EXPLORING THE SUCCESS FACTORS OF MOBILE BUSINESS ECOSYSTEMS

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Abstract: Mobile business ecosystems are based on product innovations and complements created on platforms facilitating transactions between groups of users in a multi-sided market. The purpose of this research is to present a model of success factors of mobile ecosystems. This research establishes an empirical framework based on the Android ecosystem, which has been analyzed in-depth on firm and ecosystem level, identifying 16 success factors. The model advances research in innovation platforms, through an in-depth analysis at firm and ecosystem levels. The main theoretical contribution is a model that identifies success factors of platforms, which are related to the identification of the role of users and complementors in increasing innovation success.

Keywords: Innovation platforms; business ecosystems; success factors; two-sided market; Android.

1. Introduction

The deterioration of Nokia's market share in smartphones following its renewed strategy in 2011 illustrates a rare event in business history: an industry leader collapses in terms of market share and profitability in just a few years (Canalys, 2014). Almost simultaneously, however, two new entrants to the smartphone market, Google Android and Apple, have asserted their dominance. Explaining this dramatic change in the market structure has to do with business ecosystems as explored by Iansiti and Levien (2004). Nokia had attempted to create an ecosystem around its devices and services but had failed. More specifically, we argue that certain key characteristics or *success factors* of the competing business ecosystems, possessed by Google and Apple led to a chain of events that changed the smartphone industry landscape for good, and that the explicit identification of these success factors deserves special attention. Ecosystems have been suggested as a major source of or contributor to the competitive advantage of firms by (e.g. Williamson and De Meyer, 2012).

Business ecosystems have come to play a central role in the dynamics of competition in the smartphone industry, and thus we consider it essential to understand the success factors behind them. However, these ecosystems are not immune to changes in the industry landscape, whether technology or business related, and their entrenched positions may be challenged at some point in the future, driven by emergent or changing success factors.

Ecosystems are related to the *platform* construct, as they are often formed around *industry platforms*, discussed notably by Gawer and Cusumano (2008) who identified four *levers of platform leadership* as well as generic strategies for becoming a platform leader, taking the perspective of innovation management and product strategy. An alternative platform construct originating from industrial economics, the two-sided (or multi-sided) market (e.g. Rochet and Tirole, 2003) draws heavily from the theory of network effects (e.g. Katz and Shapiro, 1994) and focuses on competitive dynamics and pricing. Although long discussed in separate streams in management research, recently at least Gawer (2014) and Thomas et al. (2014) have adopted integrative views, bridging the concepts and various streams of research. Also Cusumano (2010) has acknowledged the similarities between industry platforms and ecosystems, and Thomas et al. (2014) actually refer to industry platforms as *platform ecosystems*, a notion shared by Gawer (2014).

From this perspective, the main research gap is to bring in the discussion of success factors of innovation platforms, in particular extending the research of Gawer and Cusumano (2014). Furthermore, we argue the key shortcoming of many ecosystem-related papers and particularly case studies in smartphone business is their narrow focus, often limited to a specific aspect such as an application store, lacking a holistic view that would combine analysis of ecosystems, platforms, and multi-sided markets in a seamless manner. In particular, some studies are focusing on design aspects and users acceptance of technology (e.g. Bouwman et al. 2014), as well as the creation of mobile ecosystems that enable users to control their experiences during the use of technology (e.g. Remneland-Wikhamn et al. 2011) that are both related to the analysis of the Android ecosystem. Moreover, this research also aims at extending the work of Davis (2016) by analysing the business dynamics inside the Android ecosystem.

This paper takes a normative approach designing and presenting an analysis framework with the purpose of explicitly identifying success factors of mobile business ecosystems based on both firm-level and ecosystem-level analysis, bringing together the various theoretical constructs in ecosystem and platform research. This conceptual model is our main contribution to the field of innovation and technology management. Thus, the research question is: *What are the success factors of mobile business ecosystems, particularly in terms of engaging users and complementors?*

The paper is structured as follows: in the next section, we review research related to key theoretical constructs as they relate to success factors of ecosystems, then in the third section, we present our research design that is subsequently applied to a case study in the fourth section. This is followed by discussion of the results and the presentation of the model before conclusions and implications.

2. Theoretical Background

Management scholars have studied the origins of competitive advantage of companies, in order to explain business performance (Rumelt et al., 1991). Dyer and Singh (1998) argue that competitive advantage can stem from *idiosyncratic interfirm linkages*, forming a *relational view*. Thus, four sources are defined: (i) *investments in relation-specific assets*, (ii) *substantial knowledge exchange*, (iii) *complementary resources/capabilities enabling the joint creation of new products, services, or technologies*, and (iv)

effective governance mechanisms resulting in lower transaction costs. Although not explicitly mentioning ecosystems, the above findings are noticeably similar to those of, e.g., Williamson and De Meyer (2012) who identify the 'six keys to ecosystem advantage' as follows: *structuring differentiated partner roles*, *enabling flexibility and co-learning*, *stimulating complementary partner investments*, *reducing transaction costs*, *pinpointing the added value*, and *engineering value capture mechanisms*. Based on the above, success factors of ecosystems could well originate from *relationships between firms*.

