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Antonio Ghezzi
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Antonio Ghezzi
Department of Management, Economics and Industrial Engineering, Milan Polytechnic, Milan, Italy

Abstract
Emerging technological and strategic trends in the mobile telecommunications industry, including the evolution of mobile devices and their capability to process data and the rise in new types of contents, developers, and marketplaces, have determined a shift in the way mobile software applications are created and distributed. This entry will focus on providing a holistic view of the mobile application world, ranging from the business model analysis of the mobile application value networks, to how and by whom value is created and captured, as well as the main strategic and market implications and performances within this dynamic arena.

INTRODUCTION
The world of mobile applications is more than a multi-billion-dollar industry. It involves a plethora of intertwined actors, roles, and communities, which together create a world of seemingly endless business possibilities. The innovations in devices, such as smartphones and the network capabilities that enable fast and increased data transfer have created an important new market for mobile content and services. Since this new market is rapidly growing in terms of both public and academic interest and revenues generated worldwide, it is very important that these aspects are thoroughly researched. Within this literature review, we will examine the development of mobile applications from several perspectives, but more notably, we will focus on the strategic perspective of the mobile application markets. From its emergence as the mobile portal of mobile network operators (MNOs) to the existing and dominating app stores, there has been a clear paradigm shift with many implications to a large number of players in the information and communications technology (ICT) sector.

The two-sided markets based on complex value networks are approached from both a high-level view, examining the business models, structure, and relationships within the ecosystems, and a more focused view, adopted by some of the key stakeholders in this industry. The goal of this contribution is to provide a comprehensive view of the main aspects, drivers, and currents within the mobile application marketplace, as well as of some real-life implications and results of this exploding playground.

TECHNOLOGY CREATING A NEW MARKET
The constantly accelerating development of technological capabilities of mobile devices, such as high-resolution screens, Internet connectivity, easy-to-use graphical interfaces, faster and smaller processors, provided subscribers with improved tools for content fruition. Innovations in the fields of mobile devices and networks increased data transfer and data-handling capacity and created a new competitive market for mobile content and services in the mobile industry. Smartphones represent the fastest-growing segment of mobile devices, with more than 800 million smartphones sold in 2013, 1.6 billion mobile broadband connections, and a projected 5.1 billion connections by 2017 with the existing calculated annual growth rate of 26%. Global smartphone producers, such as Samsung, Apple, Nokia, LG, ZTE, and others, produce truly versatile multimedia computing devices, which enable the users to enrich their devices with mobile applications. This evolution has enabled newcomers in the previously MNO-dominated industry to create a great disruptive effect and cause significant structural changes in the market by imposing and enforcing their own rules for the impending development of mobile applications. The implications of these changes not only concern the incumbent players, such as the MNOs, but also bring additional opportunities and constraints for a much larger set of existing and forthcoming players.

BUSINESS MODEL PERSPECTIVE: A PARADIGM SHIFT
The mobile content market that emerged as MNOs started looking for new sources of revenues to cope
with the decline of usage of voice services and average revenue per user, and as a result, MNOs began to exploit their established position through the market making of multimedia digital content and services. With an uncontested bargaining power based on a large customer base; network infrastructure; brand identity; and a charging, billing, and accounting system, MNOs had dominance in the value-added services market.\(^{[1,2]}\)

