operating system specifications. At the moment, there are four main mobile operating systems in the market: Android by Google, Symbian by Nokia, iOS by Apple, and Blackberry by RIM (Ahonen, 2011). The global installed base of each operating system is shown in Table 1. The Installed base column represents the number of devices that run on the operating system in the market.

Table 1. Worldwide Installed Base of Mobile Phones by Operating System (Ahonen, 2011)

Operating System	**Installed base (million)**	**Market share (percent)**
Android	190	31
Symbian	190	31
iOS	114	17
Blackberry	93	14
Others	62	7
Total	649	100

To understand the level of competition among the market players, it is useful to have a look at the sales rates of each player thru the last three years (Table 2). In 2009, Symbian had a market share of 47 percent, and Android had a market share of only four percent. Nowadays, Android has grown its share to 53 percent and Symbian has seen a reduced market share to only 17 percent. Meanwhile, iOS has almost maintained its market share throughout the years.

Table 2. Worldwide Smartphone Sales to End Users by Operating System (Gartner, 2011a, 2011b)

Operating System	**2009 Units Sold (million)**	**2009 Market Share (%)**	**2010 Units Sold (million)**	**2010 Market Share (%)**	**3Q11 Units Sold (million)**	**3Q11 Market Share (%)**
Android	6.8	3.9	67.2	22.7	60.5	52.5
Symbian	80.9	46.9	111.6	37.6	19.5	16.9
iOS	24.9	14.4	46.6	15.7	17.3	15.0
Blackberry	34.3	19.9	47.5	16.0	12.7	11.0
others	25.5	14.9	23.7	8.0	5.2	4.6
Total	172.4	100	296.6	100	115.2	100

The four main operating systems, as can be seen in table 3, have their exclusive app stores, namely App Store (iOS), Android Market (Android), Ovi Store (Symbian), and BlackBerry App World (BlackBerry).

Table 3. Application Stores Provided by Main Mobile OS Developers (Distimo, 2011)

App store	**Operating System**	**Launch Date**	**Number of Apps (thousand)**
App Store	iOS	July 11, 2008	459
Android Market	Android	Oct. 22, 2008	380
Ovi Store	Symbian	May 26, 2009	117
BlackBerry App World	Blackberry	April 1, 2009	51

The novelty of the significant structural changes in the mobile application market and the ever increasing global competition among the players, as well as the emergence of new competitors has opened up a new horizon for the attention of research community.

The competition exists at different levels. The platform providers try to attract more developers and consumers to their platforms. The content providers and application developers take the opportunity to reach a global market by joining the ecosystems. They try to monetize their products and services and maximize their profits. Many businesses use mobile applications as the engagement platforms for their consumers to co-create value. By October 2011, 90 of the top 100 global brands (defined by Interband 2011 best global brands) published an application in at least one app store - an enormous increase from 50 percent at the beginning of 2010 (Spriensma, 2011).

What makes these application stores even more interesting is their global scale of operations. The application stores enable the distribution of applications from any part of the world to another, as long as the shared technological platform among the consumers and developers exists.

1.2. Research Gap

The phenomenon of the application stores in their new formats has gained a significant attention of market research and consulting firms, yet in academia the research on it has been scarce.

Some researchers undertake the mobile application ecosystems and tackle the issue from various aspects, such as: the ecosystem nature of the mobile domain (Basole, 2009; Tarnacha & Maitland, 2006a; Peppard & Rylander, 2006), the converging structure of the market (Basole, 2009; Holzer & Ondrus, 2010).

Some researchers consider the new forms of application stores in their studies. Holzer & Ondrus (2010) focus on the market trends and the opportunities offered to developers. Tilson et al. (2012) study the paradox of control and change for the platform provider. Tuunainen et al. (2011) focus on the platforms of Apple and Nokia and describe the issues for consumers and developers based on the factors of their proposed ICT intensive service innovation model.

However, the current research on application stores is still in its infancy; yet the extremely heavy impact of the phenomenon on the global mobile industry calls for the attention of researchers from various fields.

1.3. Research Goals and Questions

Considering the novelty of the phenomenon of the *app stores*, this study is an attempt to provide an insight into the mobile application ecosystems which are shaped around these stores. It regards the important factors that application developers perceive in their interactions with these ecosystems.

Hence the main research question is formulated as following:

- *What factors do developers perceive as important (both positively and negatively) in a mobile application ecosystem?*

And a sub-question is formulated as following:

- *What is the structure of a mobile application ecosystem?*

To answer the research questions, the study combines three streams of literature (business ecosystems, two-sided markets, and mobile industry) to create a conceptual model. It then undertakes the cases of the two currently largest mobile application ecosystems and analyzes their structures. Further, it focuses on the factors that application developers tend to find important in these ecosystems. It investigates the developers' perceptions of the case companies' performances in regard to each factor, and accordingly derives conclusions on developers' preferences.

The case ecosystems are the ones that have shaped around App Store by Apple, and Android Market by Google. At the time of the study, App Store contains about 460 thousand and Android Market contains about 380 thousand applications (Distimo, 2011a). Interestingly, Apple and Google have quite contradictory strategies in their businesses: Apple is famous for being a closed system while Google has got a reputation of being an open system.

1.4. Thesis Outline

This thesis is comprised of six chapters.

Following the introduction in the first chapter, the second chapter outlines the selected points from earlier research on business ecosystems, two-sided markets, and mobile industry. The chapter ends with a conceptual framework for this study.

The third chapter presents the research methodology. It is followed by the fourth chapter where the case studies and the empirical findings are outlined.

The fifth chapter analyzes and discusses the empirical findings.

The sixth chapter briefly looks at the global context of mobile application ecosystems in light of international business concerns.

The seventh chapter concludes the study in light of the earlier research and the empirical investigation. This chapter covers six sections: main findings, managerial implications, method reflection, validity and reliability, research limitations, and suggestions for future research.

2. THEORETICAL FRAMEWORK

In this chapter a review of the earlier research is presented. The newness of the research area and the scarcity of earlier research call for an investigation into three relevant research streams: firstly a review of the business ecosystem concept and the most important topics related to its analysis are presented. Secondly, the concept of two-sided market and their dynamics are discussed. Thirdly, the existing literature on mobile ecosystems and value chains are covered. Finally, a compilation of the literature is provided, and the conceptual framework is presented.

2.1. Business Ecosystem

Generally, it was the modern computer business in the mid-20th century that shed a new light onto the concept of networked business, and developed it into an advanced ecosystem level (Moore, 2006, 10; Iansity & Levien, 2004, 7). The paradigm was shifting from establishment of hierarchical organizations (Moore, 1998) to integrating into loosely connected (Iansity & Levien, 2004, 31), complex (Moore, 1998; Iansity & Levien, 2004, 35), and evolving (Moore, 1998) networks.

Business ecosystem concept came into life by Moore's (1993) study of business networks in the light of a biological ecosystem metaphor. He indicates that in an ecosystem, several species cohabit, influence each other, and the evolution of a species is related to the evolution of other species; meanwhile the entire system tries to survive against external threats. He argues that survival in the new way of competition necessitates the creation of similar business networks with a variety of firms that cohabit. The main difference between a business ecosystem and a value network is that the concept of simultaneous cooperation and competition among the members is stronger in a business ecosystem; while in a value network members cooperate more strictly and competition is mainly limited to the stage of joining the network (Peltoniemi, 2004).

Nevertheless, Moore (1993) highlights a remarkable difference between a business ecosystem and a biological ecosystem with regard to the attributes of their composing

players. In a business ecosystem, unlike a biological ecosystem, the players are intelligent (Iansity & Levien, 2004, 38) beyond their mere instincts, and the leading players are able to see the big picture and understand the dynamics (Moore, 1996, 11). In order to create value for the customers, they come together to access complementary resources as they establish relationships (Iyer et al., 2006). For any member to evolve into its full capacity, the supportive evolution of other members is necessary (Hearn & Pace, 2006). A combination of competitiveness and cooperativeness exists among the members, which is a result of the impact that members receive from both their internal capabilities and from the interactions with other members (Iansity & Levien, 2004, 35).

Several scholars elaborate on the concept of *business ecosystem*. Some of them provide general definitions (e.g. Moore, 1993, 1994, 1996; Iansity & Levien, 2004; Hagel et al., 2008; Hearn and Pace, 2006), and some define it in their research context (e.g. Power & Jerjian, 2001; Jansen et al., 2009a, 2009b; Bosch, 2009; Iyer et al., 2006). Moore (1993; 1996, 26; 1998) provides the first definition of a business ecosystem by describing it as an economic community that includes all the stakeholders who coevolve, are mutually supportive, and are ready to align themselves with the strategies of the key stakeholders (who might substitute or change over time) in order to reach their shared vision. Iansity & Levien (2004, 35) describe the business ecosystem as a network of entities that are loosely connected and have complex interactions with each other and the health and performance of each individual firm rests on the health and performance of the entire ecosystem. Both Moore (1996, 11) and Iansity & Levien (2004, 23) highlight the complex interactions of the members of a business ecosystem - the concept of *coevolution* which means the simultaneous combination of competition and cooperation (Moore, 1996, 11). Hagel et al. (2008) recognize the business ecosystem as a deep structure of a shaper and the participants that create and capture value, and learn from each other while sharing risks together. Hearn & Pace (2006) go beyond the definition of a mere ecosystem, and argue that time requires the shift from a business ecosystem concept to a value creating ecology concept which they call a *value ecosystem*. They highlight that their view to value in an ecosystem differs from Moore's (1996) in the sense that they do not see the criticality of the value creation only at the establishment of the ecosystem, but throughout the entire life of the ecosystem. Power & Jerjian

(2001, 13) define the business ecosystem in the context of e-business and explain that a business ecosystem is comprised of websites and real world entities interacting with them. Some other scholars address the concept of business ecosystems in the software industry, refer to it as *software ecosystem (SECO)* (e.g. Jansen et al., 2009a, 2009b; Bosch, 2009; Iyer et al., 2006), and define it specifically in their context. For example, Jansen et al. (2009b) defines a software ecosystem as the functioning of actors as a unit and their relations to serve a service and software shared market, and emphasizes on the role of a technological platform for underpinning the actors.

For the purpose of this study, the definition of a business ecosystem in the mobile application context is formulated as following:

> *A large network of loosely connected stakeholders (individuals, companies and organizations) who have gathered around a technological platform (specifically mobile application store). These members interact with each other in a complex way to constantly create and deliver value to the customers, who are the members of the ecosystem too. The fate of the members is highly dependent on the survival of the technological platform.*

In the next sections, the key factors in analyzing a business ecosystem are presented.

2.1.1. The Core of a Business Ecosystem

The core of an ecosystem can be based on four concepts: market, technology, platform, and firm. (Jansen et al., 2009b) In a market-based ecosystem (e.g. the market for portable music players), the members provide similar products to customers, and they have a competitive position towards each other. In a technology-based ecosystem (e.g. a programming language), members are from different related fields, but the one who holds the intellectual property right can usually benefit from a superior position, and acquire a leading role in the ecosystem (Moore, 1998; Iansity & Levien, 2004). In a platform-based ecosystem (e.g. an operating system platform), members are from different related fields and that increases the functionality of the platform using the Application Programming Interfaces (APIs). Such ecosystems have enjoyed a

considerable attention recently due to the extensive usage of digital technology and growth in ICT. In a firm-based ecosystem, the ecosystem is shaped around a firm (e.g. Microsoft). The firm can play the role of the leader in several ecosystems and members follow its strategies. The firm-based ecosystem can be an equivalent to the platform-based ecosystem, if the platform provider has only one platform. (Jansen et al. 2009b)

2.1.2. The Participants and Composition of a Business Ecosystem

The participants of an ecosystem have a broad range (Figure 1) beyond the participants of the *core business* (i.e. core contributors, direct suppliers, and distribution channels), and the participants of the *extended enterprise* (i.e. the participants of the core business plus the suppliers of suppliers, suppliers of complementary products, standards bodies, direct customers and customers of direct customers). The business ecosystem participants also include the regulatory organizations, all stakeholders, and even the competing organizations that share the same attributes in their products and services, business processes, and organizational arrangements. (Moore 1996, 27)

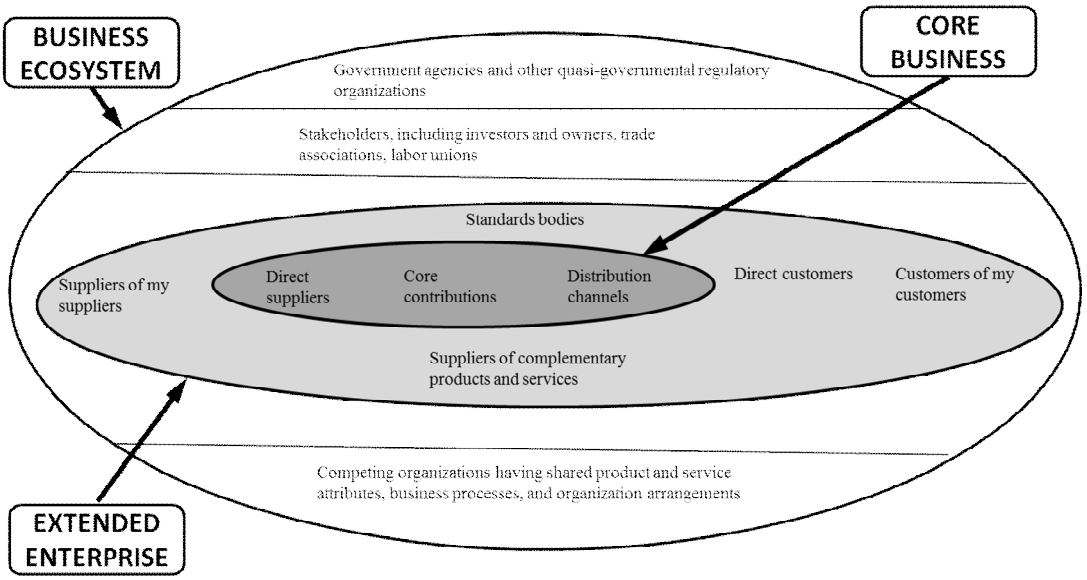

Figure 1. Business Ecosystem Participants (Moore, 1996)

The composition of an ecosystem explains about the actors in the ecosystem and their interactions. An ecosystem is basically structured by a central hub, a *platform* for the interaction of the members, and other participants who create and share value using the platform. To have a thorough understanding of the composition, it is useful to map the participants of the ecosystem and see how they connect to each other to access resources. (Iyer et al., 2006)

Although researchers (e.g. Iansity & Levien, 2004; Iyer et al., 2006; Hagel et al., 2008) agree on the basic structure of an ecosystem, yet they use different terminologies to address the same concepts. For example, in the case of the *central hub*, Iansity & Levien (2004, 68) call it "*keystone*" [and see it as an equivalent to *"hub"*]; Moore (1993) names it as "*central contributor"*; Hagel et al. (2008) address it as the "*shaper*"; and Iyer et al. despite calling it as "*keystone*", see it only as part of the "*hub*" (which in their definition includes "*dominators*" and "*niche players*", as well).

A *keystone* shapes the strategies (Hagel et al., 2008) and has a significant impact on the health of the ecosystem. It tries to increase the stability, diversity and productivity of the ecosystem through creating and sharing value on the ecosystem platform with other participants (Iansity & Levien, 2004, 70). In fact, the keystone creates value by providing the means and motivation for participants' value creation. A keystone should be alert not to turn into a *dominator*. A dominator intends to occupy a big share of the ecosystem and extract as much value as possible. Dominators are in two types: *classic dominators*, and *landlords*. A Classic dominator aims for vertical and horizontal integration in the ecosystem and tries to bring other participants under its umbrella. A landlord only withdraws the value from the ecosystem without creating any value or facilitating the value creation. The behavior of a landlord results in killing the incentives of member firms. An ecosystem occupied by dominators will lose its diversity and robustness over time. (Iansity & Levien, 2004, 116)

Besides the hub (or keystone), the *niche players* exist in an ecosystem (Iyer et al. 2006; Iansity & Levien, 2004, 76). Niche players collectively create the bulk of the ecosystem and usually have a limited number of relationships to others compared to the keystones (Iansity & Levien, 2004, 76). They possess specialized capabilities through which they

create value and complement other participants. Niche players are the critical drivers of innovation and their diversity increases the robustness of the ecosystem (Ibid, 126). Hagel et al. (2008, 85) further categorize the participants [niche players] into three types: *influencer*, *hedger*, and *disciple*. The influencer *"commits early and prominently to one shaping* [or keystone's] *strategy"*. The hedger *"develops its products and services to support multiple shaping* [or keystone's] *platforms"*. The disciple *"commits exclusively to one shaping* [or keystone's] *platform"* and unlike the hedger, does not invest in competing platforms.

Besides the keystone (and/or dominators) and niche players, in a research on software networks, Iyer et al. (2006, 44) introduce two other roles: a *broker* and a *bridge*. The broker *"makes connections between two sets of firms"*. The bridge is *"a link critical to the overall connectedness within the network"* and is played by the firms who have developed a middleware; therefore, interoperate across multiple or disconnected applications. However, these roles seem to be very much related to the context of software networks, and might not be found in all types of business ecosystems.

The participants' activities in the ecosystem are mainly orchestrated by the keystone's strategies. Proper orchestration can provide the motive for the members firstly to be willing to join, and secondly, to stay loyal to the ecosystem and increase its stability. (Jansen et al, 2009b)

2.1.3. The Health of a Business Ecosystem

The performance and development of an ecosystem is tightly related to its *health*. Iansity & Levien (2004, 46) define three health aspects for an ecosystem: productivity, robustness, and niche creation. Productivity shows how active the ecosystem is (Jansen et al., 2009b) and is measured by three factors: 1) factor productivity (i.e. the level to which the factors of production are converted into useful work), 2) change in the productivity over time, and 3) delivery of innovation (Iansity & Levien 2004, 47-50). Robustness shows how well the ecosystem can recover from major shocks (Jansen et al., 2009b) and is measured through survival rate of the participants, persistence of

ecosystem structure, predictability of changes, limited obsolescence in response to perturbation, and continuity of use experience and use cases (Iansity & Levien 2004, 50-54). The niche creation shows the ability of an ecosystem to create opportunities for both new and old actors (Jansen et al., 2009b) and is measured through growth in the diversity of firms and products, as well as technical variety in the ecosystem. (Iansity & Levien, 2004, 54-55)

2.1.4. The Life and History of an Ecosystem

The life and history of an ecosystem can be divided into four stages (Moore, 1996, 83): *pioneering*, *expansion*, *authority*, and *renewal*. In the *pioneering stage*, the ecosystem is born and tries to create value around the core innovation (new offer), while trying to protect the innovation from rivals and to attract the critical customers and suppliers. In the *expansion stage*, the ecosystem brings the new offer to a large market. It tries to gain the maximum market share and become a standard in the market by creating a critical mass. In the *authority stage*, the ecosystem develops a promising vision to encourage the suppliers, partners and customers to collaborate on improving the offer. Meanwhile, it tries to preserve its bargaining power against such customers, partners and suppliers. In the *renewal stage*, the ecosystem works with innovators to develop new ideas. In the meantime, it tries to retain its innovators and customers by developing high switching costs and high barriers to entry, respectfully.

2.1.5. Business Ecosystems and Competition

There are three foundations that shape the concept of competition in a business ecosystem: architecture, integration, and market management. Architecture and integration, in respect, refer to the way that boundaries are set between technologies, products and organizations, and the way that members of the ecosystem are collaborating across these boundaries to share their capabilities. Market management shapes the way in which firms are pursuing the fulfillment of their transactions across the defined boundaries and rules of the ecosystem. (Iansity & Levien, 2004, 145)

The architecture and integration of an ecosystem are shaped through the *platform*. The platform does not refer to a technological platform, but as a shared collaborative environment. A set of process points or interfaces are defined in the platform to help the members of the ecosystem to enjoy the capabilities of the ecosystem. The platform performs as *"the package"* used by the keystone for sharing the value across the ecosystem (Ibid, 148) and consists of two components: the implementations and the interface. Implementations are the invisible layer of a platform, and make its foundation by proprietary approaches to solving problems and bridging the technological gaps of the ecosystem. Interface, on the other hand, is the visible component and is the access point that ecosystem members use to create and share value. (Ibid, 150) A keystone's challenge in maintaining a distinguished platform is to preserve the strength of the implementations and the dramatic power of the interface (Ibid, 156). Therefore, the competition among ecosystems can be, in fact, the competition among the platforms.

2.1.6. The Holistic View of the Discussed Analysis Factors

Figure 2 combines the factors that have been discussed in previous sections and connects them in order to provide a holistic view towards the various concepts of a business ecosystem.

The business ecosystem platform locates in the center. On the left side, the different layers of the participant categories (as realized by different researchers) are shown. They connect to the ecosystem platform. On the right side, the results of the activities of the ecosystem participants are shown in the form of the health of the ecosystems and its life and history.

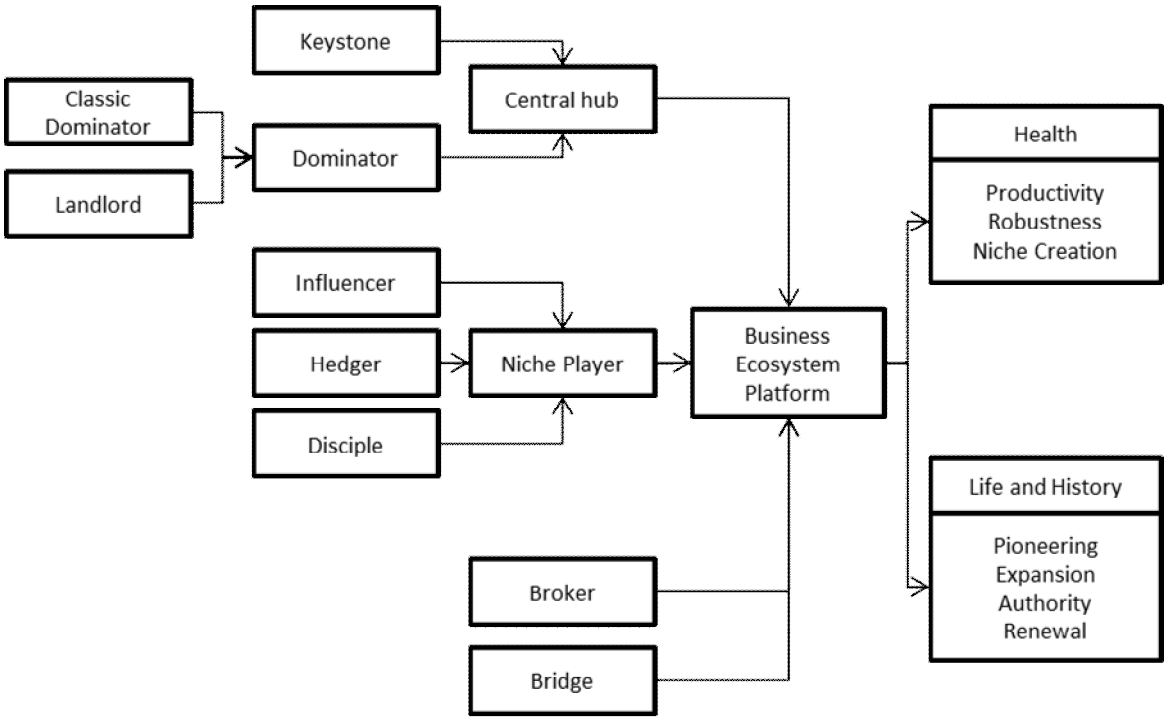

Figure 2. The Holistic View of the Discussed Analysis Factors

2.2. Two-Sided Markets

Two-sided markets have been in practice for a long time, connecting diverse groups of suppliers and customers to each other. Examples include the markets for credit cards (connecting cardholders and merchants), operating systems (connecting end-users and developers), TV channels (connecting advertisers and watchers), video games (connecting game developers and gamers), newspapers (connecting journalists and readers), etc.