The ecological analogy of *business ecosystem* has been analyzed from several different perspectives in innovation and management research, often describing the advances in information and communications technology (ICT). It has been mainly used to explain the competition and collaboration among organizations. From this point of view, the research is focused on exploring the perspective of creating value, in particular oriented to the creation of mobile business ecosystems. Furthermore, success factors could stem from health measures of business ecosystems, as defined by Iansiti and Levien (2004) and quantitatively by Den Hartigh et al. (2006). Additionally, Bosch (2009) outlines success factors for OS-centric software ecosystems. A key point is to understand that in innovation ecosystems innovation is performed through multi-partner innovation efforts, but such boundary conditions are understudied (Davis, 2016; 33).

The general literature on platforms can be seen as being divided into four distinct streams: *organizational platforms* (with dynamic capabilities as the key construct), *product family platforms*, *market intermediary platforms* (serving two or multi-sided markets), and *platform ecosystems*, as discussed by Thomas et al. (2014). This is compatible with and builds upon the typology of platforms by Gawer (2009), comprising *internal platforms*, *supply chain platforms*, *double-sided (or multi-sided) markets*, and *industry platforms*. In our study of ecosystem success factors, particularly the last two streams are of relevance.

The market intermediary stream of literature is dominated by research on *two-sided markets*, with Parker and Van Alstyne (2005), Rochet and Tirole (2003), and Eisenmann et al. (2006). Furthermore, the issue of pricing (e.g., Hagiu (2006, 2009b)) is an enduring topic of interest in this body of research, while another important topic is the subsidization of the two-sided markets whose transactions are facilitated by a platform, also considering the competitive dynamics between several platform providers serving two-sided markets. The main scholars in the latter field are Armstrong (2006), Armstrong and Wright (2007), and Hagiu and

Spulber (2013). Moreover, Hagiu (2009a) and Rysman (2009) discuss that *multi-sided platforms* could be considered as a generalization of two-sided markets. Although case studies are common within this stream of literature, often using credit cards, computer operating systems, or business directories as examples (e.g., Rysman, 2004).

Platform ecosystems, as argued by Thomas et al. (2014), roughly equate to industry platforms as discussed by Gawer and Cusumano (2008, 2014), being viewed as a hub or a central point of control in technology-based business ecosystems. The first-mentioned authors note that from a theoretical perspective, the platform ecosystem literature has drawn influences initially from the product family stream but later also from the market intermediary stream. Contextually, the literature has focused on the information technology and Internet sectors, with extensive case studies on, e.g., Intel (Gawer and Henderson, 2007).

Thomas et al. (2014) elaborate on a model of *architectural leverage*, combining three distinct logics of leverage, namely *production*, *innovation*, and *transaction logic*, with *architectural openness* based on the degree of disaggregation of the industry value chain, also identifying situated types of platform variants within the model. The authors further argue that market intermediary platforms and platform ecosystems typically exhibit so-called *many-to-many architectures* where both supply and demand sides are open to participants. This seems compatible with Eisenmann's (2008) dimensions of platform openness, although he defines openness also in terms of two additional roles, the platform provider and sponsor.

Furthermore, Muegge (2013) makes an attempt to discuss the theories of industrial platforms and business ecosystems together, arguing that in a complex hierarchical system, they represent different but complementary layers of analysis. Only few researchers have explored this perspective for business ecosystem analysis. Moreover, Gawer (2014) notes the similarities between roles such as *platform leader* and *keystone firm* in orchestrating a network of firms, constituting either an industrial platform or a platform-based business ecosystem which are largely the same thing as she elaborates through her integrative conceptual framework of technological platforms, forming a continuum spanning *internal platforms*, *supply-chain platforms*, and *industry platforms*, corresponding to the organizational forms of firm, supply chain, and ecosystem, each with distinct implications to openness of interfaces, accessible capabilities, and governance. In her view, a two-sided market is a special case of an industry platform, one where the relationships between

the participants are purely transactional. Moreover, each of these forms also represents a distinct level of analysis.

Thomas et al. (2014) also recognize different levels of analysis but do not explore the theory of platform concepts beyond the level of the firm. They do allude to, e.g., industry and ecosystem-level analysis and advocate further research from different analytical perspectives. Thus, it would appear that in management research, there is interest in multi-level analytical frameworks and more holistic exploration of the theory behind platforms and ecosystems. Furthermore, although Gawer's (2014) proposal may well be the most advanced integrative framework of platform concepts to date, she does not discuss the success factors of platforms or ecosystems, nor the interaction of decisions related to different parts of the framework, such as platform scope (including possible envelopment) and openness. Also, as she acknowledges herself, the framework requires systematic empirical validation.

Some scholars have explored the level of analysis of software ecosystems and developer marketplaces with particular focus on those of Apple, Google, BlackBerry, and Microsoft (e.g. Campbell and Ahmed (2011), Idu et al. (2011), Tuunainen et al. (2011), and Hyrynsalmi et al. (2012)). In particular, the main contributions of these scholars have been in the area of application marketplaces and developer programs without a holistic understanding of the platforms and methods for capturing value inside the respective ecosystems of organizations.