The distribution paradigm mainly developed around the “Mobile Portal” model, which represented an interface through which mobile content & service providers (MCSPs), mobile technology providers (MTPs), media companies, web editors, and others were offering their products and services (such as games, video, and personalization options). The portal aggregated and displayed the offer of different services, and the customer could search, select, and purchase them through Wireless Application Protocol or Short Message Service billing, both of which were carried out by the MNOs themselves. Mobile portals were managed in a tightly constrained manner both upstream and downstream: customers were only able to access their operator’s portal because of uniform resource locator restrictions or unsustainable extraportal data traffic fees. On the offer side, MCSPs, MTPs, and content owners were kept far away from the customer and were forced to accept nonincentivizing revenue sharing agreements, while MNOs took commission fees of + 50% on all value-added services and applications sold through them. MNOs have locked down and controlled the market while slowly developing and securing their value proposition, dubbing this approach the “walled garden” strategy.\(^{[1-3]}\) At this point, it was thought that MNOs had assumed an impenetrable gatekeeper role. This resulted in the setting up of an alternative content, service, and application distribution paradigm that could actually jeopardize the MNOs’ dominant position, breaking up the carrier-centric industry structure and opening the gates to a wide array of new entrants.\(^{[1]}\)

Traditionally, in the mobile application industry, there were several actors intervening along the value chain, in which each actor has its own importance. Of late, this has changed with the arrival of software companies with new mobile phones and platforms, such as the iPhone and Android. As a result, because of the entry of the new players following different rules, the market structure and value chain are evolving, taking new shapes and forms.\(^{[6]}\) The strategic implications of the paradigm shift will be described in the following text, but first, it is necessary to point out the characteristics of the “Apple Store” in order to see the main differences in the distribution process, which goes as follows: First, the developer uses development tools to build a mobile application—Software Development Kit (SDK) supplied by the platform owner along with third party tools. Second, the developer publishes its application on a portal, from which the consumers can download the application onto their mobile device. This model follows a mediated approach, where a third party (i.e., the application portal) plays an intermediary role between the service provider and the customer. This approach is different from the “walled garden” approach that was popular not long ago where MNOs were in charge of being the interface between customers and service providers.\(^{[6,7]}\)

In a typical two-sided market, we find developers on one side and consumers on the other. In such a market, an increase or decrease on one side of the market induces a similar effect on the other side. In other words, in our specific case, as the number of consumers increases for a given platform, portal, or mobile device, the number of developers attracted to this platform, portal, or device will also increase. Similarly, as the number of developers, and thus the number of applications increase, the platform, portal, or mobile device will attract even more consumers. Contrary to the merchant mode, in which intermediaries acquire (digital) goods from sellers and resell them to buyers, multisided platforms allow affiliated sellers to sell directly to buyers. While the technical outlook of platforms refers to a hardware configuration, an operating system, and a software framework on which a number of services run, business models in platform markets aim to balance interests of all stakeholders to assess “a strategic fit.” Successful two-sided markets can lead to a high volume of transactions and can thus be interesting for a middleman to charge a fee per sale. In the existing market, application portals play this role and charge 30% of the application retail price for each transaction.\(^{[1,8]}\) So, on the one hand, developers have an incentive to develop for the most popular mobile devices using the most popular platform, and to publish their applications on the most popular portal in order to reach the largest number of consumers. On the other hand, consumers have an incentive to buy devices running a platform with many applications. This mechanism creates a positive feedback loop.\(^{[6]}\)

The “Apple Store” model shows a number of significant differences if compared to the traditional mobile portal. From a technological point of view, application stores as mobile digital distribution platforms do not constitute a radical innovation, being quite similar to software libraries or marketplaces. However, the innovation lies in translating this computer-based and web-oriented nature in the mobile context: leveraging new smartphone features and capabilities, stores can be accessed from different networks (e.g., mobile, Wi-Fi, and fixedline), and are populated by digital content coming from external sourcing, which is integral to the success of this business model.\(^{[1,9]}\)
STRATEGIC IMPLICATIONS OF THE “APPLICATION STORE” BUSINESS MODEL

The shift in the mobile application store paradigm has inflicted several changes from the strategic perspective. Namely, there has been a transformation from a Service-as-a-Service (SaaS) model, which presents the embodiment of a one-sided market model for developing and delivering ICT services, wherein services flow in a linear fashion from independent software vendors (ISVs) to customers, with revenues flowing in the opposite direction to a Platform-as-a-Service (PaaS) one, a twosided market model, wherein a platform mediates between the demand and supply side.\textsuperscript{[7]} It has been argued that the main elements of leading platform providers’ business logic are the following:

- Fostering a thriving ecosystem of internal and external complementary innovations and innovators;
- Influencing architectural design through open interfaces combined with core intellectual property assets;
- Balancing consensus and control strategies toward contributors of complementary innovations, and
- Reflecting this in the internal organization, for example, by adopting a systemic and neutral mindset that extends to the whole.\textsuperscript{[7,10]}

This implies a structural change of the mobile phone industry from a value chain to a value network. Till date, the structure of the industry could best be described in terms of two relatively independent value chains for phone manufacturers and operators. With the addition of Internet compatibility and other functions, however, the structure of the mobile phone industry is gradually changing to a value network in which firms from a broad set of industries are interacting in the supply of a broad range of mobile Internet-related services. The concept of a value network is particularly relevant to network industries, such as the personal computer and Internet, where a firm’s internal processes are less important than the multiple ways in which firms and customers are connected to each other. Unlike value chains that connect multiple activities both within and between firms, value networks connect multiple buyers and sellers at a single node.\textsuperscript{[10–12]}

The change from a value chain to a value network has important strategic implications for firms in the mobile phone industry. Apple’s rapid dominance of the mobile market led to the emergence of a business model that weaves together Internet-enabled mobile devices with digital content, brought together within a closed proprietary platform or ecosystem.\textsuperscript{[9]} Understanding network effects, creating a critical mass of users, and managing so-called multisided platforms are much more important issues in a value network than in a value chain. In particular, when multisided platforms are used to deal with different types of buyers and sellers through different pricing structures and information-sharing arrangements, the network is built upon the relationships, capabilities, and superior customer values of key firms and individuals within the value network (Fig. 1).

They are also known as “business ecosystems.” Value networks or business ecosystems are a community of organizations, institutions, and individuals that impact the enterprise and its customers and suppliers, offering the potential to share risks and possibilities to generate economies of scale and scope, share knowledge, and facilitate learning, as well as shorten the time to market.\textsuperscript{[11–14]}

It is argued that because of the compatibility between certain technologies, businesses that sell complementary products or services have to develop relationships with their allies. Thus, forming alliances, cultivating partners, and ensuring compatibility (or lack of compatibility) are critical business decisions, especially in the ICT sector where standards are an important issue. Relationships between the firms of an ecosystem are complex and show a mix of cooperation and competition, illustrating situations of competition.\textsuperscript{[12]} Because of this, the frontiers of an ecosystem are unstable and keep changing depending on the interactions between member firms, their goals, and a wide number of strategic objectives and decisions.

COMPETITION DYNAMICS

The exponential growth and success of the market following the paradigm shift toward an “open garden” brought upon the industry a new level of dynamics and complexity. The competitive balance that was shaken by the mobile–web convergence and the alternative models it enables forced firms’ value chains to transform into complex value networks, which imply new rules of the
Companies might engage in a form of partnership or alliance to overcome a weakness in the resources, to look for new competences through interorganizational learning, to search for approval and status, or to try to create new customer values through the synergistic combination of previously separate resources. Also, participating in various consortia allows firms to reduce uncertainty and risks when trying to promote a dominant design or platform. To further confirm this, a study of 160 relationships among 92 companies has been conducted in order to examine the interrelations among MNOs, device manufacturers (DMs), web companies, and mobile platform and operating system vendors within this dynamic industry. The results found that more than half of the sample’s relationships are shared by at least two different ecosystems. The studied ecosystems did not differ in terms of exclusive relationships, which suggest that competitive strategies are particularly relevant in the ecosystem-based view. The authors also suggest that indirect competition is a clear characteristic of the business ecosystems.