In two-sided markets, the members of each side take benefit from the number of members on the other side (Armstrong, 2006). Therefore, a main struggle for the provider of a two-sided market is to bring both sides "on board" (Rochet & Tirole, 2006). The market provider, in fact, provides a shared platform for the transaction. Same as in business ecosystems, the platform concept is not limited to a technological platform, but to an environment. However, in the field of information and communication technology, the platform can refer to the technological platform. For

example in the case of app stores, the platform provider offers a technological platform and tries to attract a larger number of developers and consumers to it to make its app store profitable.

The two-sided markets are different from traditional markets in two ways. Firstly, unlike a traditional market where the value is moving from left to right - from costs to revenues, in a two-sided market the value exists on both sides. This is due to the existence of a distinct group on each side; therefore, the costs and revenues are present on both sides (Rochet & Tirole, 2006). The provider of the market can charge both groups appropriately to maximize the value. (Eisenmann et al., 2006) Secondly, the volume of transactions in these markets depends on the structure of the market, not the overall level fee that the provider is charging each side (Rochet & Tirole, 2006).

The provider brings more efficiency to the market transactions by facilitating the cross-side interactions. For this purpose, it defines the design of the platform and its set of rules. The design refers to the architecture and infrastructure for product and/or service delivery, and the set of rules refers to the protocols, rights, and pricing terms that govern the transactions (Eisenmann et al., 2008) as named under *architecture* and *integration,* respectively, by Iansity & Levien (2004, 145) in section (2.1.5).

2.2.1. Dynamics of Two-Sided Markets

The sides of a two-sided market are attracted to each other (Eisenmann et al., 2006) and experience "*network externalities" (*or "*network effect")*. Network externalities (or effect) occur when a user finds the value of a product depending on the number of other users of the product (Shapiro & Varian, 1999, 13). For example, a phone user enjoys a higher number of other phone users on the network as more calling possibilities are available.

In a two-sided market, the network effect can happen on the same-side or cross-side. In the *same side network effect*, an increase in the number of users on one side, can increase or decrease the value of the network for the users on the same side. In the *cross-side network effect*, an increase in the number of users on one side, can increase or

decrease the value of the network for the users on the other side. From another perspective, the network effect can be either *positive* or *negative*. The positive or negative network effect can happen either in one side or in cross-side. (Eisenmann et al., 2006) For instance, in the online videogame playing platforms, the larger the number of game players, the more game developers will be willing to join the platform (positive cross-side network effect). Similarly, a larger number of game developers on the platform would attract a larger number of game players to the platform, since game players might find a richer variety of games on the platform (positive cross-side network effect). Meanwhile, a larger number of game players might attract a larger number of game players to join the network, since they can have more alternatives in finding co-players or opponents and find more excitement on the platform (positive same-side network effect). Simultaneously, the larger number of game developers will bring more competition among them; therefore, might decrease their tendency to join the platform (negative same-side network effect).

Considering the network effect, the dynamics of a two-sided market can be quite complicated. Therefore, thoughtful strategy choices by the provider of the market are needed. In the next section some of the main challenges of providers are discussed.

2.2.2. Challenges for a Platform Provider in a Two-Sided Market

Eisenmann et al. (2006) define three challenges in a two-sided market: pricing, winner takes-all dynamics, and the threat of envelopment by an adjacent platform.

Pricing deals with the decision of the platform provider about charging each side based on the impact that the charge might have on the growth of the other side. Usually one side is subsidized in order to create a mass of users thanks to the *money side* which is ready to pay extra to have access to the critical mass. (Ibid) For example, in case of a software solution such as Adobe Acrobat, the software is provided free of charge for anyone who likes to use a file in the Adobe Acrobat format (PDF). Yet, those who want to use Adobe Acrobat to create a PDF file need to purchase the PDF maker version.

The winner-takes-all challenge finds its roots in the *scale* concept, and that the platform owner needs to decide whether to share its platforms with rivals or just keep it as a *stand-alone* platform and gets the economy of scale for its exclusivity. The general idea for the platform provider is to tip the market and make its platform "the standard" among the public. For example, VHS tapes took all against Betamax and became the standard of the video tapes; or the QWERTY keyboard became the standard of the market and did not allow any other types of keyboard to take its position afterwards. In order to make these decisions, the platform provider should consider the cost of multi-homing for the users on each side. *Homing* refers to the user's preference and possibility to be on one or more platforms. For example, the multi-homing for users of mobile phones is not very common and they usually have only one device. If multi-homing costs are high, the platform owner should take proper strategies to keep the vulnerable side on the platform through different initiatives such as: building strong relationships, creating a positive reputation based on past experiences, and improving the performance of the platform through better orchestration and technology (Ibid). For instance, in case a mobile phone manufacturer fails to provide the desired value that a consumer expects in its product, the consumer might completely migrate to another manufacturer, as he/she intends to have only one phone.

The threat of envelopment by an adjacent platform is very likely to happen if the functionality of the so-called platform is provided by another more powerful platform and as part of a bundled package. As such, the users can probably get the same features at a lower cost. In technology-based markets, such a threat exists at a high level as the boundaries of markets are quite blurred. Therefore, a platform provider might decide to either sell out the business to the enveloper or find a way out of it through innovative strategies. (Ibid) For example, Microsoft attacked the Real Player market. Real Player had made the two sided market for video streaming, with consumers as the subsidized side and content providers as the money side. Microsoft preformed an envelopment attack by offering the streaming video option through its Media Player on its Windows operating system, causing the migration of many content providers from Real Player to Microsoft.

2.2.3. Two-Sided Market and ICT Intensive Service Innovation

In a two-sided market, the desired value for each side of the market often differs from that of the other side (Tuunainen et al., 2011) and should be analyzed separately.

Tuunainen et al. (2011) propose a model for the analysis of ICT intensive service innovation in n-sided markets. The model takes into account the service innovation in the field of ICT, and defines dimensions that should be analyzed for each player on this market.

They analyze the platform provider through three factors: organizational factor, technology factor and market environment. Organizational factors include the way in which the platform provider company is managed and also its financial structure. Technology factors include the type of the technology that is used by the platform provider, and the market environment includes the whole market setting, such as customers, as well as direct and indirect competitors.

For each side, they analyze three dimensions of service innovation: 1) service concept, 2) client interface, and 3) delivery system. The service concept refers to the new value that is proposed to the market by the service. Client interface refers to the interface which is used between the service provider and its customers. It should be noted that the client interface is not about the technological interface of the system. The service delivery regards the link of the service provider and its client, which is usually done electronically in the field of ICT. (Ibid)

2.3. Mobile Ecosystem

Mobile industry has fitted very well into an ecosystem type of business (Basole, 2009; Tarnacha & Maitland, 2006a; Peppard & Rylander, 2006). The ecosystem has been shaped due to the shaping of networks (Basole, 2009; Li & Walley, 2002) where a variety of firms from different segments are functioning and complementing each other to create value for customers.

In research on mobile related issues, majority of researchers have taken the value chain perspective instead of business ecosystem perspective (e.g. Barnes, 2002; Buellingen & Woerter, 2004; Karvonen &Warsta, 2004; Tarnacha & Maitland, 2006a). This has been in sometimes due to the simplification (e.g. Tarnacha & Maitland, 2006a) and sometimes (e.g. Karvonen & Warsta, 2004) a mobile ecosystem has been modeled in the end.

By using the value chain perspective, researchers define the key functions and players that create value for end-users. Barnes (2002) takes a functional approach. He recognizes the processes required in the value creation, but has less focus on the operators of the processes. His illustration of the mobile commerce value chain (Figure 3) considers both technical and commercial sides of the value creation. He categorizes the functions into two areas: 1) content (content creation, content packaging, and market making), and 2) infrastructure and services (mobile transport, mobile services and delivery support, and mobile interface and application).

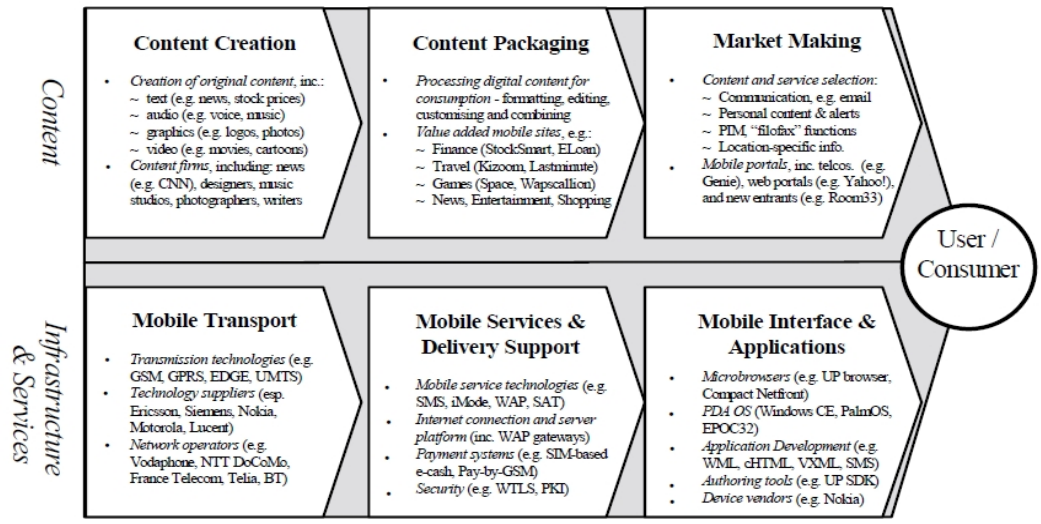

Figure 3. Mobile Commerce Value Chain (Barnes, 2002)

Buellingen & Woerter (2004) - in their two-dimensional value chain approach (Figure 4) – highlight the participants through the combination of a functional and an institutional perspective. In the functional dimension, they outline the functions that should be taken care of as infrastructure, customer acquisition, transmission, m-

commerce content and portals, and customer management billing. On the institutional dimension, they outline the responsible participants for each function.

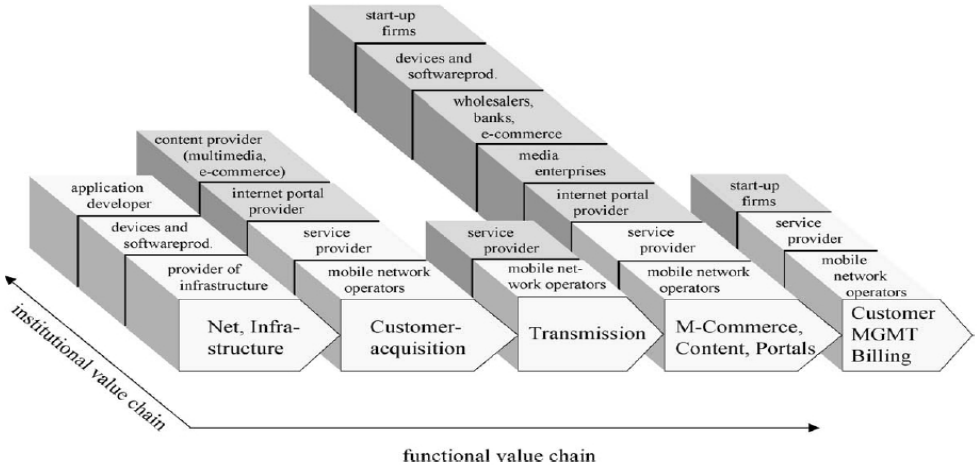

Figure 4. Mobile Value Chain (Buellingen & Woerter, 2004)

Karvonen & Warsta (2004) use Barnes' (2002) value chain perspective and model the ecosystem for mobile multimedia development (Figure 5). In their model, the participants of the ecosystem need to consider the operating system, terminals, development platform, and the network during the process of multimedia application development.

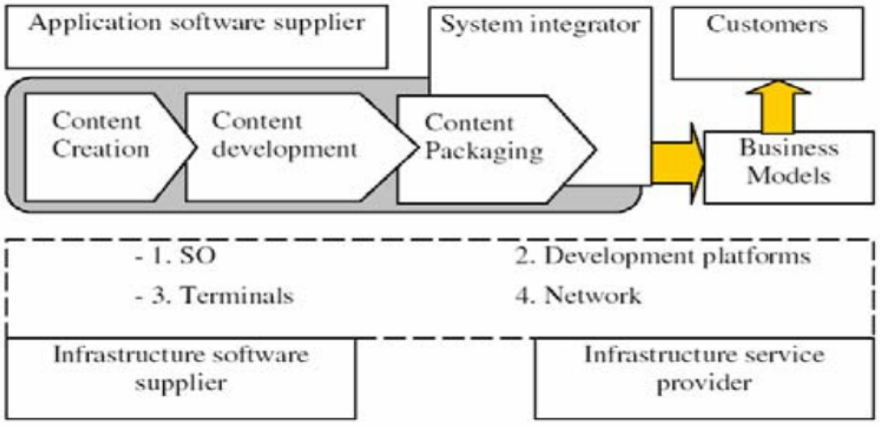

Figure 5. The Ecosystem of Mobile Multimedia Development (Karvonen &Warsta, 2004)

Basole (2009), unlike the other researchers takes a business ecosystem perspective from the very beginning. He provides an illustration of the segments in mobile ecosystem as

shown in Figure 6, and shows the emerging participants [in his time of research] by dark and the already existing ones by light circles. His defined participants include device manufacturers, network operators, infrastructure providers, silicon vendors, platform providers, system integrators, software providers, application developers.

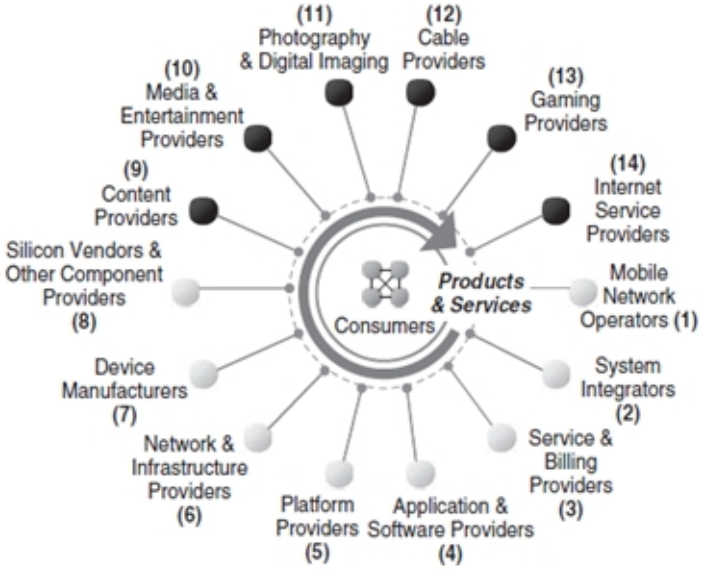

Figure 6. Segments in Converging Mobile Ecosystem (Basole, 2009)

A review of the earlier research shows that researchers define the mobile value chain and/or ecosystem participants and/or functions in two main categories: content-related, infrastructure-related. Tarnacha & Maitland (2006a) define such categories as *downstream* and *upstream* in their research in the domain of mobile applications.

Compiling the work of various researchers on mobile application ecosystems and/or mobile value chains (Barnes, 2002; Karvonen & Warsta, 2004; Buellingen & Woerter, 2004; Tarnacha & Maitland, 2006a; Basole, 2009; Nyika, 2010) the main participants in the mobile ecosystem and/or value chain are presented in Table 4, and listed as follows. Some authors have provided definition of the roles, while others have just used them on the basis of a common knowledge.

- *Content provider*: Creates, aggregates and distributes mobile content (Tarnacha & Maitland, 2006a).
- *Application developer*: Packages the content into a mobile application for execution on mobile devices (Ibid).
- *Platform provider*: Provides the necessary implementation tools for deploying mobile applications (Ibid)
- *Device manufacturer*: Manufactures information-processing mobile devices (Ibid)
- *Network operator*: Sets up the network and provides the consumers' access to the network (Ibid)
- *Internet service provider*
- *Service and billing provider:* Provides software systems necessary for provisioning, billing, and customer service (Basole, 2009)
- *Mobile/web portals*: Place for selling of applications
- *Operating system provider*
- *Network and infrastructure provider*: Provides network technologies
- *Application aggregator*: Manages the distribution of the applications through application stores and/or gateway websites (Nyika, 2010)
- *Consumer*: The end-user of mobile services
- *Mobile component provider:* Provides chips, processors, screens, power, etc. (Basole, 2009)

Table 4. Participants of a Mobile Ecosystem and/or Value Chain

Participants	Mentioned by	Other names used
Content provider	Tarnacha & Maitland (2006a) Karvonen & Warsta (2004) Nyika (2010) Basole (2009) Buellingen & Woerter (2004)	content creator and developer (Karvonen & Warsta, 2004) content creator and/or content owner (Nyika, 2010) Media enterprise, whole-sellers, banks, e-commerce (Buellingen & Woerter, 2004)
Application developer	Tarnacha & Maitland (2006a) Barnes (2006) Nyika (2010) Karvonen & Warsta (2004)	application developer (Tarnacha & Maitland, 2006a; Barnes, 2006; Nyika, 2010) Content packager (Karvonen & Warsta, 2004) Application and software provider (Basole, 2009)
Platform provider	Basole (2009)	Channel owner (Nyika, 2010)
Device manufacturer	Buellingen & Woerter (2004) Tarnacha & Maitland (2006a) Basole (2009) Buellingen & Woerter (2004) Barnes (2002)	Channel owner (Nyika, 2010) Device vendor (Barnes, 2006) Mobile phone (Karvonen & Warsta, 2004) Infrastructure provider (Buellingen & Woerter, 2004) Technology suppliers (Barnes, 2002)
Network operator	Tarnacha & Maitland (2006a) Buellingen & Woerter (2004) Barnes (2006) Nyika (2010) Karvonen & Warsta (2004) Basole (2009)	
Internet service provider	Basole (2009) Buellingen & Woerter (2004) Barnes (2002)	Internet portal provider (Buellingen & Woerter, 2004) Internet connection and server platform (Barnes, 2002)
Service and billing provider	Basole (2009) Buellingen & Woerter (2004) Barnes (2002)	Payment systems and security (Barnes, 2002)
Mobile/web portals	Barnes (2002)	
Operating system providers	Karvonen & Warsta (2004) Barnes (2002)	Technology platform vendors (Barnes, 2002)
Network and infrastructure provider	Basole (2009) Buellingen & Woerter (2004) Barnes (2002)	
Application aggregator	Nyika (2010)	
Consumer	Barnes (2009) Nyika (2010) Karvonen & Warsta (2004)	Mobile application user (Nyika, 2010) Customers (Karvonen & Warsta, 2004)
Mobile component provider system Integrators	Barnes (2009)	

2.4. A Revision of Moore's Model

Based on the literature review on business ecosystems and mobile ecosystems, Moore's model is adapted to take into account the mobile ecosystem participants (Figure 7). The core of the business, as earlier defined by Jansen et al. (2009b), is assumed to be based on a firm or platform. Therefore, the device manufacturer, platform provider, and operating system provider are located at the heart of the model. There is a strong link among them since they constitute the foundation of the mobile service by providing a mobile device to the consumer. The device manufacturer gets the necessary hardware equipment from direct suppliers such as component providers, silicon provider, etc. Meanwhile it is served by software suppliers such as operating system provider, application providers for the basic applications on a mobile device, and the platform provider that offers the necessary implementation tools for deploying mobile applications. The mobile device is distributed to the consumers through distribution channels.

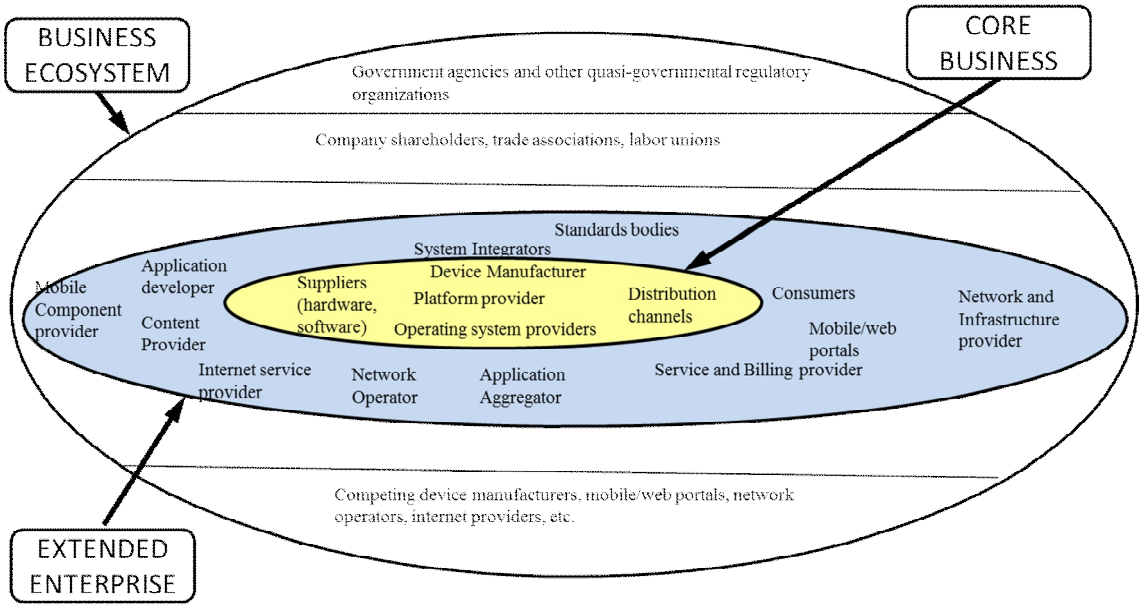

Figure 7. Mobile Ecosystem Participants – adapted from Moore (1996, 27)

During the past years, the mobile ecosystem has been converging (Basole, 2009). For example, Apple decided to join the ecosystem by introduction of its iPhone in 2007, or Nokia has extended its business by transforming from a device manufacturer to a software services company (Ibid). Additionally, with the increase in the capabilities of mobile phones, content providers have become more actively involved in the ecosystem, as was anticipated by Basole (2009). Consequently, the roles of mobile ecosystem participants have changed, combined and exchanged (Holzer & Ondrus, 2010).

Visualizing the mobile ecosystem relations, Basole (2009) remarks that there appeared to be no central segment (hub) in the ecosystem at the time of his research; yet mobile network operators had the most central role in the mobile ecosystem with larger numbers of connections to other participants. He found out that the platform providers had a strong tie with the application and software providers. Basole (2009) anticipated that in future, due to the convergence, the platform providers would become a central segment (hub) in the ecosystem. He explained the role of the platform providers as the drivers and enablers of the integration of applications and software products, as well as content (media, gaming, entertainment). According to him, the content provision was the emerging segment of the mobile ecosystem.

Following the importance of the applications in the new structure of mobile market and the introduction of app stores, Holzer & Ondrus (2010) study the mobile application market and emphasized on the role of the platform provider –which is in line with Basole's (2009) anticipation. They illustrated the mobile application distribution process (Figure 8). In this process, the developer makes the application through the development tools offered by a specific platform, and publishes it on the application portal. The consumer, on the other side, purchases the application from the portal through his or her device. The payment stream goes from consumer to the application portal to the developer.