Thomas and Autio (2012, 2014) argue, however, that although the theoretical underpinnings of business ecosystems have provided a 'fertile soil' for ecosystem thinking to evolve, they have not yet been united into a coherent theoretical framework. To address this shortcoming, they define a business ecosystem as a '*network of interconnected organizations, organized around a focal firm or a platform and incorporating both production and use side participants*', having three common characteristics: a network of participants, a governance system, and a shared logic. Furthermore, Battisti (2012) suggests the network of participants in business ecosystems enabled by technology can be considered closely related to the concept of living labs. In this way, this research takes into consideration the social aspects of user engagement in business ecosystems, considering the work of Battisti (2014) that states '*social innovation in living labs is an organizational form, which is managed by public-private partnership; it is aimed at fostering continuous interaction with citizens*

through the shaping of technology, in order to enable the citizens to use services that satisfy with their specific needs', which is supported by the research of Remneland-Wikhamn et al. (2011) related to the concept of enabling user experience and continuous engagement in the Android ecosystem, as well as supported by Magnusson et al. (2016) by exploring the user community innovation of the Android ecosystem in Europe that includes 47.000 users supporting the ecosystem development.

3. Research Design

The research methodology of this study is a case study, following an in-depth empirical inquiry of a contemporary phenomenon as proposed by Yin (2013). We focused on analysing a specific case in depth, aiming to identify relevant success factors of the case and not to generalize the findings of the case. Our study is primarily based on a literature review of both academic (i.e. using the Scopus database and Google Scholar) and non-academic literature, following the secondary data analysis method proposed by Heaton (2008). Because the subject matter of the study is very topical, receiving up-to-date information required the extensive utilization of non-academic literature such as magazine articles and web pages related to the Android ecosystem, the collection of which was based on on-line sources published between June 2005 and December 2015.

The justification for selecting this particular mobile business ecosystem for our case study is that in just six years, it has been able to capture an unparalleled 80% share of the global smartphone market (Canalys, 2014). While success could be defined in a number of ways, we considered success factors that enable innovations to be diffused throughout the markets (e.g. Rogers, 2003).

We have created an analysis framework for the empirical part of this study. As recommended by Davis (2016) this paper moves beyond the dyad and instead studies complex boundary conditions. The main goal of our framework is to explore both *firm-level* (including internal and supply-chain platforms) and *ecosystem*-level (including industry platforms) success factors of mobile business ecosystems as discussed in the previous section. When discussing platforms, we do not make a clear division between supply-chain platforms and industry platforms, as certain degree of architectural openness exist in both cases.

3.1. Firm-level framework

Firm-level forms the first and most granular part of our analysis framework, since we look at the value creation and extraction of the platform leader or ecosystem orchestrator, being the central firm of its ecosystem, followed by a discussion of the firm's platform approach and governance. It is related to the breadth of business activities of companies, such as the product offering, development and commercialization, as well as the services delivered to specific customers, and the place where the business activity is carried out.

Various monetization models may be mixed and utilized by firms sometimes simultaneously. In spite of this, our study considers the question of monetization reflecting on existing capabilities and assets, also considering historical developments. The theory of path dependence (David, 1985; Arthur, 1989) supports our idea that the historical legacy of a firm mainly in terms of its previous business and related activities, capabilities, and assets has had an impact on more recent strategic decisions and choices the firm has made with regard to ecosystems and platforms.

The four levers of platform leadership (Gawer and Cusumano, 2008) and the descriptions of the roles of platform leaders and complementors form the basis for the study of the case company's platforms. We separate the analysis of how much the firm innovates and produces complements in-house from how the firm manages and incentives its external complementors. The latter point is also relevant in the analysis of ecosystems, where software ecosystems and particularly application marketplaces are examined. We also consider the strategic approaches taken by firms to become platform leaders, such as 'coring', 'tipping' (Gawer and Cusumano, 2008), expanding the scope of one's platform by incorporating some of the functionality of the platforms being used in an adjacent market.

The control paradigm of a platform may be either *proprietary* or *shared*, and this has profound implications especially on value capture and the management of complementary innovation. Eisenmann (2008) argues that both paradigms can be successful and examines factors that are favourable to each when designing new platforms. Shared platforms are prone to free rider problems that make it challenging to

protect returns from infrastructure investments or to offer user subsidies. In contrast, proprietary platforms do not have such problems.

Regarding the effects of the number of complementors on the intensity of competition, Boudreau (2008) argues that having too many complementors can reduce a platform's ability to generate new innovation and profits for firms making complements on it, mainly due to crowding-out effects and substitution instead of market expansion. These effects would both affect the attractiveness of the platform negatively from end-user and complement producer perspective.

Differentiation through either vertical integration or exclusivity is often sought by platform providers to make themselves stand out from their rivals. Lee (2013), who has studied this phenomenon and its implications, contends that exclusive software is a key leverage for platform entrants, allowing them to differentiate and gain market traction more effectively. In terms of the overall market, however, exclusivity actually decreases the total market revenue as well as consumer welfare.

This research focuses mostly on technical and organizational concepts, comprising mainly analysis on firm level. While network effects and multi-sided markets do play a fundamental role also in platform theory, we discuss the related analysis dimensions under *ecosystem-level analysis*.

3.2. *Ecosystem-level framework*

Iansiti and Levien (2004) have studied the characteristics of business ecosystems such as their structure and health, combining in-depth research with a broader understanding of networks drawn from various academic fields. The three critical measures defined by them, *productivity*, *robustness*, and *niche creation*, are also applied in our analysis framework. Alternative health metrics are suggested by Den Hartigh et al. (2006), divided into partner health and network health metrics. These metrics, as they argue, are better suited for measuring the health of business ecosystems on the company level and of more practical value to managers.