MARKET IMPLICATIONS

The success of the new application store paradigm is apparent and proved not only by the exploding size of the app economy with 9.1 billion € from worldwide app sales, 10.5 billion € from app store subscriptions, licensing fees, Application Programming Interface (API) fees, etc., and 7.7 billion € of in-app advertising for 2013 but also by the apparent trends of all the players involved including MNOs, DMs, and platform owners. Namely, there are observable trends moving from decentralized to centralized portals, device diversity, and portal integration, which, as practice has shown, are the paths toward harvesting benefits from this dynamic ecosystem.

PRODUCT (APPLICATIONS) CONTEXT

Mobile applications can be categorized in different ways with respect to the preferred point of view. They can be business-to-business (B2B) or business-to-customer (B2C), depending on the targeted customers being businesses (to support internal processes) or individual customers, respectively. B2B apps can be further split into:

- Content-oriented apps fulfill individual needs for information, entertainment, communication, productivity, and socialization and include Twitter, instant messaging, e-mail, and social network clients for mobile phones.
- Marketing-oriented app—mostly used by companies for brand advertising or promotion.
- Service-oriented apps let users perform tasks—for example, checking a train schedule, booking theater tickets, or shopping at a mobile commerce platform.

There are many options for monetizing B2C apps, among which the most used are: 1) charging a fixed amount (paid apps); 2) free apps with reduced functionalities, which can be acquired by in-app purchases (freemium); or 3) paid apps with in-app purchases. Advertising is another option for monetizing mobile apps. In this model, ad space is sold in free apps that reach a large user base. Different monetizing options are assumed by companies and developers according to their business strategy and application type, as seen in the excerpt from the Distimo 2013 app market report on Fig. 2.

Apart from the majority of the applications available and downloaded belonging to the free (or freemium) category, the sales are constantly increasing and the European app economy size comprising app-related products and services is expected to grow from 10.2 billion € in 2012 to a projected 14.9 billion € in 2016.

![Fig. 2](image-url) Top 10 application categories in the order of largest revenue (from top to bottom), segmented by business model. Legend: Segments from left to right represent: Free apps with in-app purchases; Paid apps; Paid apps with in-app purchases.
CONTENT AS A VALUE DRIVER

Primary existence of companies is based on the value increase that they offer to customers utilizing the product or service. If these companies do not offer enough value for customers or the value is less than what the customer is willing to pay, the normal consequence is that the company exits from the markets, as Coase’s law demonstrates. For consumers, the appeal of the DMs hardware devices is closely linked with the variety of online content and services that are available to them. This market requires a continuous stream of innovation to sustain consumer interest. In opening up the platform to third-party developers, platform and application store owners have outsourced some of their software development to a global base of freelancers, thereby minimizing their own risk while developers create applications that may or may not be successful. From the reviewed literature, it is apparent that ever since the creation of the mobile portals, and before, with most previous technologies and mediums—available and interesting content is what has proven to be the biggest success factor and has influenced the market’s “decision” of whether that technology or medium will survive or not. Although technology is basically a driver for new innovative services and business models (push-model), from a customer perspective, technology is only an enabler, and the main driver is the content itself and the most important value element for platform owners is earning revenues from applications hosted in the platform. However simple this may look, application store and platform owners still face the classical chicken-or-egg problem of the platform creation business: attracting two different groups of customers who are dependent on one another, that is, to gain market shares, they need content desired by the customers, but to gain access to this content, significant market shares are required.

MNO PERSPECTIVE

The mobile telecommunication market has been shaken up by the arrival of new actors, such as Apple and Google. As a consequence, the relatively well-established MNOs have had to rethink their position in the market if they wanted to participate in the growth of mobile telecommunication revenues. However, with the existing market structure, MNOs do not hold a privileged position compared to mobile platform providers, such as Apple with iTunes. Reviewed literature argues that there is an opportunity for mobile operators to identify additional sources of revenue by exposing network functionalities through web-based service platforms. Based on the analysis of various case studies, Gonçalves and Ballon argue that web services of mobile operators are decisively shifting from SaaS to PaaS models. However, these platforms incorporate fragmentation at several levels and are likely to face challenges in order to thrive. Mobile telecommunications networks and the Internet have evolved as disjoint worlds with regard to software applications and application development technologies. Mobile operators are now at crossroads of maintaining “dumb pipes” that do not capture any value for the transactions made using their infrastructure. As large parts of the information technology industry are moving to a web service delivery model, there seems to be an opportunity for mobile operators to learn from these and their own experiences and adopt similar models by exposing network capabilities and combining these with online content and applications. Concurrent with this, MNOs seem to be bandwagoning on the application store model very quickly.