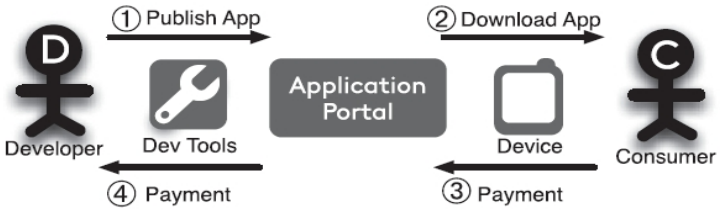

Figure 8. Mobile Application Distribution Process (Holzer & Ondrus, 2010)

Holzer & Ondrus (2010) explain that the provider of the platform (or portal) can take different roles in the application market. Some are interested in full integration and control of the entire distribution process, while others might take responsibility in some parts only. They introduce four different possibilities and locate their exampled app-store providers in each: *full-integration*, *portal integration*, *device integration*, and *no integration* (Figure 9). In *full-integration* approach, the provider of the platform has strict control over device manufacturing, platform, and application sale on its app store (e.g. Apple, Nokia). In *platform integration* approach, the platform provider concentrates on the application development and application sales on its app store (e.g. Google). In *device integration* approach, the platform provider manufactures the devices but is not providing the app store (e.g. RIM). In *no integration* approach, the focus is only on providing the app store (e.g. Microsoft).

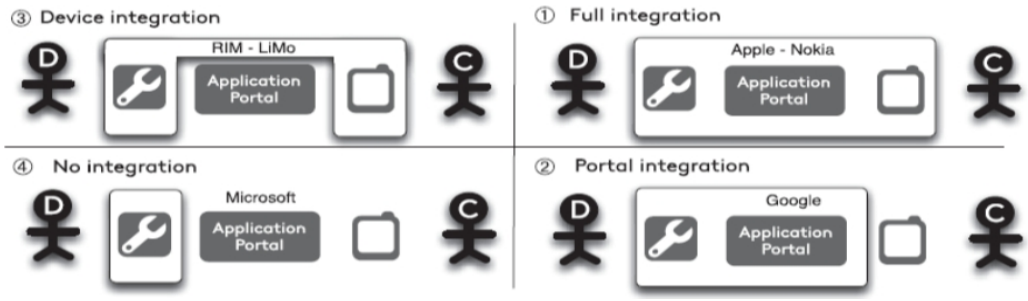

Figure 9. Platform Integration Strategies (Holzer & Ondrus, 2010)

The differences in the platform types and platform provider strategies result in different working situations for developers. Developers are creating value through developing mobile applications and distributing them via the application store provided for their

chosen platform. They need to decide which platform(s) they want to develop their applications for, or if they want to consider *multi-homing* strategy as described in section 2.2.2.

2.5. Conceptual Framework

Although the entire mobile ecosystem can be considered as a meta-ecosystem, for the simplicity of analysis the smaller ecosystems that exist within it have been considered. The border of the smaller ecosystems can be defined based on the degree that the offered value (product) is compatible and complementary (den Hartigh & Tol, 2008). By this definition, in case of the mobile application ecosystem, each application store and the network shaped around it can be considered as an ecosystem as it is offering value to only a specific group of users, without the need for dependency on other application stores. This border line setting is in line with how Jansen et al. (2009b) have defined a firm-based ecosystem (or in this case both firm-based and platform-based).

Considering the increasing importance of the mobile applications in the convergent market, a simplified diagram of mobile ecosystem with its focus on the new structure of the market is illustrated in Figure 10. In this demonstration, the network reduction approach (Basole, 2009) has been taken into account to reach a contextual overview on the mobile application ecosystem. The participants that are associated with merely technological infrastructures and have connection to all other participants (i.e. mobile component provider, hardware supplier, network and infrastructure provider, system integrator, internet service provider, and service and billing provider) are grouped under "infrastructure".

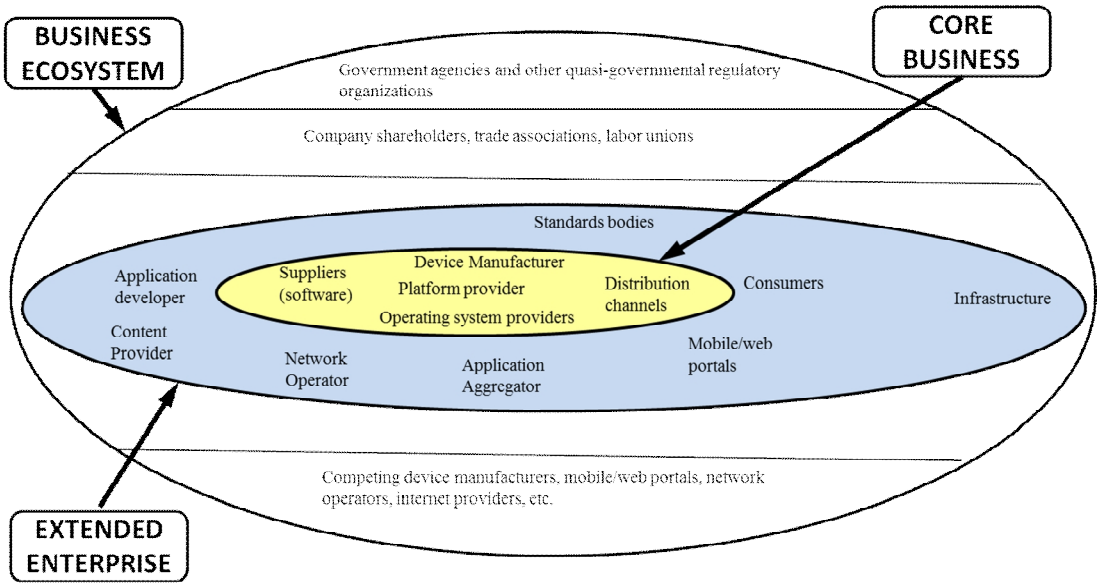

Figure 10. A Simplified Mobile Ecosystem Model – adapted from Moore (1996, 27)

Using Figure 10, the ecosystems of the case companies are analyzed, and the findings help to understand how the ecosystems create value for developers. Compliance of the value created *by* the ecosystem with the value that developers expect to receive *from* the ecosystem shapes the rationale for approaching the main research question.

Therefore, the study is comprised of two steps:

1) The first step aims to answer the sub-question (*What is the structure of a mobile application ecosystem?*). Here, the participants and their arrangements are illustrated, and the compositions of the ecosystems are discussed.

2) The second step aims to answer the main research question (*What are the factors that developers perceive to be important (both positively and negatively) in a mobile application ecosystem?*). Here, the factors that developers consider in the process of application development are discussed. These factors are basically derived from the empirical data, which are then investigated into a further depth. (For more details see section 3.3)

Figure 11 contains the factors which are considered by developers (i.e. joining the ecosystem, documentation, platform maturity, programming language, testing the application, unification of devices, publishing the application, monetizing, and promotion). As shown in Figure 11, the factors can fit into wider categories which almost follow Porter's value chain (i.e. inputs for application development, application development, application delivery, and marketing and sales). (See section 3.4 for more details on data analysis)

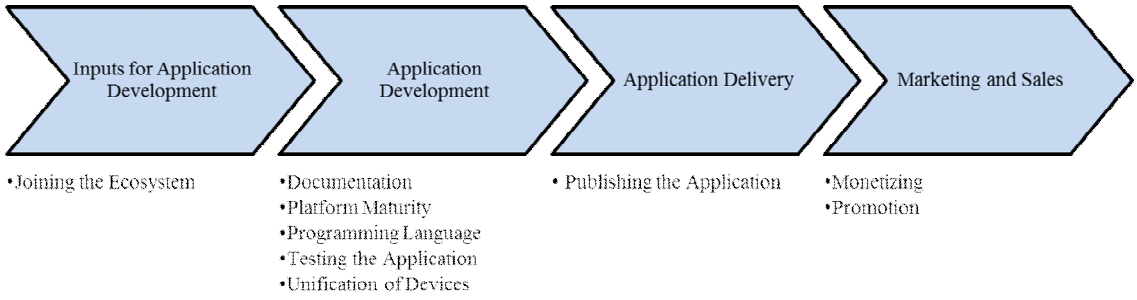

Figure 11. Conceptual Framework for the Factors Considered by Developers

3. METHODOLOGY

The methodology chapter is comprised of four sections: 1) Research philosophy, 2) Research design, 3) Data collection, and 4) Data analysis.

3.1. Research Philosophy

The paradigm of the researcher shapes the research philosophy. As Healy & Perry (2000, 118) note, the paradigm is "*the overall conceptual frameworks within which some researchers work.*" Thus, paradigm consists of the beliefs, assumptions, and perceptions that a researcher has, which obviously can influence the way that the research question is approached.

Among the four categories of paradigm that Guba & Lincoln (1994) define (i.e. positivism, realism, critical theory, and constructivism), realism seems to best suit the nature of this study. Realism paradigm believes in the existence of a *real* world which needs to be discovered (Ibid). It locates between the purely objective world in positivism and the purely subjective world in the constructivism and critical theory. (Healy and Perry, 2000)

The application ecosystem exists as a *real* world with some *real* attributes that are demonstrated through the human-ecosystem interactions. The attributes of the ecosystem cannot be fully discovered without considering these interactions. Therefore, humans' perceptions of the attributes, shaped throughout the interactions, help in comprehending the attributes. This is far from objectivism. However, taking into account the human perceptions only and without the belief in the existence of some *reality* for the attributes might provide a false insight into the ecosystem due to this purely subjectivist approach. Consequently, the understanding of the *real* attributes can happen somewhere between subjectivism and objectivism. It means that humans' perceptions of those attributes can be analyzed to get an insight into the *real* attributes.

The paradigm of realism can be defined by its elements: ontology, epistemology, and methodology. Healy & Perry (2000, 118) note:

Ontology is the "reality" that researchers investigate, epistemology is the relationship between the reality and the researcher, and methodology is the technique used by the researcher to investigate that reality.

In ontology of realism, *"the reality is "real" but only imperfectly and probabilistically apprehensible."* Further, in the epistemology of realism, the researcher believes that the findings are *probably* true, giving room to uncertainty. The methodology of realism can include case studies or convergent interviews with consideration of the triangulation techniques through qualitative and quantitative methods. (Ibid, 118)

The realism approach is a combination of theory-building and theory-testing (Figure 12). The theory building research can be highly seen in grounded theory in which the theory is systematically generated from the data; an inductive approach. On the other hand, theory testing is about testing the propositions which are developed from existing theory in the real world; a deductive approach. The constant mixture of inductive and deductive approaches is abductive approach. (Dubois & Gadde, 2002)

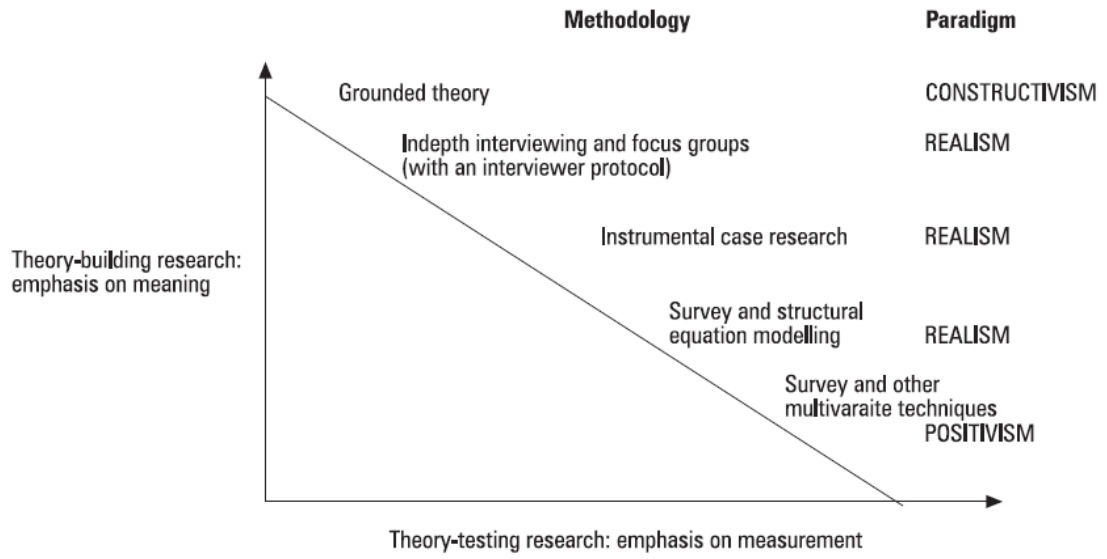

Figure 12. A Representative Range of Methodologies and their Related Paradigms (Healy & Perry, 2000)

This study locates between deductivism and inductivism, having the characteristics of both approaches partially. The empirical findings, as well as the existing theories feed each other during the research process, in line with previously defined realism

paradigm. In order to derive the findings, an instrumental case study method is used, as defined by Stake (1995, 3), to help the understanding of an application ecosystem.

3.2. Research Design

The newness of the phenomenon of the mobile application ecosystem strengthens the need for an in-depth analysis through a qualitative (Patton, 1990) case study approach. The case study approach is a good fit mainly for two reasons: 1) due to the scarcity of earlier research, the phenomenon needs to be investigated in its preliminary stage (Eisenhardt, 1989); and 2) the research question is by nature a "why" and "how" type of question despite containing the term "what"; thus, requires an exploratory research (Yin, 2009, 9).

This study uses a multiple-case study through undertaking two case ecosystems that are deliberately selected as instrumental cases. These cases (i.e. App Store by Apple and Android Market by Google) are the main players of the market with regard to their size and popularity among application developers. Interestingly, the cases hold a high level of contrast (Yin, 2009, 61) in their natures when it comes to the strategies of their ecosystems orchestrators - Apple and Google. This provides a better opportunity for cross-comparison of the findings; thus, enhances the level of analysis and the robustness of the study (Yin, 2009, 53).

The *unit of analysis* is the "*major entity that is analyzed in the study"* (Fletcher & Plakoyiannaki, 2011, 173). The *Unit of observation* is the unit from which the data is collected (Ragin, 1992; cited in Fletcher & Plakoyiannaki, 2011, 173). This study is comprised of two steps to answer the main question and sub-question (see section 1.3.). The unit of analysis for each step is different. In the first step (finding the answer to the sub-question), the *unit of analysis* is the *structure* of a mobile application ecosystem; and the *unit of observation* is a *combination of different electronic sources* (internet pages, blogs, forums, etc.). In the second step (finding the answer to the main question), the unit of analysis is the *factors* that developers perceive to be important; and the *units of observations* are developers.

The architecture on how the research is conducted is illustrated in Figure 13. The main research question is shown on the left side. As can be seen, the conceptual model is comprised of two parts and is shaped based on both literature review findings, and the empirical findings. Due to the simultaneous data collection and data analysis efforts, a continuous process of data collection across the different levels of data sources takes place.

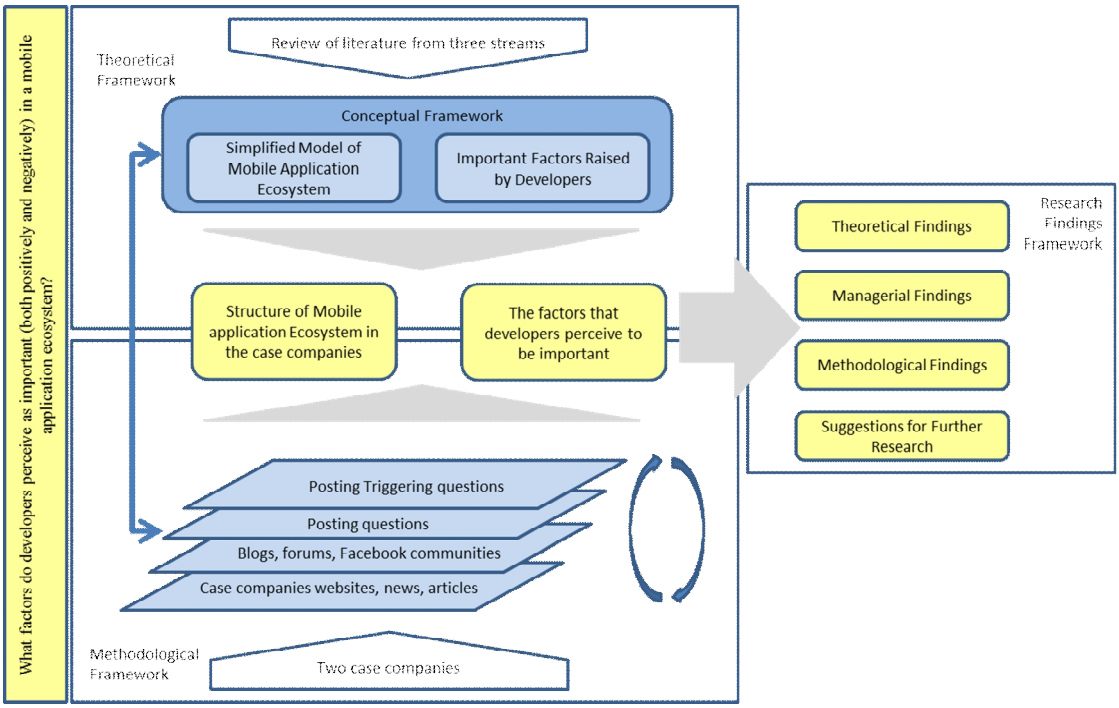

Figure 13. The Study Architecture

3.3. Data Collection

The mobile application industry is a fast moving industry by nature with constant changes taking place. To follow the industry news, the Internet seems to be the most efficient tool. The global virtual context of operation for the industry players, results in their high tendency to be active on the Internet and use it as the place for sharing information. Application developers are among these players. Locating all over the world, they use the Internet as the main means of communication with each other for sharing knowledge and opinions. Writing blogs, commenting under blog posts and news

articles, and being active in forums and communities are typical ways of communication among them.

Understanding the actual behavior, opinions and perceptions of developers can be efficiently and effectively done through following their natural activities and discussions in the context of their virtual life. Observing their discussions, comments, behaviors, and reactions to their peers in their communities can provide an invaluable longitudinal qualitative data collection source, with the possibility to interact with each and every one of them to increase the depth of understanding and/or get immediate data and updates.

The data collection of this study is done through an original method that is suitable for the virtual context under study. The data is collected on the Internet by various ways and sources in order to enhance the quality of data. The sources include news articles, blog posts, reports, developers' comments and discussions in their forums and communities, and developers' responses to direct inquiries raised by the author. The methods include both observation and interaction, depending on the situation.

The sources and ways of data collection are slightly different for each step of the study. As described in section 2.5., the study is divided into two steps. In the first step, the aim is to find the answer to the sub-question (i.e. *What is the structure of a mobile application ecosystem?)* In the second step, the aim is to find the answer to the main research question (i.e. *What factors do developers perceive as important (both positively and negatively) in a mobile application ecosystem?*) In the following, details are provided on data collection:

1. *First step - The structure of the ecosystem in the case companies*

In the first step, the concentration is on understanding the characteristics of the ecosystems in the case companies, and learning about their evolutions. The data collection is mainly done through observation and search for news and updates.

In this step, the news websites, company websites, blogs, Facebook pages and forums are studied on a longitudinal basis. Particularly, the annual reports for the last three fiscal years in each company, the website pages related to the application stores, and the sections designed for developers are reviewed thoroughly on the websites of the case companies. In the case of Apple, as the pages for developers are not publicly accessible, a *free* member account is created, and the information gained is limited to *free* account access level (Applying for a *paid* account bounds the author to some legal liability, so is not possible). Furthermore, related news articles from popular technology websites such as TechCrunch.com, PCWorld.com, Cnet.com, ZDnet.com, etc. are closely followed over a two-year period to get an insight on the evolution of the ecosystems. In addition, the websites of some market analysis firms such as Distimo.com and Flurry.com, which are among the famous sources in the mobile application market, are constantly followed.

2. *Second Step - Developers perceptions of the important factors*

In the second step, the focus is on developers' perspectives on ecosystem attributes, and their perceptions of such attributes. This step includes four levels of data collection.

At the first level, the focus is on blog posts, and their readers' comments. The data is collected via general search on the Google search engine using keywords such as "iOS vs. Android development", "iOS Android develop", etc. Among the generated search results, the developers' blogs posts are considered. Further, other developers' comments under each blog post are taken into account (in most cases, the content of the comments indicates whether the commenter is a developer, consumer, business advisor, etc. In cases of uncertainty, the post is not considered). The blogs are chosen by their ranks among generated search results on Google. In most cases, after reviewing the first two-three pages of results on Google (five-six blog posts), a sound understanding of the developers' perceptions is achieved, the factors they perceive to be important are found, and saturation is reached. It means that the marginal learning becomes small (Eisenhardt, 1989), so the search process can stop.

At the second level, developers' forums are used. The key concepts found at the first level are searched through the search engines available on forums, and the developers' earlier and possibly current discussions are followed. The forums under review are shown in Table 5.

Table 5. The Forums Used in Data Collection

iOS forums	iPhone Dev SDK Forum	http://www.iphonedevsdk.com/forum
	MacRumors Forums	http://forums.macrumors.com/index.php
	Touch Arcade	http://forums.toucharcade.com/index.php
Android forums	Android Forums	http://androidforums.com/
	Android Community	http://androidcommunity.com/forums
	Android Development Community	http://www.anddev.org/

At the third level, questions are posted to several developers' forums and Facebook community pages, basically in two forms: general questions and *triggering* questions. They serve in two ways: 1) double checking the already found data, and 2) understanding the perception at a deeper level. Some examples of such questions are:

> *If I want to build an app and sell it on only one of these stores, which one do you recommend, and why?* (posted on both Android and iOS communities)
>
> *What advantages are there to Android development over iOS Development?* (posted on Android communities)
>
> *What advantages are there to iOS development over Android Development?* (posted on iOS communities)
>
> *What do you think about the Apple review process? Would you prefer to have no review and immediate submission of the app to the market (like Android), or you find the review useful?* (posted on iOS communities)

At the final level, *triggering* questions are posted to several developers' communities and forums. *Triggering* questions are for checking the validity of a claim when a meaningful finding is not achieved from previous approaches, or when a more in-depth explanation is required. Through these questions, the claim is checked by raising the reaction of the provoked developers to reach a better understanding. The claim which is being checked has been shaped by the findings from previous approaches and data sources; for example, the blog posts, comments, and general questions. An example of such questions is:

> *I read this somewhere from a developer. Do you agree with this? How do you find the Apple documentation in general?*
>
> *"Android documentation, which is very extensive and exposes developers to nearly everything unlike the iOS documentation that hides important aspects from developers"* (posted on iOS community)

3.4. Data Analysis

The data analysis is done considering the text analysis method to find the emerging issues, and the supporting or rival arguments for them. For that purpose, a cross-case synthesis method of analysis (Yin, 2009, 156) is used. In this method, the gathered data through different resources are organized separately for each case company in two tables with a similar format. The format is defined according to the emerging issues and/or factors found in the first level of data gathering (see section 3.3.). The texts found in blogs and news and comments are read thoroughly, and common contents are highlighted and coded under labels describing the main message of the idea such as: fragmentation, documentation, market, publishing, etc. These labels shape the factors in the conceptual framework in Figure 11. Grouping the factors with similar themes then shapes the broader categories of Figure 11. Eventually, the gathered data are grouped under the respective label, and can show the overall perceptions of developers for that label.