In any given ecosystem, Iansiti and Levien (2004) proposed that firms could occupy the following actor roles: keystone, physical dominator, and niche player. The additional role of a value dominator is also

described, but it is suggested that such actors are detrimental to an ecosystem's health, leading to starvation and ultimately even the destruction of the ecosystem.

In our framework, the *software ecosystems* considered are OS-centric in the sense that the OS and its interfaces play a key role in defining what really constitutes the software ecosystem. They also set the technical boundaries for what kinds of complements can be produced on a particular platform. We use the following success factors identified by Bosch (2009) specifically for OS-centric ecosystems for the evaluation of the case company's software ecosystems: (i) *minimal effort required by developers to build applications on top of the OS, thereby enabling both breadth and quality of the application offering*, (ii) *generic, evolving functionality and set of features provided by the OS that maintains attractiveness for developers*, and (iii) *the number of customers that use the OS and that are accessible to developers for monetization*.

Being a key component of a mobile software ecosystem, a mobile *application marketplace* is also a well-known example of a two-sided market, and thus relevant characteristics of two-sided markets are used in the case study to analyze them. Joining multiple platforms to make one's products available on more than one market, i.e., multi-homing, is a key phenomenon in mobile application stores as discussed by Hyrynsalmi et al. (2012).

The *openness* of a platform ecosystem is defined by Eisenmann et al. (2008) along four distinct dimensions, each of which corresponds to a certain role in a platform-mediated network: demand-side platform users, supply-side platform users, platform providers who operate the platform and interface directly with the customer, and platform sponsors who own the platform and decide who gets to participate. Many kinds of platforms can be analyzed using this set of dimensions of openness, not tied to a particular industry. However, specific to mobile application stores, Müller et al. (2011) identify a total of 12 distinct value network roles, namely *end user*, *network operator*, *payment broker*, *advertisement broker*, *marketplace*, *operating system developer*, *testing and verification party*, *signing partner*, *software developer*, *content provider*, *software distributor*, and *device manufacturer*. Our analysis framework applies this extended list to evaluate the openness of the platforms and ecosystems.

3.3. Framework dimensions

Following the criteria and discussion above, we have synthesized a set of metrics representing the various dimensions of analysis that we utilize in this research, as presented in Table 1.

Table 1. Framework Dimensions

Levels	Dimensions	Metrics
Firm	Firm Scope and Value Creation	Understanding the sources of revenue
		Design the monetization models
	Platform Approach and Governance (Applied for each software platform)	Product technology, architecture, and openness
		In-house vs. external focus in complements
		Managing and incentivizing complementors
		Internal organization and propensity to advance the overall good of the ecosystem
		Control paradigm / openness
		Vertical integration and exclusivity
Ecosystem	Ecosystem Approach and Governance	Role of the firm in the ecosystem
		Ecosystem health metrics (e.g., productivity, robustness, niche creation)
	Software Ecosystem and Application Marketplace	Occurrence of success factors for OS-centric software ecosystems
		Openness along various roles in the value network: end users, developers, platform providers, platform sponsors
		Occurrence of multi-homing

4.   Data Analysis and Propositions

This section serves the purpose of analysing the success factors of the Google Android ecosystem. We use a step-by-step approach where we first make an analysis on the firm level, followed by an analysis on the ecosystem level.

4.1. Firm-level analysis

Google's advertising business model is by and large built on two programs: AdWords and AdSense. However, Google also provides services such as display advertising, Google Apps and Google Drive. Some of these services are subscription based and some are built on a freemium model. That is, customers can use, for example, search services free of charge as long as they can be targeted for ads and promotion. For sure, Google also sells some hardware such as Chromebooks and Nexus products. Thus, Google's primary revenue model can be described as sales of search and display advertisements on the web and on mobile devices, which is complemented by sales of subscriptions for cloud-based apps and services. Nevertheless, the main source of income is still based on sales of advertisement, apps, and other services.

More importantly, Google is also renewing its business model. Google is using its close relationship with the Open Automotive Alliance (OAA) in order to make a move to the automotive industry. This strategic move can be realized through close collaboration with already established manufacturers in the automotive industry. This type of strategic work shows some similarities with Google's previous strategy of connecting to the home entertainment ecosystem, the automotive ecosystem being yet another area of life where Google desires to be present. Google has also been testing a 'self-driving car'. The idea is to create a fully autonomous car navigating using sensors and highly accurate data. Just as in an airplane, the driver would have more of a supervising role.

Cloud-based services have become a central part of the Google business model. The cloud-based marketplace labelled Google Play has well over one million applications and games in its catalogue in addition to other media content. The company has also introduced a virtual wallet service (Google Wallet).

This service offers secure management of debit, credit, and reward cards. Google also offers a cloud based storage service directed towards consumers and small businesses.

Google has reduced the amount of complexity by focusing on software and cloud services while supporting largely generic hardware. Through this strategy, people who access the Internet are likely to use Google services, or Google Network Members' websites, and consequently such use generates income for Google.

Google has, through its strategy, created a high brand value; the brand is obviously very appreciated by its customers. Google was ranked as the third most loved firm according to Sustainable Brands (2013) and reached a fifth place in relation to brand value (Forbes, 2013). A high brand value, in turn, contributes to demand for the company's services, strengthening its ecosystem. Thus, we propose the following success factors (SF):

- **SF1**. If a platform-agnostic business model is used by a company, with independence regarding types of devices and hardware supported, then the likelihood of success of the company's mobile business ecosystem is increased.