POSSIBLE MNO REACTIONS TO PARADIGM SHIFT

Four potential business models for emerging mobile service platforms are introduced in the work by Ballon and Walravens, for which real-life cases are described and briefly analyzed. In the context of mobile service platforms, the crucial value-adding roles and key actors are identified, and from the different positions in the value network, they can assume the four business models are constructed and discussed along with the “gatekeeper” roles that can be assumed in each of them. From an MNO’s perspective, it would be advisable to explore different possible models in order to avoid the “dumb-pipe” effect. Ballon and Walravens present four different models, along with the real-life stakeholders who assume different roles. The models depict the major value-adding roles, as well as the value streams from and toward the user. Only direct revenue flows are indicated as it is still unclear how some indirect revenue models will come to fruition.

It is notable to mention that because constant improvement of hardware related to mobile computing opens new avenues for mobile application and service development, there are possible avenues for MNOs. Broadcasting sports content has proved to be a popular strategy for driving the growth of the digital premium content marketplace earlier, and mobile service operators aim to enter the sports rights market. However, as the markets for live sports broadcasting are still dominated by established broadcasters, MNOs are facing significant barriers to access premium content, creating bottlenecks in the construction of business models.

While moving to the now-dominant model, operators should adopt a platform mindset and incorporate the
right balance of characteristics that guarantee platform adoption and avoid market and platform fragmentation. The biggest challenge to guarantee adoption seems to be posed by today’s fragmentation of mobile operators’ platforms.[7]

While the literature on ICT platforms has suggested that ICT service providers often have the discretion to make active design and strategic choices to become a platform or not, platform literature also suggests that the necessary competencies to succeed in services and in platform services are not aligned, and that there are specific contextual conditions under which platforms can thrive.[1,2,7] However, the question under what conditions platforms successfully thrive has remained largely unexplored up until now.

DEVELOPERS’ PERSPECTIVE

Application developers are key players in the application value network, since they are the sole value-creating community that propels the entire industry. The shift from a “walled garden” to an “open garden” and a mobile application store has major implications on the developers or ISVs. The creation and distribution model of the mobile application store enables access and independence to third parties, following the self-publishing model.[2] Central to every development platform are the SDKs that enable third-party developers to build applications running for the platform. These kits usually include libraries, debuggers, and handset emulators, among other useful development tools. Often platforms provide integrated development environments in order to facilitate the development process.[6] The self-publishing model follows the subsequent process: the developer uses the tools to build their mobile application, then they publish it on the portal, from which the consumer can download the app onto their mobile device. The platform owner facilitates an environment for application design, development, and delivery and allows application developers to provide a service to the end-customer and get revenues from it.[9] The developers only have to deal with the hosting (membership) charges and share the revenue with the platform owner (in most cases, 70% of the revenues go to the developer).

The most important benefits for developers include potential economies of scale in production and distribution costs, more predictable revenues, the development of software with lighter operating systems and hardware requirements, and shorter sales cycles.[9] The platform model also provides the developers a direct and continuous relationship between themselves and the consumer,[2,9] as well as built-in scalability, reliability, and security; built-in integration with web services and databases and support for collaboration among developers.[9] Contrary to popular perception, money is not the only motivator for mobile app developers—in fact, far from it. Revenues, in some form or other, are the goal for just 50% of mobile developers—53% of mobile developers are motivated by creativity or the sense of achievement, making this the most popular motivator. The fun of making an app is a motivator for 40% of

![Fig. 3 How developers select a mobile platform: The top three most important platform criteria, by primary platform. Legend: Segments from left to right represent: Top choice; Second choice; Third choice.](image-url)
mobile developers.\textsuperscript{[14]} Looking at the criteria by which developers choose a platform (Fig. 3) also provide an interesting insight and possible success factors for application store owners.