The analysis meets the criteria defined by Yin (2009, 160) for a high-quality analysis. Firstly, all the evidence gathered are taken into consideration and by using *triggering* questions more light is shed on the issue through bringing the supporting and rival arguments. Secondly, the analysis is focused on answering the research questions and avoids the area beyond the scope of the study. Thirdly, the long term presence of the author in the context by following the news, observing developers' activities, and interacting with developers, allows her to have a sound level of understanding.

4. CASE STUDIES

The case companies are chosen based on their positions in the market. They are the main two application store ecosystems in the market. What makes the comparison and analysis more interesting is the publicly known difference between the strategies of the companies with regard to their openness. Apple has a reputation for providing differentiated products, being closed in publishing information or being a so called *"walled garden"*. On the other hand, Google is famous for its openness and sharing culture and its strategies to target the mass market and to provide open-source environment to engage outsiders.

4.1. Apple

Apple Inc. (referred to as Apple in this thesis) was established in 1976 in California, USA, is listed on NASDAQ, and operates globally. It is positioned as the most valuable brand in the world in 2011, having a value of 153 billion dollars (Millward Brown Optimor, 2012).

Apple is active in different lines of business in the field of technology. Its products include mobile communication and media devices (e.g. iPhone, iPad), personal computing products (e.g. Mac hardware products), portable digital music players (e.g. iPod), and a variety of related software, services, peripherals, networking solutions and third-party hardware and software products. It has also developed its own operating systems (i.e. iOS for mobile devices and Mac OS X for Mac computers).

Apple uses various distribution channels to reach its customers. Customers include consumers, small and mid-sized businesses (SMB), and the market for educational and governmental institutes as well as enterprises. The direct and indirect channels used to reach the customers consist of Apple retail stores, online stores (i.e. iTunes Store, App Store, iBookstore, and Mac App Store), direct sales force, third-party cellular network carriers, wholesalers, retailers, and value-added resellers. (Apple, 2011b)

Apple entered the mobile ecosystem by introducing its mobile device – iPhone - in 2007. Thanks to Apple's reputation of offering innovative and differentiated products, iPhone was highly welcomed by consumers. So far, there have been five generations of iPhone models: iPhone, iPhone 3G, iPhone 3GS, iPhone 4, iPhone 4S. Each generation complements the features of the earlier generation and is accompanied by one of the five major releases of iOS – Apple's proprietary operating system. iPhone generations have all the same design. Usually the release of a new generation results in the rarity of the older generations in the market. iPhone is technically closed to any software products unless they are authorized by Apple.

Apple has a reputation for its successful marketing strategies, which usually results in long queues and waiting lists upon the release of each new device to the market. With regard to iPhone, it can be observed that Apple follows a pattern in its timelines. It firstly holds a public preview session for a new version of iOS; about 3-4 months later, it releases a new model of iPhone which runs on the new version. For instance, it previewed its iOS 3.0 in March 2009, and introduced its iPhone 3GS in June 2009. It previewed its iOS 4.0 in April 2010, and released its iPhone 4 in June 2010. iOS 5.0 was previewed in June 2011, and iPhone 4S was released in October 2011.

4.2. Apple App Store

Apple launched its mobile application store in July 2008 under the name App Store. The launch of App Store was followed by the release of the iPhone 3G - a new generation of Apple mobile phones- a day later. App Store is available for only two types of iOS-based devices: iPhone (mobile phone), iPod touch (portable music player).

App Store is built on top of iTunes Store (Apple's music store). Prior to the launch of App Store, iTunes Store contents were limited to multimedia; afterwards, iTunes Store was updated to include mobile applications. In fact, App Store acts as the window shop to the available contents in iTunes Store; thus, any activity on App Store requires the users to have an iTunes account. Upon launch, access to App Store was provided either

through an embedded *App Store* application on new iPhone 3G, or downloading of the updated iTunes for older devices.

At the time of launch, App Store was available in 62 countries (Scoop, 2008) and contained about 500 applications. About 25 percent of them were offered for free and the rest were paid applications ranging from US 0.99 dollars to US 69.99 dollars with most common prices being 0.99, 4.99, and 9.99 US dollars (MacRumors, 2008).

App Store was widely accepted by Apple consumers. Three million applications were downloaded within three days of its inception, and in nine months the number of downloads reached one billion (Apple, 2009a). By December 2011, 18 billion downloads have taken place on App Store (Apple, 2011a). Within the fiscal years of 2010 and 2011, Apple had the sales revenue of four and five billion US dollars, in respect, through selling contents on its App Store and iTunes.

4.2.1. Joining the Ecosystem

In order to publish an application on App Store, developers need to be a member of the iOS Developer Program. They can apply for membership through Apple's Developer Website. The membership process takes place in three stages: paying the membership fee, signing the *iPhone Developer Program License Agreement*, and the final approval by Apple. Apple does not prohibit the developers from joining competitors' ecosystems.

The payment of the membership fee is done through a credit card, and the fee is defined according to the purpose that the developer aims to use the application for. An individual developer or a developer company who is willing to publish a developed application on App Store needs to pay $99 US/year. However, if the application is developed for an in-house use in an enterprise, the membership fee of the developer will be US 299 dollars/year. More information on the different fees charged is shown in Table 6. Furthermore, Apple provides a *free* member account possibility for those who would like to have a limited access to Apple's developer site. *Free* account holders can access the development tools, but do not have access to the technical support forums or the beta versions of new iOS release.

Table 6. Apple Developer Programs

iOS Developer Program	Description	fee
Individual	For an individual developer who creates free and commercial iOS apps for distribution on the App Store.	$99 / Year
Company	For a company with a development team who create free and commercial iOS apps for distribution on the App Store.	$99 / Year
Enterprise Program	For a company that creates creating proprietary, in-house iOS apps	$299 / Year
University Program	For higher education institutions that introduce iOS development into their curriculum.	Free

Signing the *iPhone Developer Program License Agreement* is the second step in becoming a member developer. The agreement used to remain as a confidential agreement between the signer developers and Apple. For over a year and a half since the launch of App Store, no public copy of the agreement was available. In March 2010, for the first time NASA was forced by law to reveal the agreement consequent to offering an application on App Store, due to the *Freedom of Information Act (FOIA).*(Lohman, 2010) Upon dissemination of the contract terms to public, the related section to confidentiality attracted the attention of media:

> *10.4 Press Releases and Other Publicity*
>
> *You may not issue any press releases or make any other public statements regarding this Agreement, its terms and conditions, or the relationship of the parties without Apple's express prior written approval, which may be withheld at Apple's discretion.*

Nowadays, this term has been removed from the agreement, yet the document is not easily within reach of all people, but only to members.

In addition to the membership payment and signing the agreement, an application developer needs to be approved by Apple upon membership. The approval process differs based on the type of the developer. For an individual developer it can take from a few minutes to a week. For companies it can take a few weeks.

4.2.2. Documentation and Application Development

Apple provides the developers with the tools necessary for developing and testing applications on the iOS platform. It also provides the supporting documents for developers through videos, webpages, sample codes, and developer support forums.

The iOS SDK (Software Development Kit) is offered to developers for free. It is a comprehensive development environment that contains the XCode IDE which runs on Objective-C programming language. Developers can develop and debug applications on the XCode. The iOS SDK is allowed to be installed only on a Mac machine.

Member developers can find the training documents from introductory to advanced levels on Apple Developer website. The documents include video clips, texts, and libraries of sample codes. They can also access *Apple Developer Forum*. The forum is only available to paid members. Even though the access of free members and public to these forums are restricted by Apple, some developers have independently created their iOS development communities and social community pages on the internet to help each other.

4.2.3. Publishing an Application to the Market

Apple does not allow the applications to be directly published on App Store. Instead developers need to first submit the application for Apple review process. No estimation of the review process time is given by Apple. It can take from a week to a few months.

Apple review process is known to be very "strict" and unclear. Browsing internet pages, there exist many cases of developers complaining about the unclear messages they have received from Apple upon rejection of their applications. An example is:

> *Any developer for the iPhone/Touch knows that Apple is a black box when it comes to this [review]. Their rejection emails tend to be very vague and cold. No screenshots with clear explanations. It took us 10 minutes just to decipher the email and figure out what we did wrong in the first place. We've replied to these emails in the past with more questions and it took days to get another vague*

> *answer that basically said the same thing as the first email. There's no phone number that says, "Call me if you have any more questions or concerns about this"* (Tapbots, 2009)

The review process of Apple has often received large criticism by the public, due to the lack of uniformity in the acceptance or rejection of applications. Apple is blamed for censorship, lack of stability, and above all for the ambiguity of its process. The claim is that in some cases, an application has passed the review process but later is withdrawn from the App Store. Controversially, in some other cases, an application fails the review process but later on it will find its way to the App Store.

> *Apple is notorious for allowing an application into its store, only to inform the developer at some point in the future that, as it turns out, the app should never have been in the store, after all. […] At the same time, Apple has, on several occasions, rejected an application only to allow it in after feeling a significant amount of public and private pressure."* (eWEEK.com)

The case of removal of an application has happened for different types of applications. Although Apple has usually remained publicly silent about the ground on which the removal has taken place, several possible grounds can be observed: pressure of regulations and authorities, extreme dissatisfaction of consumers, violation of carriers' rules, etc. For instance, a game called "*Fake ID*" was removed from App Store upon the request of a senator (Huffingtonpost, 2011) since the game was allowing the consumer to create a fake driver's license for any of the US states. Another removed application was "*Nullriver's NetShare",* which could turn an iPhone into a wireless modem violating the AT&T's (US carrier) terms of service agreement (iPhonehacks, 2008) An interesting and among the very first cases of application removal was the removal of the most expensive application on App Store, called "*I am rich*" priced US 999 dollars (Fox News, 2008). The application's function was downloading a red diamond to the screen of the buyer's device. Upon the release of the application, eight people bought it. Yet, a

day later the application was removed from App Store after some buyers claimed that they had bought the application by accident, as they thought it was a "joke" (Los Angeles Times, 2008). Apple did not give a clear explanation for the removal.

Following the public pressure and criticism on the unclear grounds of application review, Apple finally released its first review guidelines after two years, believed by some to be the consequences of competition raised by Google (ZDNet, 2010). The guidelines consist of rejection grounds defined in 21 categories. Its language and specifically its introduction lines are interpreted by media as the strong view of Apple towards applications as "*a core part of its brand*" *(The Wall Street Journal, 2010)*. Particularly the points on the quality of the applications and also justification of the review process grasped the attention of media.

> *We have over 250,000 apps in the App Store. We don't need any more Fart apps. If your app doesn't do something useful or provide some form of lasting entertainment, it may not be accepted. (Ibid, 2010)*

> *We will reject Apps for any content or behavior that we believe is over the line. What line, you ask? Well, as a Supreme Court Justice once said, "I'll know it when I see it". And we think that you will also know it when you cross it. (Ibid, 2010)*

4.2.4. Marketing and Sales

Through the App Store platform, application developers can offer their applications on a global scale to 123 countries.

Apple practices a revenue sharing model with developers on the App Store. Basically, a developer can offer a free or paid application. Apple does not charge the application developer upon the publication of an application, but has a share in any type of revenue that the developer is generating though App Store.

The following revenue generating tools are provided by Apple; developers can also use AdMob advertisement platform, provided by Google, to generate revenue (for more information AdMob (see section 4.4.4, *Ads*)

Paid applications

Application developers have been able to publish a *paid application* on the App Store since its inception. The price is determined by the developer within the range of US 0.99 dollars to US 999.99 dollars. For the consumers that are not located in the US, the price is converted into their local currency though a fixed rate defined by Apple. Consumers can purchase a paid application in all countries through an international credit card or in some countries (e.g. China) through their local bank cards. Apple keeps 30 percent of the application sale revenue for each application and transfers the rest to the developer.

in-App purchase

The *in-App purchase* allows the application developer to sell extra content through the published application. For instance the developer can sell newspaper subscriptions, extra game levels, or extra functionality for the application. The consumer is directed to the extra content through a link or button that the developer has designed in the application.

Apple introduced *in-App purchase* in October 2009. Similar to paid applications, 70 percent of the revenue from the sale of an application is transferred to the developer and 30 percent goes to Apple.

iAd

An application developer can use the iAd mobile advertising platform for integrating banner-type advertisement into an application. When a consumer taps on the banner, a full-screen advertisement opens and Apple charges the advertiser for US 2 dollars, plus US 10 dollars for every 1000 views. The application developer receives 60 percent of Apple's earnings from each advertisement. Just recently, in February 2012, Apple increased the share of developer to 70 percent effective since April 2012.

Apple has tried to promote its iAd network by lessening the obligations for advertisers. Originally in July 2009, upon using the iAd platform, advertisers were bound to spend at least one million US dollars on advertisement, but this requirement was lessened later to US 500 thousand dollars, and recently in December 2011, to US 400 thousand dollars (The Wall Street Journal, 2011).

App Store volume purchase

The volume purchase program was introduced in August 2011 only to the consumers in the United States. Via this program, enterprises and educational institutes can buy an application in volume and distribute it among their employees and students. The volume purchase only concerns the paid applications and the developer decides whether the application should be included in the program, and also can set a special price for the purchases of 20 and more applications.

Commission with affiliate program

The affiliate program concerns the affiliating of developers with Apple network. Basically, after joining the affiliation program, the developer embeds a link in his or her application on App Store to a targeted content (such as an application, a book, a movie, a song track, etc.) located on any of the stores owned by Apple (i.e. App Store, Mac App Store, iBookstore, and iTunes Store). If the consumer purchases the targeted content from that store, the developer receives five percent of the purchase price as commission.

Apple provides some means which can help with promotion of applications. It groups the applications under various categories in App Store (such as business, entertainment, utility, news, etc.) Developers choose the category of their applications while submitting them. Apple also allows the consumers to write *reviews* for the applications. As such,

Apple helps the developers to locate their application in a suitable place, and also helps the better applications to stand out by receiving positive reviews from users.

In addition to regular categories, Apple provides some special lists on the first page of App Store to display the top applications. The lists are named as: top free applications, top grossing applications, and Apple featured applications. The algorithm that Apple uses for placement of the applications in such lists is not publicly released.

The high competition among the applications on App Store has caused the emergence of an industry dedicated to promotional activities. For instance, there are individuals and companies that introduce and review the new applications to consumers via their websites. Meanwhile, some actors have also emerged that try to manipulate the market. For instance, upon charging a developer, these actors use their own people to download his or her application, and write reviews about it; so that the application can show a higher number of downloads and positive reviews. Recently Apple has released a warning against such activities to its developers:

> *Once you build a great app, you want everyone to know about it. However, when you promote your app, you should avoid using services that advertise or guarantee top placement in App Store charts. Even if you are not personally engaged in manipulating App Store chart rankings or user reviews, employing services that do so on your behalf may result in the loss of your Apple Developer Program membership. Get helpful tips and resources on marketing your apps the right way from the App Store Resource Center.* (MacRumors, 2012)

App Store is populated mainly by *paid* applications (60 percent). After purchase of a *paid* application, consumers are not allowed to return the application unless in some exceptional cases which needs to be approved by Apple.

4.3. Google

The global company of Google Inc. (referred to as Google in this thesis) was established in 1998 in California, USA; and is listed on NASDAQ. It is positioned as the second most valuable brand in the world in 2011 having a value of US 111.5 billion dollars (Millward Brown Optimor, 2012).

Google is active in the fields of Internet and software. It is specialized in internet search, cloud computing, and advertising technologies. Its source of revenue is mainly from advertisement. Besides its famous search engine, Google provides other globally known services such as Gmail, Google Map, YouTube, Google Chrome, and Google plus.

In November 2007, Google introduced its Android operating system for mobile phones and tablet computers. Android is an open platform and a product of the *Open Handset Alliance*, a consortium of 84 technology and mobile companies led by Google. The members include mobile operators, handset manufacturers, semiconductor companies, software companies, and commercialization companies working together to develop standards for mobile devices. Many of the major device manufacturers are among the members of the alliance, such as Samsung, HTC, LG, Sony Ericsson, Motorola, etc.

Android is an open-source operating system; thus, any mobile device manufacturer is able to use Android as the operating system for its devices. However, the trademark of Android cannot be used unless the device meets the Android compatibility requirements defined by Google. The compatibility requirement is meant as a way to maintain the coherency among the devices that enter the Google application ecosystem, and to avoid undesirable fragmentation of devices. For instance, having a camera is a must for compatible devices. Further, the license to use the *Android Market* application store is only offered to the devices that their compatibility is approved by Google.

4.4. Google Android Market

Google launched its application store in October 2008 under the name *Android Market*. The selection of the term "*Market*" instead of "*Store*" is explained by Google as the

demonstration of an *open* and *obstructed* environment for the developers to share their contents with users. The launch of *Android Market* was along with the release of the first Android-based mobile phone by HTC (i.e. HTC Dream aka T-Mobile G1) in the US and UK for the first couple of months. Users can access the *Android Market* directly from the application embedded in their Android- based device or through its website on the internet.

Android Market evolved gradually with regard to the expansion across the world and support for paid application. At the time of launch it contained about 50 applications which were all for free. Google did not allow any paid applications on its Android Market in the first four months, so developers could only offer free applications. In February 2009, developers who were located in the US and UK were allowed to offer paid applications. Within 10 months, offering paid application was made possible in eight countries while free applications were available in 27 countries. Within two years (September 2010) Android Market was available in 27 countries for paid applications and 48 countries for free applications. At present (February 2012), paid applications are available in 29 countries and free ones are available in 147 countries.

Android platform is an open platform to any application stores; meaning that Android consumers are allowed to download and install any applications as long as it is compatible to Android whether it exists in Android Market or any other application portal. This openness has provided the opportunity for other application stores to be launched on Android operating system as well. In some cases such stores are offered by mobile operators to provide exclusive applications for their consumers, such of the application store launched by China Mobile (the largest mobile operator in China) for its consumers in china. In another cases, the stores have a head-to-head competition with Android Market. For instance, *SlideME* is an application store on Android announces:

> *Have an application that Google prevents you from stocking in the Android Market, leaving you and your app stranded? Are there users desperate to buy your application but they don't have access to Google Checkout or the Android Market? Do you want to show off your app but feel limited by not having*

screenshots or video in the Android Market? If so, then you've found the right place at SlideME, the Original Market for Android (We launched our portal and mobile client in April 2008). What we do for the developer is simple. We provide a way to market, deliver and download content to users that you wouldn't have access to in your traditional channels. (Distimo, 2009)

Additionally, mobile manufacturers such as Sony Ericsson are allowed to have their own section in the Android Market exclusively for the users of their phones.

4.4.1. Joining the Ecosystem

A developer willing to publish an application on Android Market needs to become a member of the Android Market ecosystem. The membership is done in two steps: signing the *Android Market Developer Distribution Agreement*, and a one-time payment of US 25 dollars through Google Checkout (Google's online-shopping facility). The agreement is publicly available on Android Market website. After signing the agreement and paying the membership fee, an application developer instantly becomes a member of the ecosystem, and can submit his or her applications to *Android Market*. Similar to Apple, Google does not prohibit its member developers from joining other ecosystems.

4.4.2. Documentation and Application Development

Google provides the developers with the tools required for developing and testing an application. Also, through the Android developers' website, it offers training documents for developers in the format of sample codes, tutorials, articles, videos, blogs, etc.

Android SDK is offered to developers for free. Developers need to first install the *SDK Starter* (which includes some core development tools) and then install the Android Development Tools (ADT) on top of it. ADT is a custom plugin for Java-based Eclipse environment.

Android developers' website is publically available to anyone. Google suggests several forums for visitors to communicate and ask for help regarding developing on Android. *Stack Overflow* and developers' community forum are among them. Additionally, similar to Apple developers, some Android developers have created forums to exchange ideas and communicate with each other.

4.4.3. Publishing an Application to the Market

Publishing an application to the Android Market can be done immediately, without going through any review process. Upon submitting an application, it will be shown in the store within few minutes.

Although the applications do not go into a review process, Google has the right to remove any application in case it finds the application violating any rules. Cases of prohibited applications include but are not limited to: nudity and sexually explicit material, hate speech, malicious products, prohibited products (violating carriers' terms of service), and products that receive a report of abuse by consumers.

The lack of review process in some cases has caused some trouble for Android users. For instance, in May 2011, Google had to remove 26 applications due to malware danger, and it is estimated that between 30 to 120 thousand Android devices were infected before the discovery of the malicious applications (Lookout Mobile Security, 2011). The lack of control on Android has urged some rival application stores to encourage the consumers to move from Android to their platform. For instance, Microsoft (with its Windows app store) launched a competition in December 2011 on Twitter to offer a free Windows phone to an Android user who would share his or her story of malware infection (BBC News Technology, 2011). However, recently Google has introduced its Bouncer, which provides an automated scanning of Android Market for potentially or presently malicious applications. Due to the filing of records, Google can recognize the repeating offender developers and prevent their activities on the ecosystem.

4.4.4. Marketing and Sales

Google practices a revenue sharing model with developers and carriers on the Android Market. Upon selling of a paid application on Android Market, the application developer receives 70 percent of the price and the rest will be released to the carriers. In fact, Google does not receive any commission from paid applications sales. It does not charge any fee from the application developer upon submitting the application either.

Google provides several ways for generating revenue for application developers:

Paid apps

At present, developers in 29 countries can publish paid applications on Android Market. The price range should be determined by the developer based on the currency that the application is being sold in. For instance, the price range in US dollar is from 0.99 to 200, and in both Euro and Pound is from 0.50 to 100. The developer can set the price for the application in each currency separately, or can allow the price to be converted by Google according to the exchange rate on the purchase day.

In-App purchase

Similar to the *in-App purchase* in App Store, the *in-App purchase* in Android Market allows the application developer to sell extra digital content through the published application. Consumers need to have the latest version of Android on their mobile phones in order to make an in-App purchase.

In-App purchase was introduced in the end of March, 2011. Same as the paid applications, the developer receives 70 percent of the sale price and 30 percent is released to the carrier.

Ads

Google provides an advertisement platform, called AdMob, and allows the developers to generate revenue through it. AdMob connects the companies who are interested to advertise their products and services to the developers who are interested to embed an advertisement in their applications. When consumers open the application and see the advertisement or tap on it, developers will be paid by Google.

AdMob works as a cloud space containing a mass of ads. Every time the application is run, AdMob pushes an ad to it. Google has connected its AdMob platform to its other advertisement networks; therefore, in case there is no possible ad on the AdMob at some point, an ad from other networks will be pushed to the application. As such, Google tries to always provide the developers with an ad in their applications, so that they have a higher chance to make revenue.

Similar to Apple, Google provides some means which can help the promotion of applications. It groups the applications under several categories on Android Market (such as games, finance, entertainment, etc.) The users of an application have the possibility to rate it based on their level of satisfaction, and write review about it. Google also provided the following lists on the first page of Android Market to help the consumers to learn about the popular applications:

- Staff Picks: rotating set of great apps chosen by the Android Market team. The criteria for an application to be picked are: offering a combination of excellent functionality, ease of use, and deep integrations with Google applications
- Top Free: most popular free applications of all time
- Top New Free: popular free applications less than 30 days old
- Top Paid: popular paid applications of all time
- Top New Paid: most popular paid applications less than 30 days old
- Top Grossing: applications and games generating the most revenue, including application purchases and in-app payments

- Trending Apps: applications showing a hockey stick growth in the number of installments in the last 24 hours

Same as in the case of App Store, many businesses and services have emerged to help developers promote their applications in the Android Market.