- **SF2.** If no burden of legacy in the form of a hardware business exists at a company, which enables a clear focus on cloud services, software, and content, then it increases the likelihood of success of the company's mobile business ecosystem.

- **SF3.** If a company and its services are loved by consumers, combined with a high level of brand equity, then it increases the likelihood of success of the company's mobile business ecosystem.

With more than a billion Android devices in use globally as of 2014 (Gartner, 2014), Google has reached a very competitive position such that the firm can make use of the swift growth in the smartphone industry and the huge amount of connected devices running on Android. Although Google is not monetizing Android directly, it can still benefit from knowledge about customer preferences, their online activities, and patterns

of usage. Through this knowledge, Google can build user profiles and have a high precision in target advertising.

In terms of strategy, Google avoids vertical integration and physical domination in the smartphone industry. The Google strategy is to invite complementors and device manufacturers to innovate on top of the Google platform (Google, 2014). The logic behind this strategy is simple. Google strives to promote the proliferation of Android and therefore encourages the creation of external devices and apps that are Android compatible.

Android was acquired by Google in 2005, and gained customer acknowledgement after Google announcing the creation of the Open Handset Alliance (OHA), using this alliance as a way to promote Android. Through this action, Android was positioned as an open and comprehensive mobile software platform. The openness of the platform is further strengthened through the Android Open Source Platform project (AOSP), as argued by Pon et al (2014).

The Google strategy has been to develop future versions of Android, and its core platform programming interfaces (APIs), through a more closed development branch. Such development has usually also been done in collaboration with an OEM. This strategy can be seen as a deviation from the open source strategy. However, Google claims that it is in the best interest of all stakeholders since it allows for developers and OEMs to focus their development on readymade versions of the platform. This is not in line with the wishes of most OEMs, as they typically want to access the latest version of the platform. For the developers, however, this strategy fits well since they are interested in applying their solutions to a stable platform. Thus, we propose the following success factors:

- **SF4**. If a company gives more freedom to complementors with regard to developing service innovations on top of the company's technologies, then it increases the likelihood of success of the company's mobile business ecosystem.

- **SF5**. If a platform exposes enough APIs so that OEMs, accessory makers, and developers are able to create complementary products and apps with meaningful differentiation, then it increases the likelihood of success of the platform's business ecosystem.

Although Google is taking some steps to open up its core technologies also with Android, the fact remains that Google Mobile Services (GMS), Google Play Services, and a multitude of other Google's applications and services suite remain proprietary and protected by the company's intellectual property rights. These services and products will not be part of AOSP, that is, not part of open source (InfoWorld, 2014). OEMs have also been forced to follow procedures such as the 'GMS approval window'. This measure has pushed OEMs to deliver products not older than nine months if they want to keep using the Google apps and services (DailyTech, 2014).

Taking this approach, Google performs a strategy of proprietary control in relation to Android platform key elements. These elements should be seen as critical for the platform. Furthermore, most device manufacturers do not create and ship products using only the AOSP code. Instead, they use the proprietary GMS suite licensed from Google. The behaviour of relying on GMS can be explained by the fact that for example Google Play, Drive, Maps, and Gmail related APIs, central for application development, are also part of GMS. Consequently, application developers too have to decide on targeting the lean AOSP platform (with fewer APIs) or the more extensive GMS-equipped Android devices (InfoWorld, 2014). The flipside for developers using the GMS solution is that it comes with multiple requirements giving Google increased control of Android based devices (InfoWorld, 2014). Thus, we suggest the following success factor:

- **SF6**. If the software components of a platform that meaningfully differentiate it from the competition or otherwise create significant added value are kept closed source, then it increases the likelihood of success of the platform's business ecosystem.

External software development has been a possibility to the general community since the Android platform was announced in November 2007. Software developers can access the Android platform through a unique developer site. Developers can, without having to join a developer program, test their software and use the Android development tools free of charge. This is not the case with competing platforms such as Apple's iOS platform.

Google has nurtured Android applications development by announcing two Android Developer Challenges. The first challenge was announced in January 2008 and the second in May 2009. An impressive total of $10 million was awarded to developers. The first challenge was of significant importance in order to jump-start the creation of applications, and there were almost 2,000 contributions from over 70 countries. The second challenge helped in creating a critical mass of applications so that the platform became big enough to attract developers without any further nurturing. Moreover, it is supported by the research of Battisti (2014) and Magnusson et al. (2016) on the social aspects of user involvement.

Google sensibly implemented a similar revenue sharing model as Apple on the application marketplace. However, the publishing process was less rigid. Applying a method with a lack of pre-inspection before publication has a downside. Therefore, Android has had to deal with inappropriate software in a much bigger scale compared to competitors as iOS and Windows. However, in 2012 Google took measures and installed an in-house automated anti-virus program labelled 'Bouncer'. Installing that program resulted in a reduction of malicious apps with 40% (SC Magazine, 2012). Furthermore, Google has also a reputation of allowing third-party application even if they should overlap with Google offerings, something that contrasts the policies of, e.g., Apple. Thus, we suggest the following success factors:

- **SF7**. If a platform is open with regard to end users, developers, platform providers, and platform sponsors alike, it enables a high degree of open innovation but possibly also major fragmentation, nevertheless increasing the likelihood of success of the platform's business ecosystem.