Some platforms foster a developers’ community, giving developers the means to communicate, share knowledge, and re-use other developers’ code through case studies, blogs, and forums. A strong community around a platform gives developers a feeling of control over the platform and might be crucial to guarantee platform adoption. There is a never-ending cycle involved, as the presence of a community attracts more developers, which means more applications, which presumably attracts more customers, and the cycle goes on.\textsuperscript{[9]} These communities also support the development phase and shorten timeto market.

Still, the proliferation of proprietary stores based on different operator-device-OS combinations can increase app creation, design, and porting costs and also lengthen the timeto market. Moreover, raging competition can lower prices and profits and shrink the customer pool.\textsuperscript{[2,7]} Another downside for developers is when they face the prospect of transferring platforms; the applications have to be made in a different language with a different SDK and API and, more often than not, they have to be made from the ground up. This is particularly important when taken into account that a survey of 6000 + mobile developers revealed that developers use 2.9 mobile platforms concurrently.\textsuperscript{[14]} The data show that 84% of mobile developers are using iOS, Android, or HTML5 (mobile) as their primary platform, with developers preferring iOS (59%) over Android (49%) as their primary platform.\textsuperscript{[14]}

Many developers face a dire power asymmetry and weak negotiating position with the portal owners because they can be easily replaced in an ever-growing and highly competitive marketplace. The majority of developers, who occupy a peripheral position in the network, can help neutralize power differentials by connecting with other developers in order to create a form of collective power. Developers generate work based on respect and recognition from their occupational communities, and become reliant on contacts. While developers simply exist as the “crowd” to the application portal owners, developers themselves rely upon these communities for support in surviving the harsh environment.\textsuperscript{[7]} It will take a fundamental change in the pattern of competition to uproot the dominant platforms from their positions.\textsuperscript{[14]}

**CONCLUSIONS**

The innovations in the fields of mobile devices and networks increased data-transfer and -handling capacity and created a new competitive market for mobile content and services in the mobile industry. This evolution has enabled newcomers in the previously MNO-dominated industry to create a great disruptive effect and cause significant structural changes in the market by imposing and enforcing their own rules for the subsequent development of mobile applications. There has been a clear shift from one-sided to two- or multisided distribution platforms following the “Apple Store” model, going from a “walled garden” strategy to an “open garden” one, enabling self-publication by the application developers and a direct link to the consumers. Mobile application markets are successfully capturing value by serving as a mediator between the content creators and consumers by exploiting several monetizing approaches and revenue sharing models. The number of players within the industry and their complex interrelations within the value network imply that competitive strategies are often necessary in order to maintain sustainability. By exploiting crowdsourcing efforts in content creation and thus lowering design and creation costs, mobile application markets are able to capture substantial tangible benefits, and many intangible benefits too, thanks to improved brand reputation due to improved user experience and service levels. The success of the mobile application business models is evident, as the market size is within tens of billions of dollars and rapidly growing.

Despite the apparent benefits for the dominant players, the dynamic nature of the mobile application industry implies ever-changing conditions and factors for all of the players involved, from MNOs, DMs, and platform owners to the ISVs and application developers. It is thus very important to further research on how value is created and captured within the value networks, elaborating on possible business models, cooperation and competition strategies and implications of the complex network connections. There is still no consensus on the conditions for a successful business model or creating a “gatekeeper” role within such a vibrant field. Research efforts should also be directed in the direction of addressing the way content-creating communities are created and how they can be harnessed while overcoming the age-old chicken-or-egg problem.

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