Unlike App Store that is mainly populated with *paid* applications (60 percent), Android Market contains more *free* applications (65 percent). Additionally, dissimilar to Apple, Google allows the consumers to return a purchased application within 15 minutes of their purchase and obtain a refund for the price they had paid.

5. ANALYSIS AND DISCUSSION

This chapter undertakes the conceptual framework (see section 2.5.) to analyze the empirical findings and discuss them in light of the literature in order to answer the research questions. It consists of three sections.

The first two sections address the research sub-question (i.e. *What is the structure of a mobile application ecosystem?*) In the first section, the chapter provides an overview of the ecosystems' evolutions in light of Moore's (1996, 83) acknowledged challenges in the *pioneering* and *expansion* phases of a business ecosystem (i.e. value, and critical mass), along with the dynamics of a two-sided market (i.e. network effect). In the second section, utilizing the conceptual model (Figure 10), the chapter illustrates the structure of the ecosystem in each of the case companies with regard to participants, and further analyses the participants' roles according to the literature on the composition of business and software ecosystems (see section 2.1.2).

The third section approaches the main research question (i.e. *What factors do developers perceive as important (both positively and negatively) in a mobile application ecosystem?*) The chapter discusses the developers' perceptions of the attributes of the ecosystems according to the criteria defined in Figure 11, and in light of the literature on business ecosystems and the dynamics of a two-sided market.

The types of data that are used in analysis are not the same in all sections. In the first and second sections, the data are gathered through a longitudinal study of a vast range of public sources such as news articles, websites, reports, forums, blogs, etc. The author has been closely following the news on the case companies (and other competitors) for almost two years; therefore, has developed a knowledge base (partially tacit) on the evolution of the case ecosystems and their structures. Thus, the analysis is mainly based on the facts described in Chapter 4, and the author's personal judgment. Hence it does not directly involve the developers' perceptions. In the third section, due to the focus of the research question, developers' perceptions are taken into account and analysis is done based on those; therefore, direct quotes are provided. (See section 3.3 for more details on data gathering)

5.1. Ecosystems in the Case Companies

App Store and Android Market were launched with only three months difference in timing, yet they showed different performances in the early months of their inceptions. The difference can be observed in the number of available applications in the stores at the launch time, as well as the timeline of reaching the same number of application downloads by consumers. However, both application stores experienced a continuous growth and are standing at quite the same level at the present time. Figure 14 illustrates the growth in the number of available applications on both stores and shows that even though App Store experienced a faster growth in early months, Android Market was able to reach App Store's level, having a faster growth in later months.

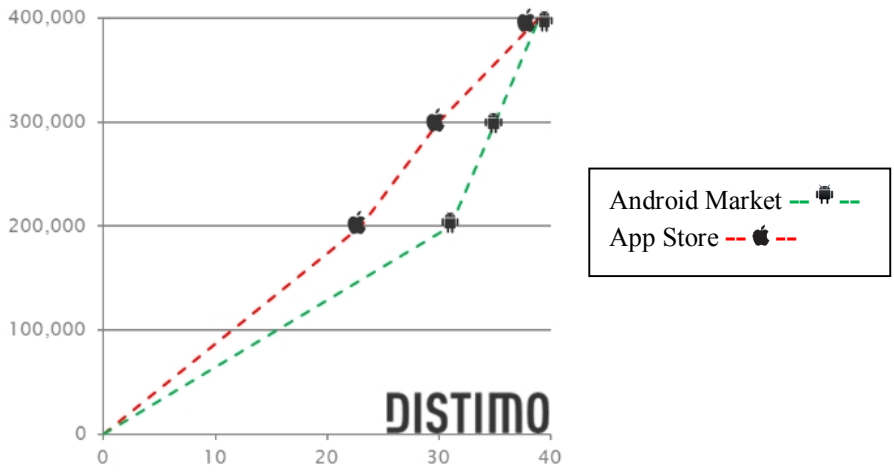

Figure 14. Number of Available Applications (Distimo, 2012)

In order to analyze the reasons behind different growth rates of App Store and Android Market in their early months, Moore's (1996, 83) *stages of an ecosystem life* is utilized. Particularly, since the focus is on early months of operations, the first two stages of an ecosystem life (i.e. *pioneering* and *expansion*) and their respective challenges (i.e. *value* and *critical mass*, respectively) are considered. The *value* is defined as the benefits that consumers and developers can get from the new offer (i.e. application store in this context); and *critical mass* is defined as the mass of consumers and developers willing to use the application store. In the following, the above issues are investigated under

three topics: 1) the market foundation at the time of launch (critical mass), 2) the consumers' benefit (value), and 3) the application developers' benefit (value). Additionally, the dynamics of a two-sided market with regard to network effects are taken into account.

The Market Foundation

Apple launched its App Store along with the release of its new iPhone 3G (the second generation of iPhone mobile device), a year after the entrance of Apple into mobile phone market. App Store was available to anyone who had a device running on Apple's operating system (*iOS*) across the world. Therefore, the old iPhone and iPod Touch (Apple music player) users, as well as the new iPhone 3G users could all access App Store at the time of launch. It should be noted that App Store was in connection with the already existing iTunes Store (Apple music store), where consumers were able to download music.

Google, on the contrary, launched its Android Market along with the release of the very first mobile phone that was running on Android operating system (HTC Dream aka T-Mobile G1) manufactured by HTC. Therefore, Android Market was launched in a market with no already existing consumers.

Clearly, Apple offered its App Store to an already existing pool of consumers across the world, unlike Google that had to enter the market from scratch. Apple consumers had already experienced its products (and iTunes Store); therefore, App Store was just an additional service for those products (i.e. iPhone and iPod Touch), as well as for the new iPhone 3G. In contrast, Android Market was a new service offered for a new product that consumers had no previous experience with, and was only offered in the US and UK within the first few months. Consequently, Google and HTC had to start attracting the consumers to use both the new product (HTC Dream aka T-Mobile G1) *and* the new service (Android Market).

The literature on the diffusion of innovation acknowledges that upon the introduction of a new innovation, only *innovators* and *early adopters* tend to use the innovation

(Rogers, 1962, 282-283) which covers 16 percent of the potential users. Considering the newness of the HTC Dream mobile phone compared to the one year old iPhone, the difference between the statuses of Google and Apple can be clearly seen. The availability of a larger critical mass of consumers and their familiarity with iTunes Store as a base, could result in more application downloads on App Store compared to Android Market. Therefore, it can be claimed that despite the quite same timing of launch, the evolution of App Store and Android Market ecosystems started from entirely different statuses considering their market foundations.

Consumers' Benefits

Apple products are basically closed to installment of any application unless the application is authorized by Apple. It means that iPhone and iPod Touch users are not able to download and install any applications on their devices, unless they get them through App Store. Therefore, prior to the launch of App Store, Apple consumers had legally no access to any third-party applications, but only to some limited digital content (such as music) through iTunes Store.

Android (Google) products, on the other hand, are open to installment of any applications as long as the application is compatible with the Android operating system. It means that Android-based phone consumers have no restrictions in downloading applications from any sources in addition to Android Market.

Consequently, for iOS consumers, App Store is the only channel to get an application, while for Android consumers, Android Market is only one of the channels.

Basole & Rouse (2008) note that consumers care about the benefit that they receive from a product or service, and not about the product or service *per se*. Considering the *closed* Apple products versus the *open* Android products, it can be claimed that in consumers' perceptions, App Store could provide a higher benefit (and value) for Apple users than Android Market could do for Android users. Therefore, the larger number of application downloads on App Store can be claimed to not only relate to the larger

number of consumers on App Store, but also to the situation of App Store as the only application downloading channel for Apple users.

Application Developers' Benefits

At the time of launch, App Store was provided in 62 countries and developers were allowed to offer paid applications on the store and receive 70 percent of the purchase price. App Store was fast expanded to over 120 countries within a couple of months.

In contrast, Android Market was launched only in the US and UK along with the first Android based phone, and did not allow the developers to offer any paid applications for at least four months after its launch. Also the rate of global expansion for Android Market has been quite lower than App Store. Within 10 months, *free* applications and *paid* applications were available in 27 and 8 countries, respectively, which expanded to 48 and 27 countries after two years.

Therefore, at the early months of their launch, App Store was covering a much larger market globally than Android Market was, resulting in the existence of a larger consumer base. Additionally, the possibility for providing paid applications was also provided in App Store since the launch time, while in Android Market it was offered on a very limited basis only after four months.

The existence of the critical mass of consumers on App Store could attract the developers according to the *positive cross-side network* effect in a two-sided market. Additionally, the chance of having direct revenue from selling applications can be perceived as an incentive for developers to join App Store. In other words, developers on App Store could directly get a share of their application price by serving the consumers who were eagerly looking for applications on the only available channel (App Store). But developers on the Android Market had to seek other sources for indirect revenue while serving a very limited pool of consumers - who could also use alternative channels for downloading applications. Therefore, it can be claimed that developers were getting more benefit from App Store compared to Android Market,

which could consequently result in the existence of higher number of applications on App Store in the early months.

Overall, considering Moore's (1996, 83) *ecosystem life stages*, it can be concluded that Apple and Google went through the stages at different paces and with different strategies. Google started its Android Market ecosystem by a quick transition from the *pioneering* stage to the *expansion* stage. In the *pioneering* stage, it created the *value* (Android Market) but not fully (e.g. no paid applications, no global installed based, etc.) However, along the *expansion* stage, it tried to not only enhance the *value*, but also to attract the *critical mass* of developers by applying very low entry barriers (discussed in 5.3.1.) Apple, on the contrary, can be claimed to have already passed the *pioneering* stage by offering an attractive *value* for both developers (global sales channel) and consumers (the exclusive application store). It had also partly passed the *expansion* stage by building its App Store on the foundation of its already existing mass of consumers across the world.

Considering the performance of Google (and also Apple) with regard to the constant enhancement of their created values, the study fully agrees with Hearn & Pace's (2006) opinion that the criticality of value creation is not limited to the *pioneering* stage of an ecosystem.

5.2. Composition of the Ecosystems

Composition of the ecosystem comprises of the structure of the ecosystem and the roles of the participants (Jansen et al., 2009b). In the following sections an analysis of the composition of the ecosystems in the case companies is presented.

5.2.1. The Structure of the Ecosystems

Considering Jansen et al.'s (2009b) definition of the different types of ecosystem cores, it can be apprehended that Apple and Google have each shaped a platform-based ecosystem. They have built their ecosystems around their application stores, which are directly linked to their operating systems platforms.

Through the structure of their ecosystems, Apple and Google altered the traditional roles that were defined in the literature on mobile applications (see Figure 10). Some of the traditional roles are combined and are merged in the technological setting, and as result a seamless system of application development and distribution is provided. Basically, in this seamlessly designed system, the need for the separate roles of *application aggregator*, *mobile/web portal*, *operating system provider* and *platform provider* is eliminated.

The application stores, *per se*, serve as an *application aggregator* in two ways. Firstly, by providing several categories of applications (e.g. business, games, music, social networking, etc.), on one hand, they enable the developers to directly submit their applications to the most relevant category. On the other hand, consumers can search among those categories to find their desired applications. Secondly, the seamless connection of the development platform to the application store provides the developers with the opportunity to know about their targeted distribution channel in advance. Hence, an application developer can directly submit his or her developed application to the relevant application store without the need for an *application aggregator*.

Likewise, the nature of the application store as an online store eliminates the need for a separate *mobile/web portal* for distribution of applications. In other words, consumers can directly access the application store through their mobile phones, and download the applications straight to their devices.

Furthermore, both companies have cannibalized the roles of an *operating system provider* and a *platform provider* by providing their development platforms on top of their operating systems; thus, they keep both roles for themselves.

Despite the above similarities in the design of the ecosystems, Apple and Google differ when it comes to the degree of integration in their platforms, as defined by Holzer & Ondrus (2010).

Apple has taken a *full-integration* approach (Holzer & Ondrus, 2010) and orchestrates its ecosystem by strictly controlling the entire process from device manufacturing, to development platform management, to application distribution. As presented earlier, App Store is available for only the devices that run on iOS operating system, all manufactured by Apple.

Figure 15 illustrates Apple's integration approach. The roles of a device manufacturer, platform and operating system provider, and App Store provider are all kept by Apple. App Store (for applications) is connected to iTunes Store (for digital contents) and are both built on top of iOS operating system.

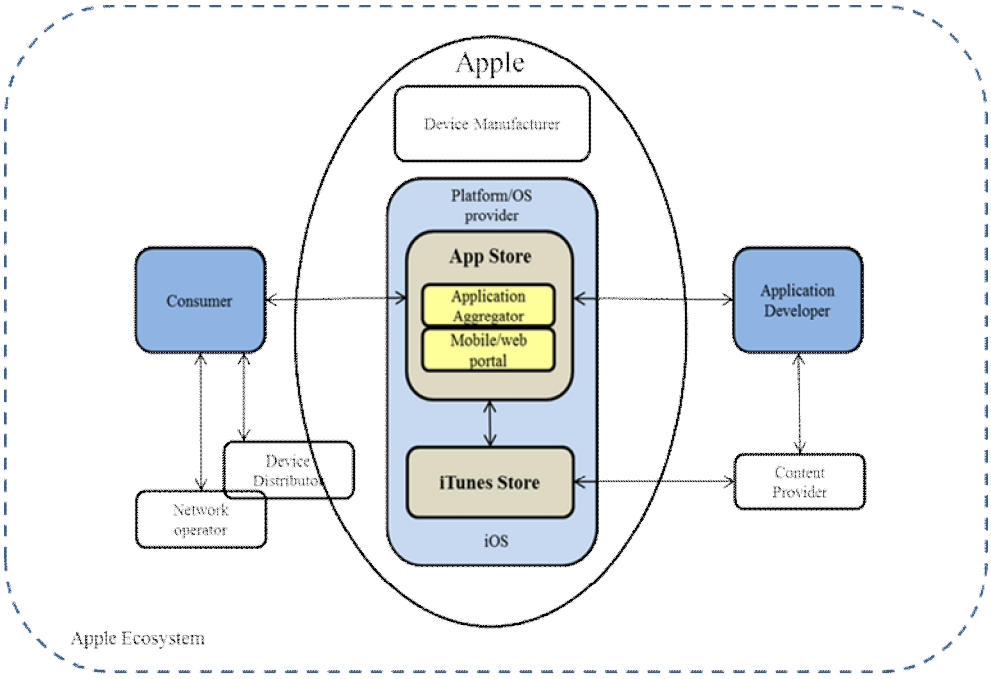

Figure 15. Apple Mobile Application Ecosystem

The *full-integration* approach provides Apple with the advantage to balance the innovation with diffusion through its two-sided market strategies. Looking retrospectively at how Apple has performed, a pattern of balance keeping between the

developers' side and the consumers' side can be observed. For instance, Apple introduced the App Store with 500already existing applications, and the next day it released its new iPhone 3G which had included the App Store application among its embedded phone applications. It can be claimed that by this strategy Apple could attract its new consumers to visit App Store. Furthermore, Apple has often let a few months (three to four) interval between previewing of a new version of iOS for developers and release of a new model of iPhone running on the new iOS. By doing so, Apple on one hand motivates developers to develop more applications for the new operating system, and on the other, attracts more consumers to its iOS platform by the new version of iPhone (causing a cross-side positive network effect).

Google has taken a different approach in integration (see Figure 16) than a *full-integration platform*. Similarly as Apple, Google is in charge of its Android Market, but does not manufacture any devices. Instead, it has a strong relationship with independent device manufacturers and lets them enter its ecosystem. However, it uses the compatibility measure as a gateway for entrance of a device to its application ecosystem and Android Market. In other words, Google has chosen a closed-system strategy for its Android Market and does not offer it to all types of devices. As a result, it can be claimed that with the control that Google is imposing upon the devices to enter its Android Market ecosystem, it does not comply fully with the *portal integration* (see Figure 8) as defined by Holzer & Ondrus (2010), but its strategy (called *semi-integrated* in this study) can be positioned somewhere between *full-integration* and *portal-integration*.

Figure 16 illustrates Google's integration approach. The roles of the platform provider, operating system provider, and application store provider are all hold by Google. The role of the device manufacturer is not hold by Google, yet a strong relationship exists between Google and the manufacturer who want to provide the access to Android Market in their devices.

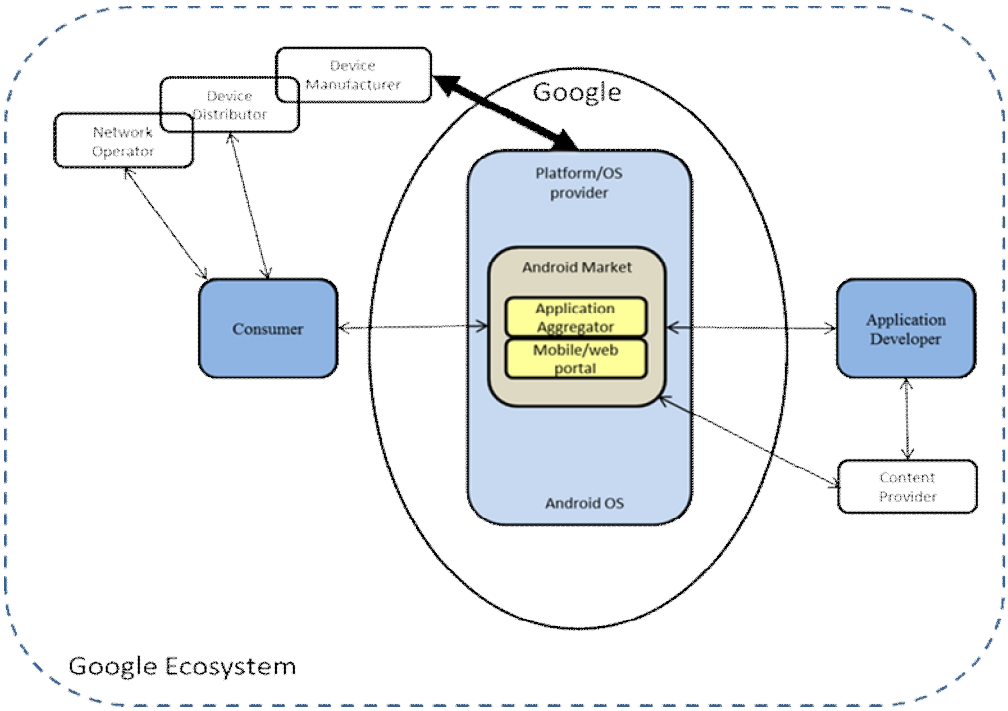

Figure 16. Google Mobile Application Ecosystem

5.2.2. The Roles of Participants

Apple and Google both take the role of a keystone in their application ecosystems, as defined by Iansity & Levien (2004, 68). They provide the platform which connects the application developers with the application users. They set the platform rules, and in fact shape the strategies of the ecosystem, as mentioned by Hagel et al. (2008). Application developers are on one hand provided with the tools and support for developing an application, and on the other, with the opportunity to offer their products to the consumers, and get a portion of any generated revenue. Consumers are also provided with the ease of access to the available applications for their mobile devices. As a result of such an orchestration strategy, the ecosystems have grown in a sustaining way and have become the main players of the mobile application market. The continuous growth observed in the number of available application on App Store and Android Market (Figure 14), is an indicator of the success.

Despite taking the role of a keystone in the ecosystem, at some points Apple has tried to take a stronger role against the participants - and perhaps move more towards a *dominator (*Iansity & Levien, 2004, 116) - through imposing stronger restrictions or obligation for participants. However, the performance of Apple shows that despite its attempt to extract more value at some points, it has been sometimes forced by the members and also competitors to pull back in order to keep the ecosystem completive.

An example is when Apple imposed a new rule for the in-app subscription for publishers. According to the new rule, the publishers who were using an application to sell contents to consumers (such as magazines, videos, music, etc.) were not allowed to sell any content on their own website if consumer was connected to their website using App Store. Therefore, the only way to sell content was through the in-app subscription, and that would give Apple 30 percent of the subscription revenue and accordingly mean a 30 percent loss in revenue for publishers. Additionally, Apple banned the publishers from offering the similar content on any other sales channel for a lower price than through the in-app on App Store. This new rule caused a debate among the publishers such as Financial Times (FT) and Apple. Consequently, Apple removed the FT's application from App Store, due to the refusing of FT to comply with the new rule (PCWorld, 2011a). However, some other big publishers such as Amazon.com, and Walmart's VUDU (movie streaming service) also joined FT in the opposition to the new rule (iGadgetsReport, 2011). In the end, after six months, Apple was forced by the large participants to back off from imposing the new rule and the new rule was dismissed (PCWorld, 2011b). Interestingly, right after impose of the new rule by Apple, Google took a competing strategy in its Android Market ecosystem. It allowed the publishers to set up a system through which a user who bought a subscription using their desktop browser could access the same content on a mobile phone browser or in the publication's apps (Wired, 2011).

It has been observed that if their resources allow them, developers often will tend to be active on more than one platform and act as *hedgers* (Hagel et al., 2008). A developer mentions this issue:

I'd personally recommend going for both platforms, thus covering like 90% of market share.

However, some developers also show interest to commit to only one platform and stay as a *disciple* (Ibid). Some of the observed reasons for making such a choice are the uncertainty about the profitability of other platforms, the lack of interest in the attributes or mechanisms of other platforms, and the lack of resources. The evidence for the existence of *influencer* developers is not observed in this study, as major applications (such as Facebook application) which join the platform in the early stages, appear to be active in other platforms in early stages as well.

The roles that Iyer et al. (2006) have defined in a software network, i.e. *broker* and *bridge*, can be observed in the application ecosystems under study. AdMob and iAd platforms are examples of *brokers* in the ecosystems which connect three sets of participants to each other. They connect the advertisers to the developers to the consumers through their advertisement platforms and create value in the ecosystems. Advertisers benefit by having their ads shown to the consumers through embedding them in applications, and developers benefit from the opportunity to make money when consumers open the advertisements. The App Store and Android Market platform, *per se*, hold the role of the *bridge* in the ecosystems as they provide the overall connectedness of the participants through their platforms.

An influential factor on the application ecosystem in the case companies, which has not been highlighted in earlier literature on mobile networks, is the *regulations*. Some researchers such as Basole & Rouse (2008) consider the general context in which an ecosystem works; yet do not mention the role of regulations specifically. Legal authorities are the participants who can have considerable impact on the entire ecosystem and particularly to the offering of an application to the market. Perhaps the earlier researchers have not highlighted the regulations due to taking a value chain approach in their studies rather than an ecosystem approach. In value chain perspective, since the regulations might not directly create value for the consumers, there is a possibility for regulations to be neglected. However, the existence of regulations affects

the entire business environment and affects the value proposition. Aside from the general regulations for application offering (such as nudity and sexually explicit material, hate speech, etc.), the regulations can influence on some specific-purpose applications. For instance, US Food and Drug Administration (FDA) issued a draft of regulations concerning medical application. As such, for instance FDA requires for overseeing the applications that can turn a mobile phone into a machine to detect abnormal heart rhythms or determine if a patient is experiencing a heart attack. Other examples can be observed on the applications which had to be removed from App Store, such as *Fake ID* game or *Nullriver's NetShare*. (See section 4.1.3 for more examples)

5.3. Comparing the Attributes of the Ecosystems

In order to compare the attributes of the case ecosystems from developers' perspective, the factors in Figure 11 (see section 2.5) are undertaken. In this section, the focus is on developers' perceptions. To enrich the quality of the findings, quotes from developers are embedded in the text.