- **SF8**. If a non-exclusive process of application development, verification, and publishing is applied on a platform, then it increases the likelihood of success of the platform's mobile business ecosystem.

- **SF9**. If a platform has the most non-restrictive policy for complementors, not limited by protective clauses against competition or substitution, then it increases the likelihood of success of the platform's business ecosystem.

Google has on regular basis been found at the top of the chart of popular workplaces in the U.S., and actually, Google's work culture can be seen as 'legendary'. Google is also known for managing its business with a relatively flat organization. Engineers and other employees are, to a large degree, empowered to make business decisions, and also decide on how to manage their own work time. The freedom of product teams has strongly helped in cultivating an innovation culture. From this freedom has also followed that customers can take part in beta testing products at an early stage of development. This does, in turn, support and encourage complementors to take part in innovation processes.

4.2. Ecosystem-level analysis

In this subsection, we cover the ecosystem approach and governance of Android, Google's role in it, and the overall health of the ecosystem as well as the software ecosystem and application marketplace.

Google aims to build an ecosystem around Android, and participation should be built on voluntary action. The idea of voluntarism is closely related to the idea of using open source code, as in AOSP, where anyone can change, use, and distribute the software to meet unique needs. Android product development teams typically focus on a limited number of devices and then integrate these devices with the latest development version of the Android software so that new product launches can be secured, supporting the roll-out of the latest Android version. This strategy using so-called flagship devices has the benefit of also carrying the risk for the wider OEM community. This community can make follow-up device development that takes advantage of new features. Google managers claim that this strategy ensures co-evolution between the platform and the need for contemporary functional devices. Nevertheless, Google is not showing consistency in its Android strategy. They have been rotating partners for different releases, with varying terms of exclusivity. Thus, we suggest the following success factors:

- **SF10**. If the OEMs benefit from having a state-of-the-art mobile OS platform, essentially royalty free and enjoying higher adoption rates than any competing platform, then it increases the likelihood of success of the platform's business ecosystem.

- **SF11**. If generic, evolving functionality and a set of certain key features provided by the OS are available on the platform, then it increases the likelihood of success of the platform's business ecosystem.

In June 2014, Google made an announcement; the program called 'Android One' was presented. The program was targeted at the lower end of the smartphone market. In collaboration with suppliers and OEMs, Google had defined a reference platform for devices that would meet a certain minimum standard of technical specifications. These products would be able to support Google's mobile services in their entirety. Yet the price would be kept at the level of 100 USD or less which was then a modest price for such devices (BBC News, 2014). The program would ultimately lead to improved performance of low-priced products and also improve the user experience of these products. Previously, the user experience of such products had proved out to be somewhat disappointing.

The Google management team is obviously aiming to secure a bigger chunk of the entry-level smartphone market, growing faster than any other handset segment. They are at the same time trying to unify the Android experience with standardized hardware and limit fragmentation by barring OEM skinning of the Android One product. Clearly, this initiative played a key role in reaching the large number of prospective smartphone users in emerging markets. The program allowed for reaching these users with Android and Google services in a controlled fashion. As a consequence, Google has also secured a fast-growing segment for its mobile advertising business. This step is vital in order to ensure future growth. With other smartphone providers such as Microsoft and other initiatives such as Firefox OS aiming to utilize the same opportunities in emerging markets, Google is seeking to secure its leading position by taking proactive steps. Thus, we propose the following success factors:

• **SF12**. If mobile operators benefit from the transition to smartphones, driving up demand for mobile data plans, then it increases the likelihood of success of mobile business ecosystems enabling affordable smartphones.

• **SF13**. If the number of customers that use the OS platform and that are accessible to developers is high compared to other platforms, then it increases the likelihood of success of the platform's business ecosystem.

Using the definition of Iansiti and Levien (2004), Google can be defined as a keystone — a platform provider who enables and facilitates value creation for the whole of its ecosystem. In the Google ecosystem, website owners generate income by hosting Google's advertisements, and advertisers make use of Google's broad customer reach and effective high-converting, targeted ads. Some other stakeholders such as handset accessory makers appreciate the possibility to work with standard, well-defined interfaces without being dependent on any single OEM. The community of developers benefit from accessing the broad installed base of Android device owners, giving them the possibility to develop commercial or free apps. Developers additionally appreciate the open and non-restrictive approach of Android in terms of app distribution.

Google has organized its business somewhat differently from rivals like Apple. As a matter of fact, Google earns only very limited revenue from selling small volumes of devices, and it does not charge for Android licenses. Nor does Google sell devices in large volumes. Consequently, Google can be seen as benevolent, willing to provide possibilities for its ecosystem members to earn revenue and grow their business as they see fit. Thus, we propose the following success factors:

• **SF14**. If accessory makers appreciate that they can work with standard, well-defined interfaces, then it increases the likelihood of success of mobile business ecosystems and platforms that support such standard interfaces.

• **SF15**. If developers value the openness and non-restrictive philosophy in application distribution, then it increases the likelihood of success of mobile business ecosystems that exhibit such policies.