5.3.1. Joining the Ecosystem

Apple sets a higher barrier to entry to its application store ecosystem for developers than Google does. It applies a higher fee for joining the application store ecosystem (minimum US 99 dollars/year) compared to Android (US 25 dollar onetime fee); it does not allow the developers to join its ecosystem before approving them, while Android allows the developers to join its ecosystem upon payment of the membership fee; and it does not allow the developers to use any computers other than Mac machines for development, while Android allows the freedom of choice for development machine.

The empirical findings show that the low barrier to entry to an ecosystem is an item recognized by developers in their decisions to join the ecosystem. Developers tend to appreciate the ability to join the ecosystem immediately at low cost and without the requirement to be approved. Among the three above mentioned factors, developers

seem to be more sensitive to the initial investment that they need to do in order to join an ecosystem – e.g. buying a Mac machine in case of joining App Store. A developer unveils this concern ironically:

> *Apple has made it pretty easy to start writing iOS apps. Of course, Step One is "Buy a Mac." Easy!*

Two developers express their feelings regarding the barrier to entry:

> *I'll be targeting Android first - it's easier to develop for, and has a lower entry threshold - I can use Linux computers to do the work, as opposed to having to buy an Apple product.*

> *To develop on iPhone, you need a Mac. This sucked, as it meant that the first step on my journey to iPhone fame and fortune was to drop $2K on a computer that I didn't really want.*

Nevertheless, the remarks by developers show that Android Market's low barrier to entry has also a negative side. The ease of joining the ecosystem allows the membership of all types of developers – even less qualified or less serious ones, which according to developers has resulted in the existence of more low quality applications on Android Market compared to App Store. Two Android developers discuss that Google needs to apply a higher membership fee in order to get more quality applications in the market:

- *Maybe increasing the developer sign up fee to a couple of grand would help [to get better quality apps].*

- *A couple of grand might be a bit much, but Google could raise the $25 it is now if they wanted to get more quality apps.*

Interestingly, the existence of low quality applications on the application stores seems attractive for some other developers, as they believe it to make the competition easier. *Mika Mobile*, a developers' team explain:

> *I'd go as far as to say that a polished, high quality product is more likely to be embraced on Android than on iOS because the quality bar on the Android market is so pathetically low [...] I think the lack of competition makes quality apps really stand out, and generates a lot of enthusiasm from app-starved android users.*

The dynamics of cross-side and same-side network effects (Eisenmann et al., 2006) can explain the developers' attitudes towards the barrier to entry and the quality of applications. Due to the cross-side network effect, having a higher quality and/or a higher diversity for applications on the store can increase the attractiveness of the store in the eyes of consumers. Thus, it can draw more consumers to the store and possibly cause a higher number of downloads to take place. However, a same-side network effect also takes place simultaneously on each side of the market. On the developers' side, it increases the level of competition among developers and necessitates more effort for promotion of an application to make it stand out among others. In fact, the desire of some developers to want to compete with lower quality applications, can find its root in the negative same-side network effect.

The simultaneous existence of the same-side and cross-side network effects in this context raises the question that which one of the same-side network effect or the cross-side one has more influence on the developers' behaviors. To answer this question, the data gathering method of this study comes to help. Throughout the process, it has been witnessed and/or tested that developers from all across the world voluntarily assist each other in international and/or local forums and communities, and try to answer any questions regarding the technical and/or business issues in order to increase the quality of their peers' activities. This behavior can be an indicator that developers tend to care more to coevolve with their peers; therefore, it can be claimed that the cross-side network effect has a stronger influence than the same-side network effect.

In general, with regard to the barrier to entry and from an ecosystem perspective, it seems like Google is following Moore's (1996, 83) approach in *life stages* of an ecosystem, but Apple is acting differently. According to Moore (1996, 83), at early stages of its life, an ecosystem tries to become the market standard by attracting customers and suppliers, and later on at the renewal stage it sets a high barrier to entry to impose a higher switching cost. It can be assumed that Google's lower barrier to entry is an indication of its effort to get more developers on the Android Market and to enhance its expansion, especially as late-comer compared to Apple. The consequences of such a strategy can be observed in the attitudes of some developers to start with Android Market due to its lower barrier to entry. On the other hand, Apple has set a higher barrier to entry even at the very beginning stages of its ecosystem evolution. It can be assumed that the reason behind this initiation is its confidence in the existing demand for applications in the market. As described earlier, Apple's products are closed to installment of any third-party applications unless it is bought on the App Store. This can result in a high demand for applications from consumers' side; hence can create a demand from developers' side to join the market even at a higher cost to reach such consumers.

5.3.2. Documentation and Application Development

In this section, the developers' perceptions on issues related to documentation and the application development in the case ecosystems are analyzed. Further, for analysis of the application development, the maturity of the platform and the ease of development are discussed.

Documentation

Documentation refers to all documented training, material and the support that the case companies provide for developers to help them to develop and offer applications to the market. Both case companies provide the documentation in the forms of sample codes,

tutorials, articles, videos, and developer forums where developers can exchange ideas and get help from each other and the companies' technical staff.

Despite the provision of documentation by both case companies, developers seem to have various opinions on the quality of the delivered documentation. Some developers tend to like Android's documentation more than Apple's, as they think Apple avoids affording all the necessary information that a developer might need. An Apple developer who has just started developing for Android explains:

> *Android documentation, is very extensive and exposes developers to nearly everything unlike the iOS documentation that hides important aspects from developer*

Whereas some developers believe in the comprehensibility of Android's documentation, some others remark that it comes short in comparison with Apple's. A developer comments on the comparison of Apple's and Android's documentation as:

> *Apple documentation is much better than Android's. There are a lot of gaps in the Android documentation and leaves a lot of questions unanswered. Apple's documentation is some of the best I've seen honestly …*

Some developers find the Apple's training documents sometimes vague and insufficient for a beginner level developer, yet state that there are some tutorials and videos on Apple developer website that come in help for beginners. A developer explains:

> *I personally feel that the developer documentation is to the point. That's why they are not a good resource for someone who's getting started. People getting started (on any new platform) like to follow tutorials because they are detailed and guide you [through] every step of the way. They spoon feed you, that's why they are easy!*

Overall, developers tend to have a more positive opinion towards the clarity and extensity of Apple's documentation in comparison to Android's with the notion that there is still room for improvement of its consistency in all sections. An Apple developer elaborates:

> *I feel Apple's is good, but could be improved, it may just be me but in some parts the documentation is very clear and extensive as to what an object does, the tasks it can perform and the properties it has available, other parts are very vague and can send you around in circles as to what an object does, tasks and properties etc. For me it depends on the object, some of the newer objects that aren't seen as important as other objects kinda get left by the wayside with a bit of info to get you going into trial and error.*

Documentation is among the factors that can enhance the quality of the interface of developers with the development platform. The importance of interface is noted by (Tuunainen et al., 2011) and Iansity & Levien (2004, 156). Ecosystem participants use the interface as the access point to create and share value (Iansity & Levien, 2004, 156). Developers, as the niche players, need to gain enough knowledge in order to efficiently and effectively use the development platform, and create value by offering applications. The global scale of the operation of the case companies, and existence of developers located in various countries all across the globe, increases the criticality of a comprehensive virtual support for developers.

Additionally, the developers' training needs are different due to their different backgrounds and knowledge level in programming and familiarity with the platform, besides their cultures and languages which might affect the communication needs. This disparity is very well observed in the responses of developers, as discussed above. Some developers are generally satisfied and some are not; further, among the satisfied ones still the level of satisfaction differs. It seems like both Apple and Google need to improve their documentations in order to cover all levels of expectations, and fulfill the developers' needs

Maturity of the Platform

Maturity of the platform, in this study, refers to the quality of the development platform (i.e. Software Development Kit- SDK) provided by case companies. Clearly, a platform is more mature if it provides a flawless and bug-free environment for development.

The empirical data show that developers tend to favor the iOS SDK more than Android's when it comes to maturity. They find it to be more polished and bug-free. They indicate that with iOS, they always receive the *final* version of the SDK, while with Android they expect to encounter flaws and bugs in the platform. A developer elaborates on this issue:

> *With iOS products, you know the product is ready when it's out, with Android, you know you as the user/developer are mostly the beta tester.*

Maturity of a platform can be related to the implementation aspect of the ecosystem platform noted by Iansity & Levien (2004, 156) (see section 2.1.5). Although Iansity and Levien (2004, 156) explain that the ecosystem platform is not necessarily the technological platform, in the context of mobile application ecosystems a considerable part of the platform refers to the technological platform, as participants mainly interact through that.

Nonetheless, in the case companies, it might be a bit simplistic to relate the differences in the level of maturity as perceived by developers, only to the implementation aspect. In other words, maturity might be partially related to the interface aspect (Iansity & Levien, 2004, 156), if not fully. This claim is made due to acknowledging the differences in the strategies of the case companies. As is publicly known, Google considers the notion of *sharing* and *engaging* of users in its service provision. The open-source Android is an excellent example of this strategy, where Google allows its users to get involved in improving Android and be the *creators* as well. In other words the line between being a *user* and *creator* is very thin. On the contrary, Apple considers the *closed* notion and views its users as only *users* and not *creators*. It enables the access of

the users to absolutely finalized products, which are supposed to be only *used*. Hence Apple products are globally known by consumers as flawless in their performance.

Therefore, the difference in the platforms' level of maturity (as perceived by developers) seems to be in line with the desire and strategy of the case companies in interfacing with developers. Google has no fear to engage the world-spread developers into improving its platform upon using it; therefore, developers can interface with a less mature platform. In contrast, Apple has a thick border line between its users and creators; thus, the developers receive a flawless platform as their default roles are set as the *users* of the platform. The only exception is when developers decide to voluntarily get involved as test users in a beta version of an Apple's SDK, before it is finalized and publicly released.

Ease of Application Development

The empirical data show three factors which can address the ease of development: 1) programming language, 2) development facilities and test of applications, and 3) unification of the devices that the applications will be installed on.

1) Programming Language

The programming languages which are used in iOS and Android are Object-C and Java, respectively.

The empirical data show quite diverse and different opinions about the programming languages. Some developers are more in favor of Object-C while some others prefer Java. However, there is a consensus that Java language is more common and perhaps easier than Object-C; thus, there are a large number of developers who are already familiar with Java before joining the ecosystem. Developers stress that the more common use of Java and the openness of the Android platform allows for the use of third-party APIs (see Technical Abbreviations and Definitions) which are helpful. A developer explains that this possibility can shorten the learning curve of development on Android:

Android code is Java based, meaning the millions of already existing Java programmers have an easy time adopting the platform. These factors, coupled with the online support that most open source technology enjoys, makes the Android development learning curve much shorter than that of an iOS developer. How many objective C developers are out there?

However, some developers express that development in both languages can be equally easy if the developer follows the rules of development in that specific language, instead of wanting to apply his or her knowledge from another language to the target language. A developer who has developed in both languages elaborates:

Many find Objective C to be incredibly natural and beautiful. Others find it bizarre and frustrating. If you're willing to embrace the iOS way of doing things, you can pick it up very fast. If you fight it and try to keep coding in Java ways (or C way, or C++ ways), then it will be very challenging. The trick is to really work through the tutorials and not just try to figure out "how do I do X that I'm used to doing?" Often the answer is "you don't do X. X happens automatically when you do Y." But the place to start is working through some tutorials.

2) *Development and Test of the Application*

Evidently, development of an application can be done efficiently and effectively if proper facilities are provided by the platform provider. The facilities refer to the tools required for development and test of applications to assure their proper running.

With regard to development aspect, developers praise the big advantage of Android over iOS in regard to memory management. Memory management refers to emptying the portions of the memory from temporary files which are created during the development of an application, and allocating those portions of the memory to the programs and files at their request. Developers find the memory management a very crucial task in developing applications, and believe it to be a challenge even for

experienced programmers. They indicate that Android is facilitating the development process by offering the *Garbage Collector*, which is an automatic memory management facility. However, for development on iOS they need to learn to do the memory management manually. Two developers explain:

> *Having written a fair amount of both Java and Object-C, I have to say I prefer Java. Manual reference counting – c'mon – it sucks. iOS has some nice stuff in it, but the memory management is painful.*
>
> *iOS development forces a developer to learn the details of memory management and when to free it. Android on the other hand, has efficient and automated garbage collection capabilities.*

With regard to testing aspect, iOS and Android provide a simulator and an emulator, respectively; in which developers can test their applications. A simulator makes a simulation of the environment where the application runs in, but an emulator creates the exact copy of the actual environment.

Android developers seem to be quite frustrated by the Android emulator, due to its slow speed. They express that since in the Android emulator, a phone environment is completely recreated; the developed application is actually tested on a virtual mobile phone. According to developers, on one hand this is worthy as it shows how the application will perform on an actual phone; but on the other hand, the virtual environment allows the test experience at a very low speed, even less than its speed on an actual device. It is because when the emulator is run, the processor power of the computer on which they are developing the application is not used anymore, but the emulator simulates a processor similar to a mobile device's, which evidently has a lower power and speed than a computer's. Android developers desire to have a fast testing environment, so that they can run quick tests while altering the codes during their development process. Some developers mention that in order to lessen the frustration of testing an application on the Android emulator, they alternatively connect an actual mobile phone to their computers and test their applications on them. A developer

stresses this issue and also mentions that due to the fragmentation of Android devices, it is better to buy several devices [in order to make sure that it runs properly on different phones]:

> *Every time I change a bit of Java and need to rerun the app, it takes about 30 seconds to redeploy and start up in the Emulator. Compare that to 5 seconds on the iOS Simulator. It may not sound like much but remember you'll be doing this hundreds of times throughout your day. Fortunately, it turns out to be much quicker to deploy and boot up your app on a physical device over USB. So trust me, just go out and buy an Android phone. Better: buy a few of them to test against fragmentation.*

In contradiction to Android developers, iOS developers highlight the fast speed of testing an application on iOS simulator – even a higher speed than that of an actual device. They indicate that despite the ease of testing at such a high speed, they concern that the fake speed can cause a false assumption on the actual running speed of the application. A developer explains his concern:

> *To run your code in the simulator, you actually have to build a separate binary, and the code all executes basically at the full speed of the host computer. We've actually been bitten by this before, because it's really easy to believe that your code is crazy fast when your main interaction with it is on a quad-core Core i5 chip, instead of a single-core ARM chip. Overall, the empirical data shows that developers demand a test environment in which they can quickly test the application as a simulated environment, yet also demand to have the option to test the application on an emulated mobile phone.*

3) Unification of the Devices

Unification of devices is the opposite of fragmentation, meaning that all the mobile devices in the ecosystem have similar software and hardware specifications in such a way that an application can perform similarly on all.

Apple has a high degree of unification of devices. The devices in the App Store ecosystem are limited to iPhone and iPod touch (iPad has its dedicated iPad App Store), which have the same size, a touch-screen, and run on a same operating system (with slight changes across versions). Often by the release of a new iPhone, the earlier versions become quite rare in the market – and consumers move towards the new version.

On the contrary, Google has a low degree of unification of devices. Android-based devices are produced by various device manufacturers and are offered in different sizes, with different features and prices. Despite the control of Google on the devices that enter its Android Market ecosystem, still those that manage to do so experience a higher fragmentation compared to Apple's devices. Additionally, different manufacturers decide on the release time of new devices, as well as the version of Android that they use as operating system. Moreover, the competition among the device manufacturers exists as each of them aims for a higher market share. As a result, Android Market devices are in the market under very different conditions: some have old operating systems and some have new, some are touch-screen devices and some are not, some are very expensive and some are very cheap, some are very popular and some are neglected, etc.

Developers show different attitudes towards the fragmentation of Android-based devices. Some developers tend to see the fragmentation as a big problem that makes them unsure of how their developed application would perform on different devices. They are likely to find the development for Android more challenging than for iOS due to the fragmentation. A developer shares his concern for lacking of adequate resources to provide support for the potential consumers:

As a developer I would also like to point out that it makes a big difference when you know what device you are targeting. The fragmented nature of Android makes it less attractive for me to develop for. In the future I could see myself targeting e.g.: The Kindle Fire, The Galaxy Tablet, The next Moto Google device. So I would be more encouraged to start Android development once I'm given a kind of representative device which I feel has a huge traction. This is because I simply don't have the resources to go cross Android platform and then answer support queries as to why my App doesn't work on <insert Android device & Android OS version>. Basically it's just so much easier with one piece of dedicated hardware.

However, some other developers tend to believe that the fragmentation issue has been overexaggerated by the media, and point out that if the proper design and development practices of an application are taken by its developer, the application will work properly on various devices and the fragmentation will not be a major issue. Two Android developers express their opinions:

Fragmentation is not really an issue, despite what you might hear. The underlying Android layout system scales your app almost perfectly for the different screens.

While not a major issue on most devices, Android developers have to consider the different devices their apps will run on during development, this is even worse now that tablets are becoming ever popular

Contrary to Android developers, iOS developers are satisfied when it comes to unification of devices. An owner of an application development company stresses that the unification of Apple devices is the main reason for their tendency to develop first for App Store and next for Android Market:

Most start with [developing applications for] iPhone [and not Android devices], with the driving reasons that (i) there is only one UI size you have to deal with

and (ii) a huge majority of iOS users are within 2 versions of the current OS, whereas Android users tend to lag much further behind.

Considering the issues raised by developers with regard to the ease of development in the case companies, it can be concluded that both ecosystems have room for improvements. However, an overall view on developers' behaviors in the ecosystems and the continuous growth of the ecosystems shows that despite some difficulties, developers are willing to participate actively in both ecosystems. A possible reason can be the benefit that these ecosystems provide for developers (*value*), which possibly outweighs the inefficiencies. Through these application stores, the developers have the possibility to reach global consumers seamlessly and at a very low cost; therefore, take advantage of the economy of scale on a global basis. Developers show the tendency to cooperate with each other internationally through different channels in order to overcome the barriers in the way and assist each other to perform better in the ecosystem.

5.3.3. Publishing the Applications

As presented in sections (4.2.3 & 4.4.3), publishing an application in the application store takes place in different ways in the case companies.

In the case of App Store, Apple imposes a review process for an application before allowing it to be published. The review process can take from a week to a few months, and might result in the acceptance or rejection of the application. The review process applies to all submitted applications, either they are new versions of the already existing applications or are totally new.

On the contrary, Google does not apply any review requirement on an application, and allows it to be published immediately on the Android Market upon submission by the developer. However, Google has recently introduced an automated real-time controlling program, called *Bouncer* (see section 4.1.7) which monitors the Android Market

constantly, as well as the new applications upon submission. Its aim is to prevent the malware, Trojans, and spyware to enter the Android Market.

Developers find the non-existence of the review process in Android Market quite likeable. They tend to enjoy the possibility for immediate delivery of their applications to consumers without the need to wait long to have their applications either on the market, or rejected. Nevertheless, they seem to believe that the lack of review process has resulted in an overall lower quality of applications on Android Market than App Store. As a developer argues that the difference is not originated from Apple doing a quality control on the applications:

> *Apple routinely passes utter shit through as well. They're just checking there's nothing like racism, porn or anything else that might get them into trouble. But if it did help the quality then I'd be well up for it*

Rather, developers tend to believe in the indirect effect of the review process on the quality of application. They think that the higher barrier to entry and the need to wait for the review result increase their carefulness upon submitting an application to App Store compared to Android Market. A developer who develops for both Android Market and App Store clarifies:

> *Apple's process, for all its warts, does encourage better software. I know we have spent time making sure things are "just right" on iPhone, where I think we might not on Android; it's a lot easier to think "we'll just push another version tomorrow." I'll be interested to see how this plays out.*

Overall, developers tend to favor an initial review process for quality control, but they stress that a review process like Apple's puts an obstacle in the way of publishing an application. An iOS developer explains:

> *I am in favor of an app review process, but not in its current state. The current review process is a joke. Some apps get approved while violating every supposed*

rule in the book, yet other seemingly legitimate apps get rejected for no good reason […] The current review process does not keep out the riff raff at all. It is merely a frustration factory for the honest indie developer trying to make a living on the app store. While the giant patent troll companies and spam crap developers seem to flourish. Make the review process reasonable and fair and I am in favor, keep it as is and I would like to see it gone.

Apple and Google show different levels of control on the applications that enter their application stores. The difference is to a high extent in line with the general strategies of the companies – Apple has its strict control system and Google has its open sharing system.

However, from the ecosystem point of view, Apple and Google seem to be in different *stages*. Apple appears to act more inside the *authorization stage* (Moore, 1996, 83) by trying to maintain a high bargaining power with its participants. Considering the developers' perceptions combined with the facts in section 4.1.3, Apple tries to maintain its gate keeping power in the App Store with all sorts of controls on it. Google, on the other hand, is more involved into the *expansion stage* (Moore, 1996, 83) through having more applications and developers on its Android Market. The interesting fact that Google also allows competitor application stores to open their own stores on Android and even inside the Android Market (e.g. mobile manufacturer stores, see section 4.4) indicates the desire of Google to expand its Android platform as much as possible.

Moreover, comparing the revenue models of Apple and Google can shed more light on this difference. Google's main revenue model from its Android Market is based on advertisement. Obviously, the greater the number of applications on the market, the more opportunity is provided for advertisement through the AdMob platform (see section 4.1.8). Apple on the contrary has more focus on the commission that it receives from developers upon *selling* an application on App Store. Therefore, Apple seems to care less for the quantity of applications as the money that each application makes is more important. The behavior of Apple with regard to its review process as described in section 4.1.3 is an indicator of its lower attention to quantity.

5.3.4. Marketing and Sales

Monetizing refers to generating revenue from an application. Currently there are over 350 thousand applications on App Store and Android Market, each. Therefore, promotion and sale of an application requires proper strategies, as in any other market.

The application stores in both case companies provide some facilities to help developers promote their applications. A consumer who downloads an application can rate the application and write a *review* on it. Clearly high rating and positive reviews help in confirming the satisfaction of existing consumers, hence attracting new consumers. Additionally, the top application lists that are provided on the first page of the stores (for instance the top free ones or the top paid ones - see sections 4.1.4 & 4.1.8) can help in bringing the application to the consumers' attention when consumers enter the application stores. However, these lists have a retroactive nature; meaning that the applications that they display have already shown good performance in downloads, sales or the other specific criteria of the respective list. Therefore, promotion of applications in order to get them to such lists is among the hot topics of developers' communities.