There are also some health issues in the Android ecosystem that are of interest to discuss. For example, the Google Play marketplace offered just about 1.5 million Android applications in its catalogue as of January 2015 (AppBrain, 2015). Such a vast offering of apps is clearly a sign of healthy diversity that we consider as an adequate proxy for niche creation, and also a sign of productivity. Actually, already in late 2012, Android managed to effectively close the gap in terms of available applications compared to iOS, then the market leader (e.g., Hyrynsalmi et al., 2012). It is unfortunately very difficult to evaluate ecosystem robustness since there are no statistics illustrating the survival rates of developers. However, robustness might be questioned since a high proportion of developers only publish one application (58%). The situation also seems to be the same in the iOS ecosystem. This translates to higher churn than with large, professional developers. It should also be taken into account that from Android's fragmentation follows that the platform scores less satisfactorily in terms of *limited obsolescence* and *continuity of user experience and use cases*. These are metrics associated with the ecosystem health measure of robustness according to Iansiti and Levien (2004). Thus, we suggest the following success factor:

- **SF16**. If an ecosystem is healthy, based on metrics of productivity, robustness, and niche creation, then it increases the likelihood of success of that ecosystem also in a mobile business context.

5. Discussions and Findings

In order to present the main contribution of this research, a model that analysis the success factor of mobile ecosystem, we grouped the 16 factors in four findings, as presented as follows:

- **Finding 1**. Google's platform-agnostic business model, independent of devices and hardware and free of any burden of legacy, enables a clear focus on cloud services, software, and content, which in turn has enabled Google as well as its Android ecosystem partners to thrive (SF1, SF2)

The first finding elaborates the notion that Google's firm scope, its historical legacy and current business and monetization model are beneficial to the Android ecosystem in the sense that they leave plenty of room and ways for ecosystem members to create value. Search advertising remains Google's key revenue source, and ultimately, any devices or platforms can serve to drive this revenue, not just Android. Unlike the orchestrators of some other mobile business ecosystems, Google does not attempt to capture the majority of the value created in the ecosystem, a behaviour favoured by physical and particularly value dominators, as described by Iansiti and Levien (2004). Moreover, as the company lacks a burden of legacy and path dependency in its technology choices, it has been able to avoid being locked in to unfavourable technologies, also allowing its ecosystems partners more freedom to innovate and produce complements. This finding also appears to support the third hypothesis of Gawer (2014) stating that 'collaborative governance will increase complementors' incentives to innovate in platform-enhancing ways', although whether all innovation in the Android ecosystem is platform-enhancing is subject to debate.

• **Finding 2**. While the Android platform has a generic, evolving set of functionality and exposes enough APIs so that various complementors are able to create products and apps with meaningful differentiation, the software components of the platform that meaningfully differentiate it from the competition or otherwise create significant added value are kept closed source (SF5, SF6, SF11)

With the second finding, we emphasize the importance of having a sufficiently broad and evolving set of APIs that enable complementary innovation with potential for meaningful differentiation, a key prerequisite for a viable third-party application ecosystem. This is also in line with the observations of Bosch (2009) for OS-centric software ecosystems. At the same time, however, Android also has certain key components developed by Google that are kept closed source, and it would appear that the number of such components has increased rather than decreased as of late. This is to protect the substantial investments made by Google against free riders as described by, e.g., Eisenmann (2008), and to ensure that certain key features of the platform remain positive differentiators and are not simply copied by competing platform providers. Furthermore, it would appear that Google is also taking action in response to certain complementors-turned-

competitors like Apple, who decisively replaced Google Maps with its own mapping software, or Facebook, who exploited Android APIs to create its own UI layer replacing the standard Android home screen, thus directly competing with Google for end-users' attention and advertising revenue. These two examples were also used by Gawer (2014) to justify her second hypothesis (a number of platform complementors will turn into competitors over time even in platform ecosystems whose participants are largely complementary) and fourth hypothesis (emergence of competition from former complementors is likely to elicit a reaction from the platform leader, either closing its technical interface or enveloping the complementors-turned-competitors).

- **Finding 3**. Android's appropriate balance of architectural openness, evident in mostly open and non-exclusive but also some closed policies, processes, and interfaces with regard to complementors such as device manufacturers, accessory makers, and application developers, content providers and publishers, platform providers such as alternative application store operators, and mobile operators, has enabled a high degree of innovation and added value in complements but also potentially severe fragmentation that is already evident in the various forked versions of Android available (SF3, SF4, SF7, SF8, SF9, SF14, SF15)

The third finding emphasizes the partially shared, partially proprietary control paradigm and considerable openness of the Android platform and ecosystem with regard to the dimensions defined by Eisenmann et al. (2008) and Müller et al. (2011). It would not be very meaningful to simply say to that Android is either 'open' or 'closed' as the matter is more complicated than that, depending on multiple dimensions of openness relating to the value network and ecosystem around the platform. Moreover, as argued by Müller et al. (2011), both relatively open and closed models have advantages and disadvantages.

Also, what works for the Android ecosystem may not be ideal for just any ecosystem, as is the case with, e.g., the considerably more closed iOS ecosystem where Apple as the sole device manufacturer and platform provider takes as much as 65% of the whole smartphone industry's profits, according to Canaccord Genuity analysts' statistics for the first quarter of 2014, cited by Fortune (2014). The iOS ecosystem has low fragmentation, whereas with Android, the breadth of releases and forked variants of the platform in use is

remarkable. The stricter testing and verification approach of iOS combined with a limited number of different hardware devices supported has contributed to an application catalogue where the number of low-quality applications is generally lower than with Android, the latter having 15% of its applications ranked as low quality according to AppBrain (2015).