Individual developers and/or small development companies in the both case companies tend to mainly use various low cost and/or zero cost social channels and networks to promote their applications. Among those channels are Facebook, Twitter, blogs, word of mouth, and review websites. The review websites make a review for an application regarding its performance and features for their audience, usually at a cost. Additionally, developers tend to also help their peers by downloading and using each other's applications and writing reviews about them. An iOS application developer has voluntarily listed the different ways that he has tried to promote his application:

> *Many members are asking how to promote a free app. Here I just share some my own experience during the work. Hope it is help to you!*
> *1. Join Facebook, Twitter to showcase your app.*
> *2. Send out a press release to the media announcing your new app.*
> *3. Create a video and place it at YouTube.*
> *4. Get friends to create a buzz by posting on Twitter, Facebook and Google+.*

5. Participate in forums online to promote your app.

6. Get listed in free online directories.

7. Create a blog and post an announcement about your new app.

8. Get reviews of your app placed at review sites.

9. Collect user reviews and post them on your website.

10. Collect celebrity endorsements and place on website.

11. On LinkedIn, join groups and post links to your press release or blog.

12. Exchange reviews with other app developers. (My free app is Toilet Time Killer. Welcome to exchange review with me.)

Besides the promotional tips that developers share with each other, they seem to show an understanding of the need for having a high quality application regarding consumers' needs. They recognize it as the first stage of gaining success in the number of downloads. Following the post of the above developer in the forum, another developer elaborates:

> *There's no certainty your app will do well. Lots of factors. But the advice is sound. Still, some key things are missing. Is the app any good? Does it provide something people will want? Does it look attractive? All the social media posting in the world won't do any good if you don't start off with something decent in the first place.*

The promotional vehicles mentioned by developers for App Store and Android Market do not show considerable difference between the case companies. In both cases, developers tend to use all the available channels within their resources to promote their applications. However, developers seem to hesitate to use the possibilities which might cause annoyance for consumers as they might negatively influence the consumers' rating and reviews. For instance, some Android developers show their hesitation to use the advertisement facility on Android called *"air push"* (through *airpush* an ad is pushed to the notification bar or the screen of the users' device, misleading the

consumer towards assuming that it is a notification sent by the phone). A developer explains his concern about the effect of using *air push*:

> *I'd imagine if a user figured out an app had starting putting ads in his drop down he'd not only rate it badly, but possibly mark it as malicious (from his perspective).*

However, when it comes to pricing and sale of the applications, developers have the tendency to use different sale and pricing strategies based on the structure of the competition in each market. They acknowledge that on the Android Market the majority of applications are offered for free, as opposed to App Store where majority of applications are paid ones. They stress that for paid applications, App Store might provide more revenue. A developer explains:

> *If you charge an upfront fee for your app and nothing else you will probably make more money on iOS.*

Some developers try to explain the reason behind the difference between App Store and Android regarding the *paid* applications. They mention that many of the Android phone users are not much familiar with the operating system of their phones, and this has a negative impact on the demand level for applications, particularly in regard to paid applications. A developer explains:

> *Good proportion of Android users may not even know they're on Android.*

Further, a developer explains that Apple users are generally more open to pay for applications:

> *How many of them are buying the phones because they feel they can't afford an iPhone? iOS buyers have shown that they are not afraid to pay money.*

However, some developers mention the economy of scale of Android as a promising factor for profit making and stress that in the end, the larger number of Android users can compensate their less tendency for paying for applications. A developer elaborates:

> *Android developers can now post their apps to a variety of other popular markets, such as Amazon, where their apps get a global audience. While users of iOS powered devices are better spenders than their android counterparts, this stop being an advantage when you look at the economics of scale. More android users.*

Considering the above factors, Android developers seem to take advantage of *indirect* sources of revenue from their applications, by using the facilities provided by Google such as embedded advertisement (through AdMob platform), in-app purchase, and freemium (i.e. offering an application for free and letting consumer enhance it through in-app purchase).

On the contrary, Apple developers feel safer in offering paid applications. Some developers are inclined to take advantage of iAd (by Apple) and/or AdMob (by Google) advertisement platforms to generate more revenue. Since revenue making is related to the exhibition of ads, some developers tend to consider the integrating and using of the two platforms simultaneously to increase the chances of showing an ad in their application at all times. A developer explains how he has complemented the iAd advertisement with AdMob by using the mechanism of an error called "*didFailToReceiveAdWithError*" on iAd and replacing it with an advertisement from AdMob:

> *About two weeks ago I updated one of my apps to use AdMob mobile ads when iAd fails to deliver (pretty damn often). Instead of swapping out iAd for AdMob, I use the iAd "didFailToReceiveAdWithError" delegate method to request an AdMob ad when iAd fails.*

The developers' perceptions on the marketing and sales of applications can be analyzed considering the platform value-creation facilities, the dynamics of two-side markets, and the coevolution nature of an ecosystem.

Regarding the promotion of applications, developers consider to use the facilities that are provided by the platform, as well as other possibilities which evolve in time by other participants, such as review websites. Developers cooperate with each other and share promotional tips, yet compete with their peers to get to the top application lists provided by Apple and Google – a resemblance of coevolution (Moore, 1996, 83).

Regarding the pricing of applications, developers consider the dynamics of the competition on two-sided markets. The same-side as well as the cross-side network effects seem to play a big role in this context.

In the case of Android Market, the developers tend to consider consumers' behavior with regard to unwillingness to pay or consumers' unawareness of their mobile phone features (cross-side network effect). Consequently, they seem to put more focus on offering *free* applications, hence building the structure of the competition mainly on the basis of *free* applications (65 percent). Accordingly, due to the same-side network effect, developers tend to realize the need to define their revenue model on the basis of indirect revenue from advertisement.

In the case of App Store, the same dynamics take place with the difference that the market competition is more based on paid applications (60 percent).

Even though developers tend to believe that App Store is generating more revenue for them at present, they also consider the opportunity that the economy of scale in Android Market will provide for them in future. This can be related to the growth potential of the installed base of Android devices, as well as the openness of Android allows them to submit their applications on other Android based application stores, too. In fact, opposed to iOS which is a *standalone* platform, Android seems to have the potential to tip the market and become the market *standard* for mobile phone operating system in future, according to (Eisenmann et al., 2008). However, the powerful newcomers such as Microsoft might change the rules of the game.

The existence of AdMob advertisement platform on both App Store and Android Market indicates that the two case ecosystems are not fully separated despite being competitors, but there are intermediary platforms that can create value for both, and developers tend to use them to combine the advantages of both ecosystems. Such intermediaries fall in to Iyer et al.'s (2006) definitions of a *broker*.

Overall, the monetizing of applications causes the emergence of many participants in the ecosystem. There are independent small firms and individuals who are active in reviewing applications for developers as well as the manipulating businesses (see section 4.2.4). However, Apple and Google, as the keystones of the ecosystem set the rules against such behaviors and forbid the developers to collaborate with such businesses at the price of losing their membership.

6. MOBILE APPLICATION ECOSYSTEMS FROM THE LENS OF INTERNATIONAL BUSINESS

As mentioned in the introduction section, *app store* platforms enable the distribution of applications from any part of the world to another, as long as the shared technological platform among the consumers and developers exists. As such, the phenomenon of *app stores* is by nature a global business, which can be an interesting topic from international business perspective in several aspects, such as:

1) Individual developers and small firms can immediately reach the markets beyond their territorial borders. Therefore, the traditional approaches of internationalization (i.e. from domestic to international to global markets), as discussed in Uppsala stages model, are not necessarily followed. Instead, the nature of developers' operations may fall into the category of *born globals*.
2) Being a *born global* in the context of these virtual ecosystems can have its specific positive and negative attributes. For instance, due to the utilization of the virtual channel, the developers have possibly less resource-based challenges. However, the developer competes with many other peer developers in each and every market; therefore, finding a market niche can be a challenge.
3) The orchestration of such global ecosystems has its own specifications. The platform provider needs to manage its resources and application store all across the world, considering the differences between cultures, legislations, financial systems, etc.

As the research on mobile application ecosystems is during its infancy, the scope of this study was set to give a holistic view towards these ecosystems and their developers. The study served to bring this novel context of operations to the attention of scholars in the field of international business, and pave the way for future research on this phenomenon.

7. CONCLUSION

This study sheds light on the new structure of mobile application ecosystems. Combining the literature from three streams of business ecosystem, two-sided markets and mobile industry, the study provides an overview of the current composition of an application ecosystem, and defines its participants and their roles in the two largest ecosystems in the market, i.e. App Store and Android Market. Further, the study finds out developers' perceptions of the significant factors in the process of application development and distribution.

In its effort to understand the developers' perceptions, the study exploits an original method for data collection on the internet. The method suits the fast moving and global context of the study through enabling the collection of vast, in-depth, and immediate qualitative data from a large number of developers all across the world.

The findings are important mainly for three reasons: 1) the study is a pioneer in furthering the business ecosystem literature into the mobile application context, hence contributes to the literature on both business ecosystems and mobile industry; 2) the findings of developers' perceptions are empirically supported which not only fill the gap in the earlier research on application stores, but also are helpful for the active companies in the application store market; and 3) the original data collection method can open up a new horizon on internet-based data gathering for future research.

In the following, firstly, the main theoretical findings of the study are presented. Secondly, the managerial implications are suggested. Third, a reflection on the data collection method is outlined. Finally, the validity and reliability of the research as well as the limitations of the study are discussed.

7.1. Main Findings and Contributions

The main findings of the study are categorized into two sections according to the research questions.

7.1.1. Structure of Mobile Application Ecosystems

In regard to the research question on the structure of the mobile application ecosystem, the study utilizes an adaption of Moore's (1996, 27) model of business ecosystem participants in the context of mobile application ecosystems. It concludes that the current structure of mobile application ecosystems has made a significant impact on the traditional participants of the industry, and has resulted in the merging of some of the participants into the technological setting (platform) of the ecosystem. Specifically, the study finds out that the roles of an *application aggregator*, *mobile/web portal*, *operating system provider* and *platform provider* which traditionally used to exist in the mobile ecosystem *(*Barnes, 2002; Karvonen & Warsta, 2004; Buellingen & Woerter, 2004; Tarnacha & Maitland, 2006a; Basole, 2009; Nyika, 2010) are all cannibalized by the platform provider through the technical design of its provided application store. As such, the study confirms Basole's (2009) anticipation for the platform provider to hold a central role in the new structure of mobile ecosystems.

Further, the study notes the findings of Holzer & Ondrus (2010) on the platform provider's integration strategies, yet proposes a new integration strategy (*semi-integration)* which is not noted by Holzer & Ondrus (2010). The new strategy stands between the fully-integration and portal-integration strategies. Following this, the study disagrees with Holzer & Ondrus' (2010) opinion that Google has a portal-integration strategy. It claims that Google's strategy fits better into *semi-integration* due to the control that it applies on the mobile phones that enter its Android Market ecosystem.

The study underlines the importance of the roles of brokers (Iyer et al., 2006) and regulations in a mobile application ecosystem. The role of advertisement brokers is not a focal point in the existing literature. Yet this study shows that in the case of Android Market ecosystem, the advertisement platforms (by brokering among advertisement providers, developers, and consumers) play as the main revenue making enablers for the platform provider (Google), and a significant source of revenue for application developers. Furthermore, it shows that the activity zone of such advertisement brokers is not limited to one ecosystem; instead it can bridge between several ecosystems and create joint value for the participants of all.

Furthermore, the study highlights the role of regulations and legal authorities, which is currently in a shadow in the existing literature on the mobile ecosystems. By providing examples of the direct influence of regulations on the application stores' contents, the study shows how the regulations can affect a mobile application ecosystem.

Figure 14 shows an adaptation of Moore's (1996, 27) model to illustrate the structure of a mobile application ecosystem. The model shows three levels: core business, extended business, and business ecosystems. The participants are named based on their main roles. The arrows show the possibility of the movement of a participant to another level and/or role. The core business is based on the application store which is offered by the provider of the platform and operating system. There is a possibility that the device manufacturer moves towards the core business, and takes the role of the platform provider as well (as in the case of Apple). In regard to competing participants, there is a possibility that they move into the extended business area resulting in creation of joint value for both competing application stores. An example is the linkage of Apple and Google through the AdMob platform which enhances the creation of shared value for participants in both ecosystems. Compared to the original Moore's (1996, 27) model, the regulatory organizations are brought closer to the extended business level, due to their significant surveillance and impact on the application store contents. However, this does not convey a role less important than before for company shareholders, associations and labor unions.

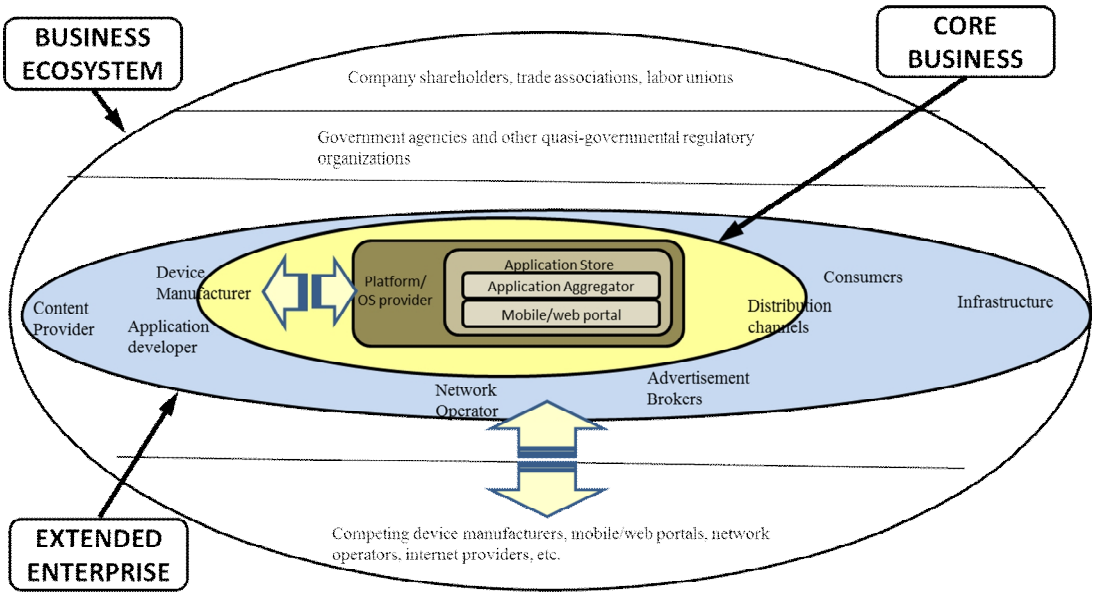

Figure 14. Proposed Model for Mobile Application Ecosystem – adapted from Moore (1996, 27)

The study contributes to the general literature on business ecosystems by reconsidering Moore's (1996, 83) opinion on the *coevolution* strategies during the life stages of a business ecosystem. As a critique on current literature, it claims that dissimilar to Moore's viewpoint, maintaining a high barrier to entry does not necessarily take place in the renewal stage of a mobile application ecosystem, but can possibly happen at earlier stages. The case of Apple shows that the high barrier to entry can be set even at the time of providing the new offer (application store) to developers and expansion as it assures the company of the need for the offer. Additionally, it fully agrees with Hearn & Pace's (2006) opinion that contrasting to Moore's (1996) view, the criticality of value creation is not limited to the *pioneering* stage of an ecosystem but throughout its entire life. The case of Google and how it managed to fast expand its ecosystem along with value enhancement is an example.

7.1.2. Important Factors Perceived by Developers

Regarding the research question on the factors that developers perceive as important, the study contributes to the literature on two-sided markets in the mobile industry, by providing an insight on the specific market of mobile applications. This contributes to the research area taken under consideration by several researchers such as Tuunainen et al. (2011), Holzer & Ondrus (2010), and Tilson et al. (2012) by providing empirically-based findings.

The study claims that basically for application developers, the cross-side network effect in an application store seems to be stronger than the same-side network effect. The proposition is on the ground that developers provide support for each other in development of applications and show tendency to have high quality applications in the market, in spite of the consequent increased competition. The empirical findings suggest that developers are voluntarily active in communities and forums to support each other in programming, promotion, and sales, despite their competition in the market. They care for the quality of the market and stress their desire for a value-adding control by the platform providers in order to avoid the abundance of low quality applications. This is fully in line with Moore's (1996, 11) *coevolution* concept in a business ecosystem where the simultaneous cooperation and competition of members occur.

The findings more specifically show the issues raised by application developers in their perceptions over the mobile application ecosystem: the level of ease in joining the ecosystem, comprehensibility of documentation and application development, ease of publishing applications, and the issues related to marketing and sales.

Developers tend to demand from the application store provider to set a reasonable barrier to entry to the ecosystem. In the case companies, the lower barrier to entry of Android Market compared to App Store is attractive for developers, yet increases their concern of the quality of applications in the market due to the negative influence it might have on the quality of the market. On the other hand, the high barrier to entry to App Store also provides them with concern on the level of investment that they need to do.

Developers tend to receive a documentation which is comprehensive and is designed for all levels from beginners to advanced. The overall comparison of the case ecosystems is complicated as they show strengths and weaknesses in different areas. Some developers tend to believe that Android documentation is very good; yet some others believe that iOS documentation is more comprehensive than Android's. In general, it seems that developers tend to be more satisfied with iOS' documentation than Android's, although they stress that there is room for improvement of iOS documentation in order to reduce its ambiguity in some parts particularly for beginners. It can be concluded that both companies need to work on improvement of their documentation in order to make it more suitable for the developers with diverse levels of skills. The criticality of this issue increases considering the global scale of operations of the case companies as does the significance of proper virtually available education for developers from all across the globe.

Further, developers have tendency towards having a flawless developing environment, where the tools for development and test of applications are provided to the level so that they do not need to waste time over non-value adding concerns. They seem to be more satisfied with the flawless development platform provided by Apple than the "test" development platform provided by Google. Meanwhile, they appreciate the automated memory management tool which is offered on the Android platform, and expect Apple to offer such a feature on iOS development platform. Furthermore, they tend to criticize Android's emulator due to its low speed in performance, and appreciate the fast speed of iOS' simulator.

In publishing the applications, developers tend to appreciate a review process which can provide a fast quality control on the applications. They seem to be very dissatisfied with Apple's review process due to its unclear and time-consuming notion, and appreciate the possibility that Android provide for them to publish immediately. Yet, developers request some level of quality control to reduce the number of low quality applications on the market. In this regard, they are optimistic towards the future quality of Android Market due to the introduction of *Bouncer*.

In promotion and sales of applications, the study shows that developers tend to use all the promotional channels within their limit of resources, while they care for the economy of scale. They have the tendency to be careful and/or hesitant in using the promotional channels which might cause a negative impact on consumers (such as *Air push* in Google). Additionally, as in any other case of competition, developers have an eye on the structure of competition in the market. The higher number of paid applications on App Store provides the possibility for developers to sell their paid applications easily on the market; while in the Android Market, the existence of many free applications forces the developers to seek other ways of revenue making than paid applications, mainly through advertisement. Meanwhile, developers have a positive perspective towards the economy of scale of Android Market due to the high variety of devices, despite the challenges that the fragmentation of devices causes for them. They tend to believe that Android Market will eventually take off in profitability due to its larger installed based.

7.2. Managerial Implications

This study provides several implications which can be useful for companies such as Microsoft and Nokia who are latecomers in the market. Currently, Apple and Google are performing quite successfully in the market; thus, the new entrant needs to compete with two powerful ecosystems. Considering the two-sided nature of the application store market, it is necessary to find a good balance between the quality of the mobile phones and the quality of the application stores, so that the market can enjoy a positive cross-side network effect.

Since this study has concentrated on the application developers' perceptions, in the following the issues that should be considered with regard to attracting the application developers are proposed.

Firstly, the provider of the application store should have a clear strategy for its business model and support it in orchestration of its ecosystem. This study shows that despite the quite similar structure of the application ecosystems, the business model of the

keystones (i.e. Apple and Google) can be quite different. In case of Apple, the company tends to earn the revenue mainly from selling applications on the market, and claiming 30 percent of the purchase price. On the other hand, Google seems to have set an indirect revenue making model. It does not take a share of the generated income from the application sale; instead, it focuses on the revenue earned from advertisement. Consequently, the more advertisers and applications are available on the market, the more benefit Google can get. This is absolutely in line with Google's strategies in posing less restriction to its ecosystem compared to Apple's. Considering developers' behaviors, it is obvious that they tend to match their business models with the companies' aims. In the case of Apple, developers have the tendency to offer paid applications, and in the case of Google, they tend to focus more on indirect revenue making. Concerning the latter, this is fitting to lowering the entry barrier that they face to the ecosystem; therefore, there is less sensitivity of immediate revenue making to meet the break-even. Matching of the business model with the orchestration strategies of the application store providers can help in gaining mutual benefit for developers..

Secondly, the study indicates that in the development of an application, the important issues for developers are the documentation, the Software Development Kit (SDK), the testing environment, and the resolution of fragmentation issues. It is crucial to provide the developers with the comprehensive documentations to help them in understanding the platform. In the SDK, the lack of bugs and flaws, and the availability of a memory management tool are raised to be significant in developers' perceptions. In addition, developers require a test environment which can simulate a real mobile phone environment for them, yet, enable the quick conduct of the test. The facility for testing the application as fast as possible, as well as the facility to see how the application would perform on an actual phone should be considered by the platform providers in their SDK. With regard to fragmentation of devices, developers' tend to believe that it would not be a big issue; however, the publicity against it is quite high in the media. Therefore, the platform provider needs to not only provide the necessary information in order to facilitate the testing of applications on different models, but also give public awareness on such efforts in order to neutralize the already existing or possible negative opinions.

Thirdly, considering developers' opinions, some level of control imposed by the platform provider is beneficial to improvement of the quality of applications in the market. The long review process of Apple does not seem to be favorable by developers, yet the existence of such a review process seems to both directly and indirectly benefit the quality of market. Developers are not willing to spend their time and energy to submit a low quality unfinished application to the review process so they work their best to have a faultless application before submission. However, the length of the review process and the unclear guidelines seem to frustrate the developers. Hence, in case of a review process, it is suggested that clear guidelines are provided for showing the grounds of the decision making for acceptance and rejection of applications. What seems to be most desired by developers is a review process which can keep the low quality malicious applications away from the market, yet does not reject the quality applications for unknown reasons.

Finally, the study shows that application developers consider the economy of scale as an important factor in their business. This might raise the question of whether it is better to be a *standalone* platform, or to be an open platform with opportunities for collaboration with other ecosystems and even competitors. This study suggests that although in the short run the stand alone platform might create more profit for developers, yet in the long run the platform with more collaboration can be more tempting for developers to join. An example for this is the case of Android. Although, according to developers, Android is not as profit making as Apple at the moment, but developers tend to believe that by being active in Android platform, they will have higher chances of making revenue in future due to the larger installed base.

7.3. Method Reflection

The original method of data collection in this study proves to suite the context of this study where the *units of observation* are active on the internet and are globally oriented. The method enables access to such units without any time, location and cost restrictions.

Using different sources of data on websites, blogs, forums, and communities, not only provides the researcher with the opportunity for longitudinal study, but also embraces constant triangulation, by allowing for persistent testing of the findings from one source with another. Unlike the traditional qualitative method of interview, in which the data can be gathered at one (or few) confrontation of the researcher with the interviewee, this method provides the possibility for getting immediate data at different points of time from several people and various sources. In fact, the researcher has a real-time understanding of many different opinions at almost zero-cost, as well as the flexibility to reduce any ambiguity via interacting with any of the data collection units, if necessary. In other words, the researcher can act both as an observer to see what has been and is going on, and an actor to start a discussion or to lead it to another direction, if necessary. The dynamics of discussing publicly in a forum increases the chance of other audiences' reaction which can result in a more in-depth knowledge. In this respect, the method used in this research contains aspects pertinent to resembling discourse analysis, concerning the "dialogue" between application developers.

The findings related to the choice of data gathering method show that the general questions are far less answered by developers than narrowed-down and particularly *triggering* questions. Developers tend to see the inquirer as their peer (i.e. a developer), so they have the tendency to provide practical hints related to the question, in order to help the developer to get on board, and even open up new alternative ways for the inquirer. It has been noticed that the tendency towards answering a question drops considerably when the developers know that the inquirer is not a peer but a researcher, unless there are some bonds involved (for instance a researcher from Aalto University asking a question in Aalto Android community).