Müller et al. (2011) argue that the iOS approach may lead to a better user experience and help prevent diseconomies of scale. On the other hand, they argue that the more open approach of Android would support a strategy aimed at becoming the largest application store provider, and it may lead to increased competition in both software and hardware, resulting in lower prices. Regardless of this, both platforms have broadly speaking an equal number of applications available, although Android enjoys a much larger share of the smartphone market than iOS, 80% versus 15% for 2013 (Canalys, 2014). It would seem that Android's model of openness and governance works for a more distributed ecosystem with less vertical integration, whereas the iOS model works for a highly vertically integrated, centralized ecosystem where most roles in the value network are under proprietary control.

Again, this finding could be seen to support Gawer's (2014) third hypothesis but also her first hypothesis, 'as the platform interfaces become more open, more agents will be attracted into the platform ecosystem, and the platform leader will be able to access a larger set of potentially complementary innovative capabilities'. As evidenced by the fragmentation of the Android platform, however, extensive openness can also work against the platform despite spurring a higher degree of complementary innovation.

• **Finding 4**. The strong market position and healthy, established ecosystem of Android appeal to OEMs building devices on the platform, operators selling mobile broadband subscriptions and devices, developers and other complementors making complements for the devices, and ultimately consumers who enjoy an unrivalled variety in Android devices, accessories, and applications (SF10, SF12, SF13, SF16)

The fourth finding highlights the importance of the Android ecosystem's health to its various members, particularly in terms of metrics such as productivity, robustness, and niche creation as defined by Iansiti and Levien (2004). Furthermore, the large established user base of Android device owners, contributing to strong

network effects, makes the ecosystem attractive to device OEMs and complementors such as application developers. Accounting for four fifths of the global smartphone market, Android is simply too large to be ignored by any party willing to address a major demographic of smartphone users. Furthermore, operators in many countries see affordable smartphones based on Android driving the transition from voice-centric feature phones to mobile broadband enabled smartphones, helping them sell more mobile data plans and at least partially offset the decline in traditional voice and text message revenue that, not coincidentally, is also related to the proliferation of smartphones and certain popular applications and services such as Skype and WhatsApp.

The above four findings together constitute the answer to the research question. To illustrate the relationship between these findings in the context of our multi-level analysis framework, we have crafted a model, as presented in Fig. 1.
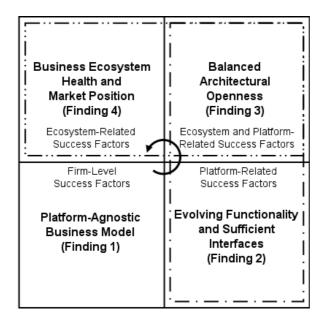

Fig. 1. Ecosystem Success Factor Model

Although the findings are derived from the case study, the model of success factor itself is not specific to just Android. The basic notion of the model is that as the level of analysis becomes less granular, moving from firm-level analysis through platform analysis to ecosystem-level analysis not discretely but in a continuum as illustrated by the arched arrow, we eventually cover the whole breadth of success factors. Some of these may be attributed just as well to platform characteristics as to ecosystem characteristics, as is the case with Finding 3 that is enclosed both in the horizontal and the vertical dotted-line rectangles that group together ecosystem-related and platform-related success factors respectively. Both points appear compatible with the thinking of Gawer (2014) whose classification of technological platforms is also a continuum where the last category, industry platform, takes the organizational form of an ecosystem. Similarly, Thomas et al. (2014) see platform ecosystems as the ultimate platform type that combines many-to-many architectural openness (as in Finding 3) with regard to three distinct logics of leverage: production, innovation, and transaction logic. They liken the construct to industry platforms.

As for limitations, this research deals with the success factors of the Android ecosystem. Furthermore, our perspective of analysis is that of qualitative research, thus to explore and validate the generalizability of the results, additional case studies would be needed, applying the same analysis framework as used in this paper. Such case studies on, e.g., the iOS ecosystem or the Windows Phone ecosystem would be suitable for further research.

6. Conclusions and Implications

Although business ecosystems and platforms have been studied also in the context of the smartphone industry, few existing studies have considered firm-level as well as ecosystem-level aspects and dimensions of analysis jointly, integrating the different but related concepts into a single framework. Thus, this paper draws on Davis (2016) who recommends studies of group dynamics that goes beyond the traditional dyad studies traditionally performed in this field of research. The proposed model contributes to the literature of innovation platforms via clustering the success factors leveraged both on firm-level and ecosystem-level analysis.

We identified 16 success factors for the Google Android ecosystem, clustered into four findings pertaining to (i) the business model and focus of the ecosystem orchestrator, (ii) a generic, evolving set of functionality and APIs enabling the creation of differentiating complements, (iii) the balance of mostly open and some closed policies with regard to ecosystem partners and complementors, and (iv) a strong market position and a healthy, established ecosystem. These findings should help scholars of innovation management research as well as managers (particularly those that operate in the smartphone industry or adjacent industries such as consumer electronics or automotive infotainment) understand the key factors that have contributed to the rise and success of mobile business ecosystem. Especially the latter group, whether seeking to join the Android ecosystem or perhaps replicate its success in a different industry context, would do well to implement or enable the key success factors in their companies.

Policy makers could enable the development of innovation platforms that create economic and social value. From this perspective, the contribution of our research for policy makers is a conceptual model with critical success factors of mobile business ecosystems, which can be taken into consideration during the definition of initiatives for the development of innovations that can create economic and social impact for scaling up at the global level.

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