Observations show that on average, the number of responses that a post can get in a forum is less than 10 while the number of visitors to a post is usually above 100 within the first week, which is the average time of expecting answers. Therefore, there is a need to use various sources of data (several forums, communities, blog post and their comments, news and their comments, etc.) in order to derive a conclusion.

7.4. Validity and Reliability

The validity of the study complies with the criteria proposed by Healy & Perry (2000, 122) for elements of the Realism paradigm. Table 7 shows the elements and the criteria for each, and the initiatives which are taken in this study to meet the criteria.

Table 7. Validity of the Research – adapted from Healy & Perry (2000, 122)

Element	Belief	Criteria	Applied
Ontology	Reality is imperfectly probabilistically apprehensible	1- Ontological appropriateness 2- Contingent validity	1- Selection of research problem including the "how" and "why" factor in nature 2- Emphasis on "why" through digging out the data and asking triggering questions
Epistemology	findings are probably true	3- Multiple perception of participants and peer researchers	3- Multiple sources of data gathering, multiple developers, finding supporting and rival arguments
Methodology	triangulation	4- Methodological trustworthiness 5- Analytical generalization 6- Construct validity	4- Creating case study database, description and documentation of the process 5- Review of earlier theory before the data collection and identification of the research issue 6- Use of prior theory and triangulation

For the matter of reliability, according to Yin (2009, 45), the documentation of all the procedures and creating a database is undertaken. The report, *per se*, describes all contents of the study and the research method and findings. In addition, a database of the gathered data is created. However, it should be noted that implementing the exact same situation of the scenario and data gathering might not be possible due to the fast and ever changing characteristics of the ecosystems. Further, the study gathers the opinion of different random developers who have expressed their opinions on the websites based on the current situation of the ecosystems. In future contacts, other developers might be involved with a different view; thus, the reliability cannot be fully reached.

7.5. Research Limitations

There are number of limitations in this study that should be considered.

Firstly, the collected data is limited to the data gathered from the developers who have found the urge to write their opinions in blogs, individual comments, forums, and Facebook pages. This might cause some bias in the results, as the developers who might have different opinions but are not participating in the discussions are excluded.

Secondly, as the data has been collected on different internet pages, there is a possibility that a developer has participated in different discussions under different screen names. However, attention is paid to the language of authors and their screen names to try to prevent the inclusion of the same developer's opinion more than once.

Thirdly, the author lacks an in-depth knowledge of the technical aspects of application development. This limitation might have had some effect on the deep understanding of the technical issues mentioned by developers. However, in case of there being any doubts in understanding, the author has approached the developers with further questions and/or has searched other sources for getting a sound understanding of the concept. However, the positive side of having a limited familiarity with technical issues has provided the author with an unbiased lens for analysis of data; meaning that she has no previous pre-assumptions (for instance, *like* for a programming language and *dislike* for the other) which can affect the analysis.

Fourthly, generalization of the findings can be problematic as the study has considered only two case ecosystems; the study is in a preliminary and exploratory phase with the aim to initiate further research on the topic.

7.6. Suggestions for Future Research

This study is in nature an exploratory type of research to understand the new structure of the mobile application ecosystems and to figure out the developers' perceptions on the factors that they consider important in a mobile application ecosystem. In future, the study can be extended by taking the research into a further depth to get a better

perspective on each of the important factors. Further, the perceptions of other participants of the market, such as consumers, mobile operators, and platform providers can be investigated.

This study considers the companies in their global context of operations. An interesting area to study is the issues related to this global context as discussed in Chapter 6. An example can be to focus on the developers who offer local or regional applications and/or those developers that belong to a specific country and/or region to understand their perceptions on different issues.

This study has focused on two largest players of the market as the case companies (App Store by Apple, and Android Market by Google). A topic for further research can be analyzing the ecosystems of other companies, such as Microsoft and Blackberry. Particularly, analyzing the case of Nokia Ovi Store can bring on a new perspective as Ovi Store could not sustain in the competition.

The process through which developers decide to work on a platform can be researched to understand how they reach to the stage of exploiting the opportunity that the ecosystems provide. The research can reveal the reasons behind the commitment of some developers to only one platform. Additionally within the same line of research, the existence of *influencers* (Hagel et al., 2008) and their motivations could be investigated.

Additionally, a further research can be conducted to understand the borders of the competition and cooperation of the developers in the application stores. The attitude of developers and the degree to which they act cooperatively and competitively in a complex environment of a two-sided market within an application ecosystem might open up new horizons for platform providers with regard to their business models.

8. REFERENCES

Ahonen Tomi, 2011. *Smartphone Penetration Rates by Country! We Have Good Data (finally)*. Communities dominates brands blog, [blog] Available at: http://communities-dominate.blogs.com/brands/2011/12/smartphone-penetration-rates-by-country-we-have-good-data-finally.html [Accessed 19 December 2011].

Apple, 2009a. *Apple's Revolutionary App Store Downloads Top One Billion in Just Nine Months,* [Online] Available at: http://www.apple.com/pr/library/2009/04/24Apples-Revolutionary-App-Store-Downloads-Top-One-Billion-in-Just-Nine-Months.html [Accessed 22 January 2012].

Apple, 2011a. *Apple's Mac App Store Downloads Top 100 Million,* [Online] Available at: http://www.apple.com/pr/library/2011/12/12Apples-Mac-App-Store-Downloads-Top-100-Million.html [Accessed 22 January 2012].

Apple, 2011b. *Form 10-K 2010-2011*, [Online] Available at: http://investor.apple.com/secfiling.cfm?filingID=1193125-11-282113&CIK=320193 [Accessed 9 January 2011].

Barnes, S.J., (2002). *The Mobile Commerce Value Chain: Analysis and Future Developments*. International Journal of Information Management, Volume 22, Issue 2, April 2002, Pages 91-108.

Basole, R.C., 2009. *Visualization of Interfirm Relations in a Converging Mobile Ecosystem*. Journal of Information Technology advance online publication, 24 February 2009.

Basole, R.C., and Rouse, W.B., 2008. *Complexity of Service Value Networks: Conceptualization and Empirical Investigation.* IBM Systems Journal, vol. 47, no. 1, pp. 53-70.

BBC News Technology, 2011. *Google Moves to Delete 'RuFraud' Scam Android Apps,* [Online] Available at: http://www.bbc.co.uk/news/technology-16177013 [Accessed 14 December 2011].

BBC News Technology, 2012. *Apple, Google Move to Tackle App Store Issues,* [Online] Available at: http://www.bbc.co.uk/news/technology-16944933 [Accessed 3 October 2011].

Bosch, J., 2009. *From Software Product Lines to Software Ecosystems*. 13th International Software Product Line Conference (SPLC 2009), August 24-28, 2009, San Francisco, CA.

Buellingen, F, and Woerter, M., 2004. *Development Perspectives, Firm Strategies and Applications in Mobile Commerce*, Journal of Business Research, Volume 57, Issue 12, December 2004, Pages 1402-1408

Cellular-News, 2010. *Sales of Smartphones to Total 2.5 Billion During 2010 to 2015* [Online] Available at: http://www.computerworld.com/s/article/9139301/Symbian_Android_will_be_top_smartphone_OSes_in_12_Gartner_reiterates [Accessed 11 October 2011].

Chu Eric, 2008. *Android Market: a User-Driven Content Distribution System. Android Developer Blog,* [blog] 28 August, Available at: http://android-developers.blogspot.com/2008/08/android-market-user-driven-content.html [Accessed 9 November 2011].

ComputerWorld, 2009. *Symbian, Android will be top smartphone OSes in '12*, Gartner reiterates, [Online] Available at: http://www.computerworld.com/s/article/9139301/Symbian_Android_will_be_top_smartphone_OSes_in_12_Gartner_reiterates [Accessed 3 February 2012].

Den Hartigh, E., and Tol, M., 2008. *Business Ecosystem.* In G. Putnik, & M. Cruz-Cunha (Eds.), Encyclopedia of Networked and Virtual Organizations (pp. 106-111). doi:10.4018/978-1-59904-885-7.ch014.

Distimo, 2009. *Independent App Store for Android – SlideME,* [Online] Available at: http://www.distimo.com/blog/2009_09_independent-app-store-for-android-slideme/ [Accessed 16 October 2011].

Distimo, 2011a. *App Stores,* [Online] Available at: http://www.distimo.com/appstores/ [Accessed 9 December 2011].

Distimo, 2012. *Google Android Market Tops 400,000 Applications,* [Online] Available at: http://www.distimo.com/blog/2012_01_google-android-market-tops-400000-applications/ [Accessed 3 January 2012].

Dubois, A., and Gadde, L.E., 2002. *Systematic Combining: an Abductive Approach to Case Research*, Journal of Business Research, Volume 55, Issue 7, July 2002, Pages 553-560

Eisenhardt, K., 1989. *Building Theories from Case Study Research*. Academy of Management Review 1989;14(4):532– 50.

Eisenmann, T., Parker, G., and Alstyne, M., 2006. *Strategies for Two-sided Markets*. Harvard Business Review, 84(10), 92-101.

Engadget, 2009. *Nokia Ovi Store Unveiled, Launches in May,* [Online] Available at: http://www.engadget.com/2009/02/16/nokia-ovi-store-unveiled-launches-in-may/ [Accessed 9 November 2011].

EWeek, 2010. *10 Reasons Why Apple's App Store Policies Make No Sense*, [Online] http://www.eweek.com/c/a/Application-Development/10-Reasons-Why-Apples-App-Store-Polices-Make-No-Sense-104681/ [Accessed 9 January 2011].

Fletcher, M., and Plakoyiannaki, E., 2011. *Case Selection in International Business: Key Issues and Common Misconceptions*. In: R. Piekkari, and C. Welch. (Eds). 2011. *Rethinking the Case Study in International Business and Management Research*, Cheltenham: Edward Elgar Publishing Limited. Ch.10.

Fox News, 2008. *I Am Rich' iPhone App Removed After 8 Bought It,* [Online] Available at: http://www.foxnews.com/story/0,2933,399461,00.html#ixzz1v7G13mDS [Accesses 18 November 2011].

Gartner, 2011a. *Gartner Says Worldwide Mobile Device Sales to End Users Reached 1.6 Billion Units in 2010; Smartphone Sales Grew 72 Percent in 2010,* [Online] Available at: http://www.gartner.com/it/page.jsp?id=1543014 [Accessed 3 February 2012].

Gartner, 2011b. *Gartner Says Sales of Mobile Devices Grew 5.6 Percent in Third Quarter of 2011. Smartphone Sales Increased 42 Percent,* [Online] Available at: http://www.gartner.com/it/page.jsp?id=1848514 [Accessed 9 October 2011].

Guba, E.G., Lincoln, Y.S., 1994. *Competing Pradigms in Qualitative Research*. In N. K. Denzin, and Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105-117). Thousand Oaks, CA: Sage.

Hagel III, J, Brown, J, and Davison, L, 2008. *Shaping Strategy in a World of Constant Disruption*, Harvard Business Review, 86, 10, pp. 80-89.

Healy, M., and Perry, C. 2000. *Comprehensive Criteria to Judge Validity and Reliability of Qualitative Research within the Realism Paradigm*, Qualitative Market Research: An International Journal, vol. 3, no. 3, pp. 118-126.

Hearn, G., and Pace, C., 2006. *Value-creating Ecologies: Understanding Next Generation Business Systems*, foresight, Vol. 8 Iss: 1, pp.55 – 65.

Hearn, G., Roodhouse, S., and Blakey, J., 2006. *From Value Chain to Value Creation Ecology.* International Journal of Cultural Policy Volume 13, Issue 4, 2007.

Holzer, A., and Ondrus, J., 2011. *Mobile Application Market: A Developer's Perspective.* Telematics and informatics, vol. 28, no. 1, pp. 22-31, Febr. 2011.

Huffingtonpost, 2011. *Fake ID App Removed From App Store After Senator Complains,* [Online] Available at: http://www.huffingtonpost.com/2011/12/15/fake-id-iphone-app-remove_n_1151047.html [Accessed 16 December 2011].

Iansity, M., and Levien, R., 2004. *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability.* Harvard Business Review Press (August 1, 2004).

IGadgetsReport, 2011. *VUDU Says No to Apple's In-App Subscription Rule, Releases iPad Optimized Web App,* [Online] Available at: http://igadgetsreport.com/2011/08/10/vudu-says-no-to-apples-in-app-subscription-rules-releases-ipad-optimized-web-app/ [Accessed 11 August 2011].

International Telecommunication Union, 2011a. *Mobile Applications Downloads Approached Eight Billion in 2010,* [Online] Available at: http://www.itu.int/ITU-

D/ict/newslog/Mobile+Applications+Downloads+Approached+Eight+Billion+In+2010.aspx [Accessed 15 December 2011].

International Telecommunication Union, 2011b. *Mobile App Downloads to Approach 48 Billion in 2015,* [Online] Available at: http://www.itu.int/ITU-D/ict/newslog/Mobile+App+Downloads+To+Approach+48+Billion+In+2015.aspx [Accessed 10 July 2011].

International Telecommunication Union, 2011c. *Mobile cellular subscriptions*, [Online] Available at: http://www.itu.int/ITU-D/ict/statistics/ [Accessed 3 February 2012].

IPhonehacks, 2008. *NullRiver's iPhone App is Available in App Store again and It's Gone Again,* [Online] Available at: http://www.iphonehacks.com/2008/08/netshare-back.html [Accessed 3 January 2009].

Iyer, B., Lee, C., and Venkatraman, N.N., 2006. *Managing in a "Small World Ecosystem": LESSONS FROM THE SOFTWARE SECTOR*. California Management Review, 48(3), 28-47.

Jansen, S., Brinkkemper, S. and Finkelstein, A., 2009b. *Business Network Management as a Survival Strategy: A Tale of Two Software Ecosystems.* In Proceedings of the First Workshop on Software Ecosystems (pp. 34-48), CEUR-WS.

Jansen, S., Finkelstein, A., and Brinkkemper, S., 2009a. *A sense of community: A research agenda for software ecosystems.* Software Engineering - Companion Volume, 2009. ICSE-Companion 2009. 31st International Conference on , vol., no., pp.187-190, 16-24 May 2009.

Karvonen, J., and Warsta, J., 2004. *Mobile Multimedia Services Development: Value Chain Perspective*, published in Proceedings of the 3rd international conference on Mobile and ubiquitous multimedia.

Le Bodic, G., and Lennartz, C., 2009. *Mobile services with applications,* Intelligence in Next Generation Networks, 2009. ICIN 2009. 13th International Conference on , vol., no., pp.1-4, 26-29 Oct. 2009.

Li, F., and Walley, J., 2002. *Deconstruction of the telecommunications industry: From value Chains to value networks*. Telecommunications Policy, 26, 451–72.

Lohman, F.V., 2010. *UPDATED: All Your Apps Are Belong to Apple: The iPhone Developer Program License Agreement* [blog] 9 March, Available at: https://www.eff.org/deeplinks/2010/03/iphone-developer-program-license-agreement-all [Accessed 10 December 2011].

Lookout Mobile Security, 2011. *Update: Security Alert: DroidDreamLight, New Malware from the Developers of DroidDream,* [Online] Available at: http://blog.mylookout.com/blog/2011/05/30/security-alert-droiddreamlight-new-malware-from-the-developers-of-droiddream/ [Accessed 2 September 2011].

Los Angeles Times, 2008. *Apple removes $1,000 featureless iPhone application,* [Online] Available at: http://latimesblogs.latimes.com/technology/2008/08/iphone-i-am-ric.html [Accessed 8 January 2011].

MacRumors, 2008. *Apple Sets App Store Launch Deadline for Developers,* [Online] Available at: http://www.macrumors.com/2008/07/02/apple-sets-app-store-launch-deadline-for-developers/ [Accessed 20 January 2012].

MacRumors, 2012. *Apple Warns Developers Not to Manipulate App Store Rankings*, [Online] Available at: http://www.macrumors.com/2012/02/06/apple-warns-developers-not-to-manipulate-app-store-rankings/ [Accessed 7 February 2012].

Marshall, A., 1920. *Principles of Economics. An introductory Volume. 8th edition. London: Macmillan,* [online] Available at: http://www.econlib.org/library/Marshall/marP11.html#III.III.2 [Accessed 7 May 2012].

Mashable Tech, 2009. *BlackBerry App World Now Live,* [Online] Available at: http://mashable.com/2009/04/01/blackberry-app-world/ [Accessed 9 November 2011].

Millward Brown Optimor, 2012. *BrandZ Top 100 Most Valuable Global Brands 2011,* [Online] Available at: http://www.millwardbrown.com/Libraries/Optimor_BrandZ_Files/2011_BrandZ_Top100_Chart.sflb.ashx [Accessed 3 January 2012].

Moore, J.F., 1993. *Predators and Prey: A New Ecology of Competition*, Harvard business review [0017-8012], vol.: 71, 75-83.

Moore, J.F., 1996. *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems*, West Sussex. Harper Collins, 1996.

Moore, J.F., 1998. *The Rise of a New Corporate Form*. Washington Quarterly. Vol. 21(1), pp. 167-181.

Moore, J.F., 2006. *Business Ecosystems and the View from the Firm*. The Antitrust Bulletin 52, 31–75

Nyika, J., 2010. *The Mobile Applications Ecosystem: A Primer*. White paper. Triton Federal Solutions, [Online] Available at: http://www.ppc.com/Documents/Mobile%20Applications%20Ecosystem_White%20Paper_09-2010.pdf [Accessed 14 June 2010].

Patton, M.Q, 1990. *Qualitative Evaluation and Research Methods*. 2nd ed. London. Sage Publications.

PCWorld, 2011a. *Financial Times Ousted from Apple's App Store,* [Online] Available at: http://www.pcworld.com/article/239231/financial_times_ousted_from_apples_app_store.html [Accessed 31 August 2011].

PCWorld, 2011b. *Apple Backs Off In-App Subscription Demands, Says No to 'Buy' Links,* [Online] Available at: http://www.pcworld.com/article/229880/apple_backs_off_inapp_subscription_demands_says_no_to_buy_links.html [Accessed 10 January 2011].

Peltoniemi, M., 2004. *Cluster, Value Network and Business Ecosystem: Knowledge and Innovation Approach.* Presented at the Conference "Organisations, Innovation and Complexity: New Perspectives on the Knowledge Economy", University of Manchester, 9-10th September 2004. NEXSUS, The Complexity Society and CRIC Centre for Research on Innovation and Competition, [Online] Available at: http://www.tut.fi/units/tuta/tita/tip/Peltoniemi_Manchester2004.pdf [Accessed 10 October, 2011].

Peppard, J., Rylander, A., 2006. *From Value Chain to Value Network: Insights for Mobile Operators*, European Management Journal, Vol. 24, Issues 2-3, April-June 2006, pp. 128-141.

Power, T., Jerjian, G., 2001. *Ecosystem: Living the 12 Principles of Networked Business*. Pearson Education Ltd.

Read Write Mobile, 2011. *App Development Services Market to Reach $100 Billion by 2015,* [Online] Available at: http://www.readwriteweb.com/mobile/2011/07/app-development-services-market-to-reach-100-billion-by-2015.php [Accessed 3 October 2011].

Rochet, J.C., and Tirole, J. 2006. *Two-sided Markets: a Progress report*. The RAND Journal of Economics, 37: 645–667.

Rogers, E. M., 1962. *Diffusion of Innovations*. New York: Free Press.

Scoop, 2008. *New App Store Available in 62 Countries,* [Online] Available at: http://www.scoop.co.nz/stories/BU0806/S00164.htm [Accessed 20 January 2012].

Shapiro, C., Varian, H.R., 1999. *Information Rules: a Strategic Guide to the Network Economy*, Harvard Business Press.

Speriensma, G. J., 2011. *The 2011 Top 100 Global Brands and Their App Store Status* [blog] 28 August, Available at: http://www.distimo.com/blog/2011_10_the-2011-top-100-global-brands-and-their-app-store-status/ [Accessed 10 November 2011].

Stake, R.E. 1995. *The Art of Case Study Research*. Thousand Oaks, CA: Sage Publications.

Strauss. A., Corbin. J., 1990. *Basics of Qualitative Research, Grounded Theory Procedures and Techniques.* Newbury Park: Sage Publication.

Tapbots, 2009. *A Well-Timed Letter of Rejection* [Online] Availabe at: http://tapbots.com/blog/app-store/a-well-timed-letter-of-rejection [Accessed 7 February 2012].

Tarnacha, A., Maitland, C., 2006a. *Standards Competition and the Role of Intermediation in the Supply of Mobile Applications.* Presented in 34th Annual Research Conference on Communication, Information and Internet Policy (TPRC).

Techcrunch, 2012. *Amazon's Appstore For Android Turns One: 31K Apps, Millions Sold* [Online] Available at: http://techcrunch.com/2012/03/15/amazons-appstore-for-android-turns-one-31k-apps-millions-sold/ [Accessed 16 March 2012].

The Telegraph, 2011. *Microsoft Windows app store announced* [Online] Available at: http://www.telegraph.co.uk/technology/microsoft/8940845/Microsoft-Windows-app-store-announced.html [Accessed 15 December 2011].

The Wall Street Journal, 2010. *Apple's Review Guidelines: 'We Don't Need Any More Fart Apps'* [Online] Available at: http://blogs.wsj.com/digits/2010/09/09/apples-review-guidelines-we-dont-need-any-more-fart-apps/ [Accessed 14 April 2011].

The Wall Street Journal, 2011. *A Rare Apple Compromise.* [Online] Available at: http://online.wsj.com/article/SB10001424052970204336104577094872512502942.html [Accessed 2 February 2012].

Tilson, D., Sørensen, C. and Lyytinen, K., 2012. *Change and Control Paradoxes in Mobile Infrastructure Innovation - The Android and iOS Mobile Operating Systems Cases* HICSS2012, Maui, HI, USA, Jan 4-7, 2012.

Tuunainen, V.K.; Tuunanen, T., and Piispanen, J., 2011. *Mobile Service Platforms: Comparing Nokia OVI and Apple App Store with the IISIn Model*," Mobile Business (ICMB), 2011 Tenth International Conference on Mobile Business , vol., no., pp.74-83, 20-21 June 2011 doi: 10.1109/ICMB.2011.42.

Wired, 2011. *Google Answers Apple With A More Open Subscription System,* [Online] Available at: http://www.wired.com/epicenter/2011/02/google-one-pass/ [Accessed March 17 2011].

Wireless Intelligence, 2011. *Smartphone Users Spend More Face-time on Apps vs Voice Calls Web-browsing,* [Online] Available at: https://www.wirelessintelligence.com/analysis/2011/03/smartphone-users-spend-more-face-time-on-apps-vs-voice-calls-web-browsing/ [Accessed 5 March 2011].

Yin, R., 1999. *Case study research. Design and methods*. 4th edition. Thousand Oaks: Sage Publications.

ZDNet, 2010. *Apple's New Review Guidelines: Thoughts on Fart Apps*, [Online] Available at: http://www.zdnet.com/blog/bott/apples-new-review-guidelines-thoughts-on-fart-apps/2410 [Accessed 5 March 2011].

ZDNet, 2012. *Microsoft reveals more Windows 8 app store details* [Online] Available at: http://www.zdnet.com/blog/microsoft/microsoft-reveals-more-windows-8-app-store-details/11711 [Accessed 21 January 2012].

Zhu, F, and Iansiti, M., 2012. *Entry into platform-based markets*, Strategic Management Journal, 33, 1, pp. 88-106